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3,450,087

HYDRAULIC STEERING FOR WATERCRAFT

Filed Feb. 2, 1968

Sheet 1 of 2

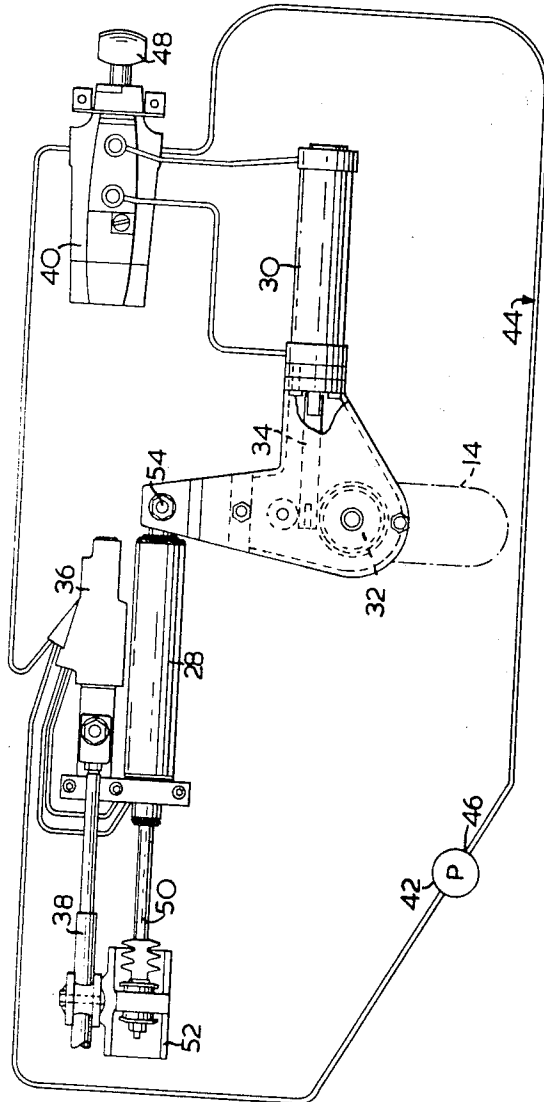


FIG. 1

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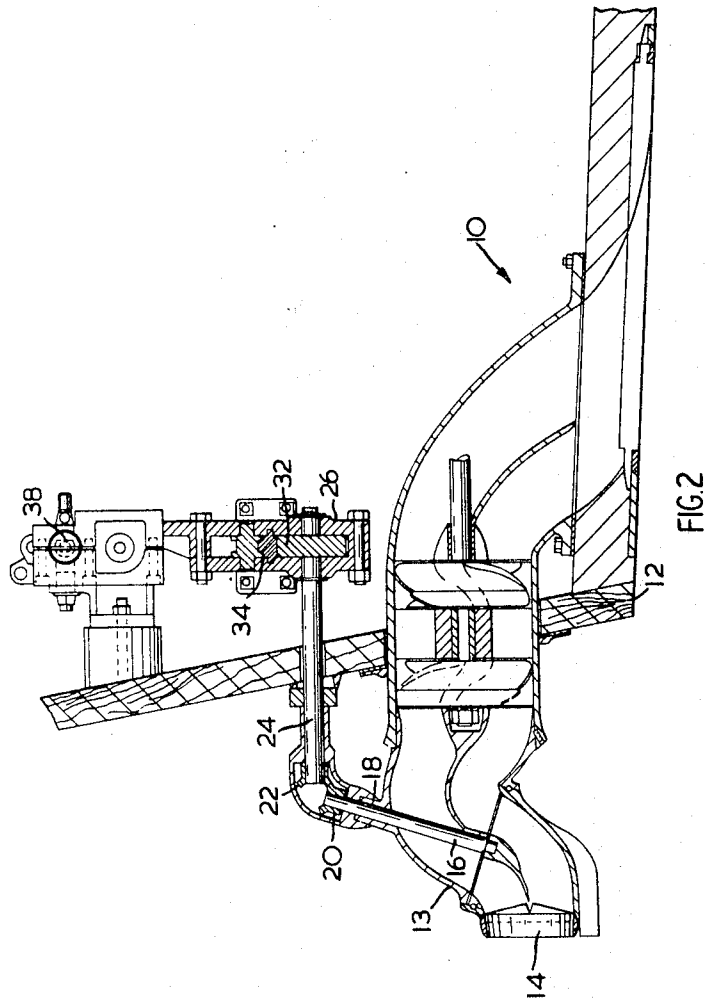
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Sheet 2 of 2



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HYDRAULIC STEERING FOR WATERCRAFT
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992,420

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4 Claims

ABSTRACT OF THE DISCLOSURE

A power steering system for aqua-jet units which have a rotatable exhaust elbow for steering. The system includes a first steering member for normal swinging of the nozzle of the unit and another hydraulic member combined with the nozzle in a rack and pinion for complete rotation of the nozzle for reversing the craft in which the unit is installed.

This invention relates to steering for watercraft and in particular to a power assist type of steering for watercraft equipment with the aqua-jet type of propulsion unit.

In Canadian Patent No. 767,926 issued Sept. 26, 1967, there is described a steering apparatus for an aqua-jet type of craft and specifically means for rotating a water jet nozzle. In units of this type, the outlet end of the aqua-jet protrudes through the transom or rear portion of the craft and terminates in an elbow and associated nozzle that is rotatable for steering of the craft. In accordance with the above mentioned patent application, the nozzle is adapted for complete 360° rotation in relation to the elbow and the plane of rotation with respect thereto is at an angle to the horizontal so that when the nozzle is turned so as to direct a water jet in a forward direction, it will be directed below the bottom of the watercraft. On the other hand, the nozzle is rotated so as to discharge the water jet dead astern, the lowest extremity of the nozzle does not project below the bottom of the watercraft.

This nozzle is rotated through a pair of bevelled steering shafts, one of which projects into the craft and which is provided with means for both fine and normal steering control. This consists basically of one lever acting directly on the shaft and a second lever acting indirectly on the shaft through a planetary gear arrangement. The planetary gears of the indirect control were mounted for rotation on stub shafts which in turn were secured to the direct control steering mechanism. Therefore, the rotation of the direct lever while the indirect lever was held motionless, would cause rotation of the planetary gears and their stub shafts and effect rotation of the elbow through 180°. Fine control of the nozzle was achieved by keeping the direct lever stationary while moving the indirect lever through the selected degree of rotation. If it was desired to rotate the nozzle through 180° in order to reverse the thrust and the direction of the craft, the indirect lever was held motionless and the direct lever was rotated either clockwise or anticlockwise depending upon which way it was desired to rotate the nozzle.

In the present invention, a similar steering mechanism is used on the nozzle itself, but due to the high speeds attained by the modern aqua-jet craft it has been found necessary to utilize some means of power assist steering. At high speeds on water, the pressure on the hull is extremely great, especially during maneuvering. The power assisted steering system in accordance with the present invention provides a fingertip control and sensitivity and it comprises, essentially, a motor mounted pump which generates line pressure which in turn is valve controlled in activating hydraulic cylinders for the required to and fro

steering and reversing motion. This hydraulic mechanism is interconnected with substantially the same steering shaft arrangement as in the manual mechanism previously described.

In one aspect, the present invention provides an hydraulic power assist steering system for watercraft aqua-jet units of the type including an exhaust elbow and a nozzle rotatably mounted on said elbow, said system comprising a steering shaft having one of its ends secured to said nozzle; primary steering means secured to the other end of said shaft for normal orientation of said nozzle; secondary steering means associated with said primary means and operatively engaging said steering shaft; an hydraulic circuit for actuating said steering system including (i) a first cylinder secured at one end to the watercraft and at the other end to the primary means, a control valve for said cylinder and (ii) a second cylinder mounted on said primary means and a control valve for said second cylinder; the first cylinder when actuated orienting said primary means and the second cylinder actuating said secondary steering means; and pump means and hydraulic line connections between the latter and said cylinder and valves.

The invention will now be described, by way of example, with reference to the accompanying drawings wherein:

FIGURE 1 is a schematic layout of the power steering mechanism with the apparatus being in an elevational view as applied to the transom portion of a watercraft and looking at the transom portion within the watercraft, the hydraulic mechanism such as lines and pumps being laid out schematically; and

FIGURE 2 is a partial cross-sectional view of the mechanism of FIGURE 1 and includes a schematic connection between the steering mechanism and the rotatable nozzle.

Referring firstly to FIGURE 2, an aqua-jet unit 10 has its rearward portion extending through the transom 12 of a watercraft and this rearward end terminates in elbow 13 to which is rotatably secured a water jet nozzle 14. A first steering shaft 16 has its lower end freely passing through the elbow 13 and it is centrally secured to the rotatable nozzle 14 as shown. The upper end of the first shaft 16 passes through a boss 18 which it is journaled and it has secured to its upper end a bevel gear 20. The gear 20 meshes with a similar gear 22 secured to the outer end of a second steering shaft 24 that extends through the transom 12 of the watercraft and the shaft terminates in the steering mechanism.

The steering shaft 24 is connected to primary starting means in the form of a bellcrank housing 26 which is partially rotated or steered by a steering hydraulic cylinder 28 (see FIGURE 1). The bellcrank housing 26 is provided at one end with a reversing hydraulic cylinder 30. A secondary steering means comprises a pinion gear 32 secured to the end of shaft 24 within the housing 26 and this pinion gear is in mesh with a rack 34 also mounted within the housing and connected to and actuated by the reversing cylinder 30.

It will be appreciated that actuation of the secondary reversing cylinder 30 will effect a rapid rotation of the shaft 24, shaft 16 and nozzle 14 to turn the latter 180° for reversing the craft. The primary steering cylinder 28 is governed by a steering valve 36 which in turn is controlled by a steering wheel (not shown) in the watercraft through the intermediary of linkage 38. The reversing cylinder 30 is controlled by means of a reversing valve 40 which in turn is governed by the well-known push-pull cables (not shown) and a reversing lever, also not shown, at the control center of the watercraft.

A pump 42 is adapted to be mounted to the engine pulley of the motor in the watercraft and is adapted to be driven by the usual V belt mechanism. The hydraulic

circuit indicated generally at 44 interconnects the pump with the steering valve 36, reversing valve 40 and the cylinders 28 and 30. The circuit 44 is normally open so that the working pump 42 is only circulating the hydraulic fluid without effecting pressure as the valves 36 and 40, in central position, hold open a flow through passage for the circulating hydraulic fluid. The fluid emitting from the pressure outlet 46 of the pump 42 is directed to flow through the reversing valve 40 and thence is directed to flow through the steering valve 36 and subsequently, by way of the return line, back to the pump 42.

In order to reverse the nozzle 14, the reversing lever in the craft is pulled back from its central or neutral position and the connecting push-pull cable moves the lever 48 of the reversing valve 40 from its central position so as to direct the flow of fluid into the blind end of the reversing cylinder 30. As a result, the cylinder rod and the rack 34 attached to the rod are moved out to an extended position and the rack engages and rotates the pinion 32 which swings the nozzle 14 180° into a reverse position. It should be mentioned from the operating point of view that it is essential that at this point the reversing lever should be returned to the neutral or central position which in turn would return the reversing valve 40 to its neutral position thereby opening the circuit again for the circulation of hydraulic fluid. This prevents an undesirable buildup of pressure in the valve 40 from the pump 42.

The nozzle 14 is held in the reverse position by the hydraulic fluid positioned in the blind end of the reversing cylinder 30 even though the valve 40 is returned to the neutral position. As the reversing cylinder 30 is secured to and forms a part of the bellcrank housing 26, the cylinder 30 holds the nozzle in reverse position while the bellcrank housing steering arm 26 responds to the ordinary steering wheel which swings the nozzle 14 as desired. Thus, there is steering in the reverse position.

In order to move the nozzle 14 from the reverse position to the forward position, the reversing lever is moved to the forward and held just long enough for the reversing cylinder 30 to complete the nozzle swing from the reverse to the forward position. Then again it is essential to move the reversing lever back to the central position so that once again the circuit is opened for circulation of the hydraulic fluid. The trapped hydraulic fluid in the cylinder 30 will lock and hold the nozzle in forward drive.

The steering cylinder 28 has its piston rod 50 secured at one end to a flange 52 which is adapted to be secured to the transom of the watercraft. This flange also supports the actuating rod 38 of the valve 36, the latter being mounted in piggyback fashion on the cylinder 28. It will be appreciated that the actuating rod 38 is interconnected by cable means, not shown, to the steering wheel, also not shown, in the operating cockpit of the watercraft. Valve 36 is normally in an open position and constitutes part of the open hydraulic circuit so as to allow the hydraulic fluid to flow through the valve freely. Steering wheel motion instantly changes this open circuit condition as it shuts off the open circuit so as to divert the flow of fluid to the steering cylinder 28. When the steering wheel is held motionless, the fluid is locked in at both ends of

cylinder 28 holding the nozzle rigidly in the position it is at that instant. It will be noted that the end of the cylinder 28 remote from the piston rod 50 is pivotally secured at 54 to the bellcrank housing 26. As the cylinder 28 is actuated i.e., when its body portion is drawn towards or away from the flange 52 the bellcrank 26 will steer the nozzle 14 by virtue of its connection to the shaft 24 as shown in FIGURE 2.

It will be appreciated that the present system is also applicable to general marine use wherein the primary cylinder would be secured to a rudder shaft instead of a nozzle as in the present application.

I claim:

1. An hydraulic power assist steering system for watercraft aqua-jet units of the type including an exhaust elbow and a nozzle rotatably mounted on said elbow, said system comprising a steering shaft having one of its ends secured to said nozzle; primary steering means secured to the other end of said shaft for normal orientation of said nozzle; secondary steering means associated with said primary means and operatively engaging said steering shaft; an hydraulic circuit for actuating said steering system including (i) a first cylinder secured at one end to the watercraft and at the other end to the primary means; a control valve for said cylinder and (ii) a second cylinder mounted on said primary means and a control valve for said second cylinder; the first cylinder when actuated orienting said primary means and the second cylinder actuating said secondary steering means; and pump means and hydraulic line connections between the latter and said cylinder and valves.

2. A steering system according to claim 1 wherein said primary means comprises a bellcrank housing secured onto said steering shaft; and said secondary means comprises (a) a pinion gear secured to said shaft, and (b) a rack for rotating said pinion and shaft, said rack being actuated by the secondary cylinder.

3. A steering system according to claim 1 wherein the primary means and its associated valve are responsive to a steering wheel positioned in said watercraft; the secondary means being responsive to a reversing lever positioned in said craft.

4. A steering system according to claim 1 wherein said steering shaft includes a first member secured at one end to said nozzle; a second member extending through said transom to the connection with said primary steering means, said first and second shaft members being angulated with respect to one another and being interconnected by bevel gears.

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