ABSTRACT

A system for controlling the forward and reverse operation of a boat having a jet propulsion unit, which unit is mounted on the boat and swivelable to provide normal steering of the boat. Included is a mechanism for initiating a rapid turning of the propulsion unit through a turn of approximately one-half circle to redirect the force of propulsion forwardly and thus provide the reverse drive of the boat. The mechanism includes a means associated with the propulsion unit itself for generating and applying a turning moment of force or torque for reorienting it through the half-circle turn. A detent means is coupled to the unit and selectively positioned in the path of a stop mounted on the unit during its turning to retain it in either the forward or reverse operating position. The propulsion unit is of the thrust type in which a pressurized fluid flow is passed through a nozzle to provide the thrust force for propelling the boat.

11 Claims, 9 Drawing Figures
BOAT STEERING AND REVERSING SYSTEM

REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U. S. application Ser. No. 249,168 filed May 1, 1972 for "Boat Steering and Reversing Mechanism."

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 through a jet nozzle rearwardly of the boat to move it in a forward direction. The invention is particularly suitable for use with a propulsion system in which the propulsion unit is swiveled about an upstanding and substantially vertical axis to provide for a controllable steering of the boat. The major directional control is through the selective directing of the thrust force through the propulsion unit itself, which may incorporate a modified rudder construction when such effect is desired.

It will be seen that the present invention in its several embodiments may be applied to a number of systems in which the jet nozzle is either of variable or fixed size. It similarly may be applied to propulsion systems comprising dual units and in which internal combustion engines are included for rotating impellers and thus generating the pressurized fluid flow. Alternately, the propulsion unit may be connected to a hydraulic motor driven by gas fuel, an electrical motor, a turbine engine, a Wankle type engine, or any similar drive source.

More specifically, this invention is directed toward a propulsion unit in which a pump-like unit is included which provides for pressurized fluid flow, with the flow being generated by an impeller coupled to the output shaft of the rotating drive source. In any case, the changeover as between forward and reverse operation of the boat is achieved through a special rapid reversing mechanism which generates a force to the propulsion unit itself and reorients the thrust direction.

Prior art propulsion systems for watercraft show a variety of drive systems in which there is generally included a propulsion unit used with a propeller shaft and propeller, sometimes with a modified rudder or fin. The entire propulsion unit is mounted in a manner swivellable for 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 propeller through a cable and bevel gear arrangement.

U. S. Pat. No. 1,824,213 makes a further showing of an outboard motor again having the propeller housing swivelably controlled relative to the motor housing for steering of the boat. Swiveling action is provided in that case by the direct mechanical forces applied by a sector gear and rack mechanism.

Other mechanisms are known similar to that disclosed in U. S. Pat. No. 1,744,956 in which the propulsion unit and steering unit include a turret-like structure which encloses the driveshaft and the lowermost projecting portions of the propulsion unit. For normal steering, the turret of the assembly is turned 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 the propulsion unit may be swiveled 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. The mechanisms to provide this swiveling effect are generally directly operable through the steering wheel and the extent of turning is not precisely controllable by the operator. Additionally, relatively large magnitude forces must be applied from an external source to provide the rapid changeover between the forward and reverse direction.

All of the aforesaid arrangements are subject to the obvious disadvantages arising from the fact that the swivelable propulsion unit itself is not visible to the operator and the steering wheel does not always clearly indicate the exact alignment into which he has directed the propulsion unit.

Other patents and publications have shown steering systems which make general reference to the rapid turning of the propulsion unit through a turn approximating 180°. But while these in several cases, for example in U. S. Pat. No. 2,834,313, refer to providing a quick rotation, there is no actual disclosure of a working mechanism whereby such turning may be achieved.

The present invention has directed itself to the problem of providing a mechanism which utilizes the torque available from a novel arrangement of the elements of the propulsion unit itself to swivel the propulsion unit in a rapid turning operation to make a reversing changeover through a rapid rotation of the propulsion unit.

SUMMARY OF THE PRESENT INVENTION

The present invention thus relates to a rapid reversal mechanism for reorienting a propulsion unit in which the reversing mechanism is operable by forces independent of the normal steering system and without the need of a complicated reverse drive or gear train mechanism. The present invention in its simplest form includes a reverse control system in which a detent-stop arrangement provides limits for rotation of the propulsion unit through a 180° turn between two accurately spaced positions, one representing the forward and the other representing the reverse orientation of the thrust force. The mechanism itself in one embodiment is constructed to include an offset jet nozzle. Alternately, the friction forces provided by the flow of the water through the jet body are employed to provide a reversing moment of force. In this manner, the reversing control system needs only manipulative means to arrest the propulsion unit in the position desired, while the turning force is rapidly generated through the unit itself. In several of the alternate forms of the invention, it is possible to provide a variable jet nozzle in which the nozzle can be trimmed to provide an optimum running point or to provide low speed maneuverability.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in the accompanying specification with reference to the accompanying drawings in which like numerals are used to refer to like parts which appear in the several drawings, and wherein:
FIG. 1 is a partly schematic, cross-sectional view of a pump-type jet propulsion unit, with parts broken away;

FIG. 2 is a partly schematic, cross-sectional view of an alternate embodiment of the present invention, with parts broken away;

FIG. 3 is a bottom plan view along the line 3—3 of FIG. 2;

FIG. 4 is a partly schematic, cross-sectional view of a different embodiment of the present invention, with parts broken away;

FIG. 5 is a bottom plan view of the mechanism of FIG. 4;

FIG. 6 is a partly schematic, cross-sectional view of a still further embodiment of the present invention, with parts broken away;

FIG. 7 is a schematic view of an installation of a pair of jet propulsion units similar to the one shown in FIG. 1;

FIG. 8 is a schematic drawing showing an installation of a pair of units similar to the one shown in FIGS. 2 and 3; and

FIG. 9 is a schematic view showing an installation of a pair of units similar to the one illustrated in FIGS. 4 and 5.

DETAILED DESCRIPTION

With reference to FIG. 1, the drawing illustrates the basic parts of a jet thrust unit 15 which is of the pump operated type. Included in the unit is a driveshaft 10 which is vertically oriented and has connected to its lower end an impeller 12. A drive source, such as the output shaft of an internal combustion engine, not shown, is attached to the upper end of the driveshaft 10. The driveshaft 10 is enclosed within a steering tube 14. The steering tube 14 is secured at its lower end to the jet thrust unit 15. The steering tube 14 and a jet body 16 are swivellable by means of a steering control wheel and associated linkage to provide normal steering. Reference is made to the aforementioned U. S. Pat. application No. 249,168 for an explanation of an appropriate steering system. The lower portion of the propulsion unit 15 includes the body 16 having an inlet port 18 at its left-hand end and a jet nozzle 20 at its right-hand or rearward end relative to the boat. The body 16 is mounted for free rotation within a supporting strut 22. Bearings 24 and 26 are mounted between the strut 22 and the upper, laterally extending bearing portion 27 of the body 16 to allow its free rotation.

Also shown in FIG. 1 is the manual control system for providing changeover of drive between forward and reverse operation. This includes a reversing control lever 28 which is pivotally mounted on a pin 30 fixed to the propulsion unit 15 proximate the steering tube 14. The lever 28 further includes an upstanding arm 32 to which a reverse cable 34 is attached. An opposed pair of lateral arms 36 and 38 each have pivotably mounted proximate its end detents 40 and 42, respectively. It will be seen that each of the detents 40, 42 is freely and pivotably mounted on its respective arm 36, 38 so that according to the rocking movement of the lever 28 about the pin 30, one or the other of the detents 40, 42 will be placed in the path of a fixed stop 44, which stop is fixed to the upper surface of the bearing portion 27 of the body 16.

A manual operating lever 46 is shown with the three positions “forward”, “neutral” and “reverse” indicated by letter designation F, N and R. The thrust unit 15 is illustrated in FIG. 1 in its forward position in which detent 40 is in abutment with the side of the stop 44 to arrest its movement and that of the body 16 and thus direct the thrust force from the nozzle 20 in a rearward direction. When the lever 46 is placed in its right-hand or reverse position, as designated by the letter R, the lever 28 will be rocked in a clockwise direction to place the detent 42 in the path of the stop 44, thus finally arresting the rotation of the propulsion unit 15 at a point substantially 180° from its original or forward position.

With the nozzle 20 open, the friction of the water passing through the jet body 16 will provide torque force T to give a rotation of the propulsion unit 15 into its reverse operating position.

Also shown in FIG. 1 drawing in block diagram form is a clutch 48 which is operable in an intermediate or neutral position of the control lever 46 to provide for disengagement of the drive from the engine associated with the driveshaft 10. The clutch 48 may either be a mechanically operated dog-type clutch, a solenoid operated clutch, a hydraulic operated clutch or like device. Examples of several clutch mechanisms suitable for use in connection with the present invention are shown and described in U. S. Pat. application No. 249,168 hereinbefore referred to.

FIGS. 2 and 3 show an alternate embodiment of the present invention in which the basic parts of the thrust unit 15, including the driveshaft 10, the impeller 12, the steering tube 14 and the body 16, are all mounted on a boat rear transom, while the rotation and changeover between forward and reverse operation is provided by the turning through a half-circle turn of a lower separately rotatable jet nozzle 50. The nozzle 50 is rotatably supported below an exit outlet 21 for the central pump chamber 13 with the fluid being directed through a final jet nozzle 20. The nozzle 50, as better shown in the drawing of FIG. 3, is shown in solid line designation in its forward operating position and in phantom line designation in its reverse operating position.

The nozzle 50 is supported off-center relative to its longitudinal axis on the body 16 on a shaft 23. The basic operating mechanism for reversing control is provided again through a rockable lever 28 which alternately and selectively positions the detent 40 or 42 into or away from alignment with the stop 44 provided on the upper surface of the rotatable nozzle 50. In a manner similar to the FIG. 1 embodiment, there is included a clutch 48 which is actuated in the neutral position of the selector lever 46 to disconnect engine drive from the driveshaft 10. The detail of construction of the clutch 48 is omitted in the interest of brevity.

FIGS. 4 and 5 show a different embodiment of the present invention which is substantially similar to the embodiment of FIG. 1 except that the jet nozzle 20, instead of being centered in the body 16, is offset rightwardly of its center O. This offset position of the nozzle 20, as best shown in FIG. 5, provides a reversing moment arm force F. Thus the entire body 16 is rotated counterclockwise about its center O and the operation of the reversing control lever 28 raises detent 40 and lowers detent 42 into the path of the upwardly extending stop 44. This stops and retains the thrust unit 15 in its forward or reverse operating position. In a similar manner to the previous embodiment shown, there is provided a clutch 48 which is operable in the neutral selection position of the lever 46 to disconnect drive
from driveshaft 10 and hence from the thrust unit 15. It will be understood that the supporting struts 22 are attached to a suitable mounting bracket fixed to the boat transom. While the present invention is illustrated with respect to the thrust unit 15 being mounted at the rear end of the boat, the invention is not so limited but is equally adaptable for forward or mid-ship installations on a boat.

The FIG. 6 embodiment is substantially similar to that shown in FIG. 1 but differs with respect to the control provided for the nozzle 20. The nozzle 20 opening size may be selectively varied through operation of a control lever which serves to position a pivoting vane 20a on the nozzle 20 between an extreme open position illustrated in the upper phantom line designation and a completely closed position illustrated in the lower phantom line designation. It will be understood that with the nozzle 20 closed off there will be developed a torque T, the direction of which is shown by arrow through the friction of the water in the body 16. This torque will then rotate the propulsion unit 15 into a reverse position. The selection of forward or reverse operation again is made by the reversing control lever 46 and the reversing cable 34, which serve to operate the reversing control lever 28 and to rock it either clockwise or counterclockwise to place the detent 40 or 42 in abutment with the stop 44. The mechanism of FIG. 6 in which the nozzle is variable allows for trimming of the nozzle 20 to an optimum running point during operation of the boat.

FIG. 7 schematically shows the mode of operation of a pair of units, such as those shown in FIGS. 1 and 6, in which the turning force which orients the nozzle 20 in its forward or reverse position is either permanently opened or adjustable movable between open and closed positions. In either case, the friction of the water in the jet body 16 provides a turning force so that the units will be rotated in the direction of the arrows. The right-hand unit turns counterclockwise and the left-hand unit turns clockwise to eliminate side thrust during the changeover between forward and reverse operation. Also shown are the drive shafts 10 about which the turning of the two propulsion units 15 occurs. The two units 15 are mounted on the transom 11 in a partial showing of a boat although, as has already been indicated, this invention is equally applicable to dual units mounted in different locations in the boat.

The drawing of FIG. 8 shows a dual installation on a boat transom 11. The two units 15 are of the jet-type such as was illustrated in FIGS. 2 and 3, with the jet nozzle 20 in each case being rotatable about a point or shaft 23 extending from the lower surface of the unit 15. Again, in a manner similar to the FIG. 7 embodiment, the dual installation provides the advantages of opposite direction rotation of the two independently rotatable nozzles 50 to cancel out side thrust during the changeover between forward and reverse boat operation.

The FIG. 9 embodiment illustrates a dual installation of a pair of jet propulsion units like the one illustrated in FIGS. 4 and 5 in which the entire propulsion units 15 are rotated about their centers by reason of the moment of force F which is provided by the offset of each fixed nozzle 20 relative to the center of its associated body 16. In this embodiment, the two units likewise are rotated in opposite directions to cancel out side thrust forces.

It will thus be seen that the present invention provides a substantially improved and novel boat steering and reversing system in which with a minimum of apparatus it is possible to provide a rapid changeover in boat direction between forward and reverse. This changeover is accomplished by forces generated in the propulsion unit itself to provide the rapid turning of the propulsion unit. The present invention further includes mechanisms which are specially adaptable to dual installations and serve to eliminate side thrust during changeover.

What is claimed is:
1. In a boat having a jet type propulsion unit mounted on it and swivelable about a substantially vertical axis, a steering means coupled to said propulsion unit for normally steering it in a forward direction, and a control system operably connected to it and controlling said propulsion unit for rapidly turning it about said axis through about 180 degrees to effect a changeover between the forward and reverse drive condition of the boat, said control system including a detent means selectively positionable in the manner of a stop fixed to said propulsion unit, said propulsion unit further having its jet nozzle offset relative to said axis to apply an unbalanced force to rotate the propulsion unit between its forward and reverse drive positions.

2. The combination as set forth in claim 1 wherein a means is operably connected to said jet nozzle opening for selectively adjusting its size and providing optimum running condition.

3. The combination as set forth in claim 1 wherein said jet type propulsion unit includes an impeller mounted for rotation to provide the thrust force through its jet nozzle.

4. The combination as set forth in claim 3 wherein a vertical driveshaft is connected between the output of an engine and said impeller for driving it, and a clutch means is operably connected to said driveshaft for selectively controlling its operation to provide a neutral operation.

5. The combination as set forth in claim 1 wherein said detent means comprises a pair of detents pivotally mounted at opposite ends of a control lever, and wherein a reversing cable is operably coupled to said lever for rocking it to engage one of said detents with said stop for holding said unit in a selected one of said drive conditions for said boat.

6. In a boat having a pair of spaced propulsion units of the jet type mounted on it with each of said units swivelable about its own substantially vertical axis, a steering means connected to both of said propulsion units for normally steering them in a forward direction, and a control system operatively connected to and controlling said propulsion units for rapidly turning each in an opposite direction about its respective axis through substantially 180 degrees to effect a changeover between the forward and reverse drive condition of the boat, each of said propulsion units having its jet nozzle offset relative to its axis but on an opposite side for providing opposite direction forces of rotation to said units, and a stop means for retaining both said units in a like selected one of said conditions.

7. The combination as set forth in claim 6 wherein each of said propulsion units includes a body and wherein a drive impeller is rotatably mounted in said body and fixed to the end of a driveshaft, each of said
driveshafts aligned with one of said substantially vertical axes.

8. The combination as set forth in claim 7 wherein an engine is connected to each of said impellers through its associated shaft for driving it, and wherein a clutch is operably connected between said engine and said shaft to provide for selective drive disconnect and neutral operation.

9. In a boat having a pair of propulsion units of the jet type mounted on it and each swivelable about a substantially vertical axis, a steering means connected to said propulsion units for normally steering them in a forward direction, and a control system operatively connected to and controlling said propulsion units for turning them about said axis through substantially 180° to effect a changeover between the forward and reverse drive conditions of the boat, said system including in each case relating to each propulsion unit a drive means and a driveshaft coupled to the output of said drive means, said shaft aligned with said vertical axis, an impeller connected to the lower end of said shaft, a body enclosing said impeller and having a jet nozzle opening normally directed to the rear relative to the boat to provide forward drive, a means for adjusting the size of said jet nozzle opening, a selectively engageable stop means cooperative with said propulsion unit for holding it in one of the two positions, one for forward and the other for reverse drive condition, said pair of propulsion units mounted on said boat in lateral spaced relationship, one to the other, each of said units having its impeller normally rotatable in an opposite direction thereby to provide rotation of the two propulsion units, one relative to the other, in a different direction during changeover between forward and reverse drive conditions of the boat.

10. In a boat having a propulsion unit of the jet type mounted on it and swivelable about a substantially vertical axis, a steering means connected to said propulsion unit for normally steering it in a forward direction, and a control system operatively connected to and controlling said propulsion unit for turning it about said axis through substantially 180° to effect a changeover between the forward and reverse drive condition of the boat, said system including a drive means and a driveshaft coupled to the output of said drive means, said shaft aligned with said vertical axis, an impeller connected to the lower end of said shaft, a body enclosing said impeller and having a jet nozzle opening normally directed to the rear relative to the boat to provide forward drive, a means for adjusting the size of said jet nozzle opening, and a selectively engageable stop means cooperative with said propulsion unit for holding it in one of the two positions, one for forward and the other for reverse drive condition, said stop means comprising an extension on an upper surface of said propulsion unit, and wherein said means for controlling the reversing operation comprises a rockable lever having a detent at each of its ends, one of said detents selectively engageable with said stop means.

11. The combination as set forth in claim 10 wherein said lever includes a central arm, and wherein a reversing cable is coupled to said arm to provide a rocking motion of said lever to engage one or the other of said detents with the stop of said propulsion unit.

* * * * *
UNIVERS STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,802,376 Dated April 9, 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 1, line 63, change U.S. Pat. No. "1,744,956" to --1,774,956--.

Column 2, line 66, change "draw-ings" to --drawings--.

Signed and sealed this 10th day of September 1974.

(SEAL)
Attest:

McCoy M. Gibson, Jr. C. Marshall Dann
Attesting Officer Commissioner of Patents