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Archer

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[54] **PROPULSION AND STEERING SYSTEM FOR BOATS**

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[73] Assignee: **Charles R. Archer**, Los Angeles, Calif.; a part interest

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[52] **U.S. Cl.** ..... **115/12 R**, 114/151

[51] **Int. Cl.** **B63h 11/04**

[58] **Field of Search** ..... 115/12 R, 14, 16; 114/144 R, 172

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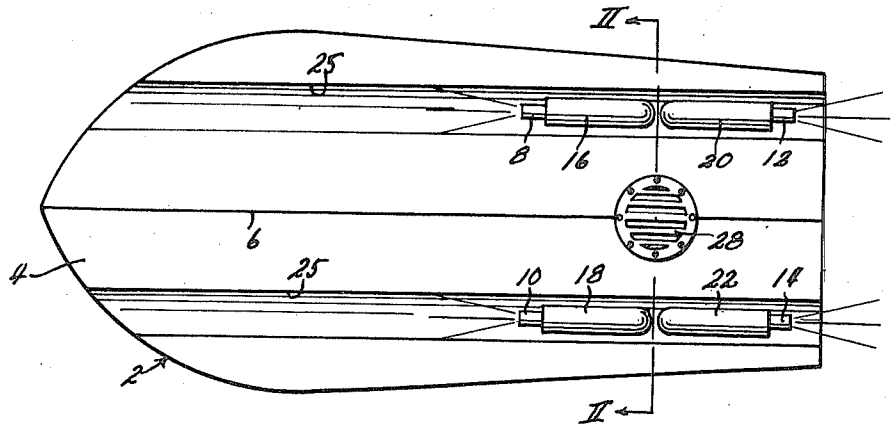
[57] **ABSTRACT**

A propulsion and steering system for boats consisting of four water jet nozzles carried by a boat beneath the waterline thereof, the nozzles being arranged in two pairs at respectively opposite sides of the midline of the boat, with the jets of each pair being directed respectively forwardly and rearwardly of the boat, a powered apparatus for directing water outwardly through the nozzles, and a control system for varying the proportions of the amounts of water delivered to the various nozzles, whereby the boat may be propelled forwardly or rearwardly, braked or stopped, and steered. A safety system is also provided for steering the boat in a straight line, and bringing it to a halt, if for any reason the boatman should leave the controls.

5 Claims, 3 Drawing Figures



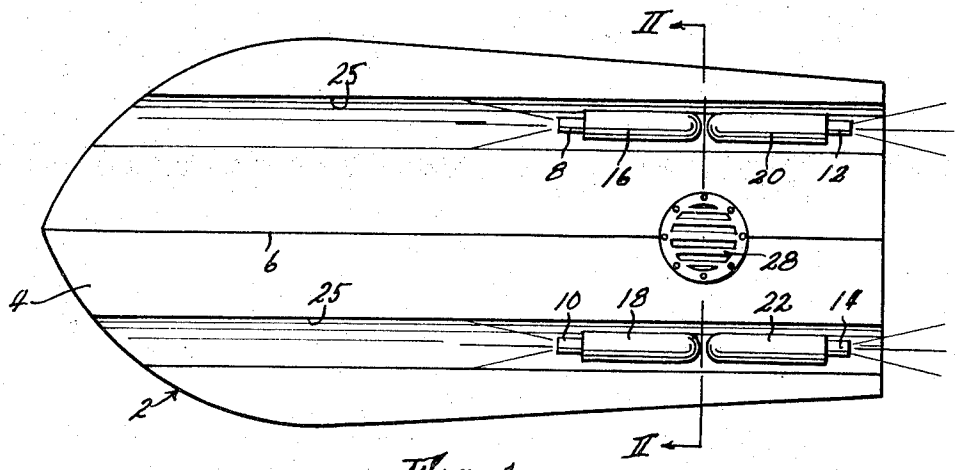

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Fig. 1

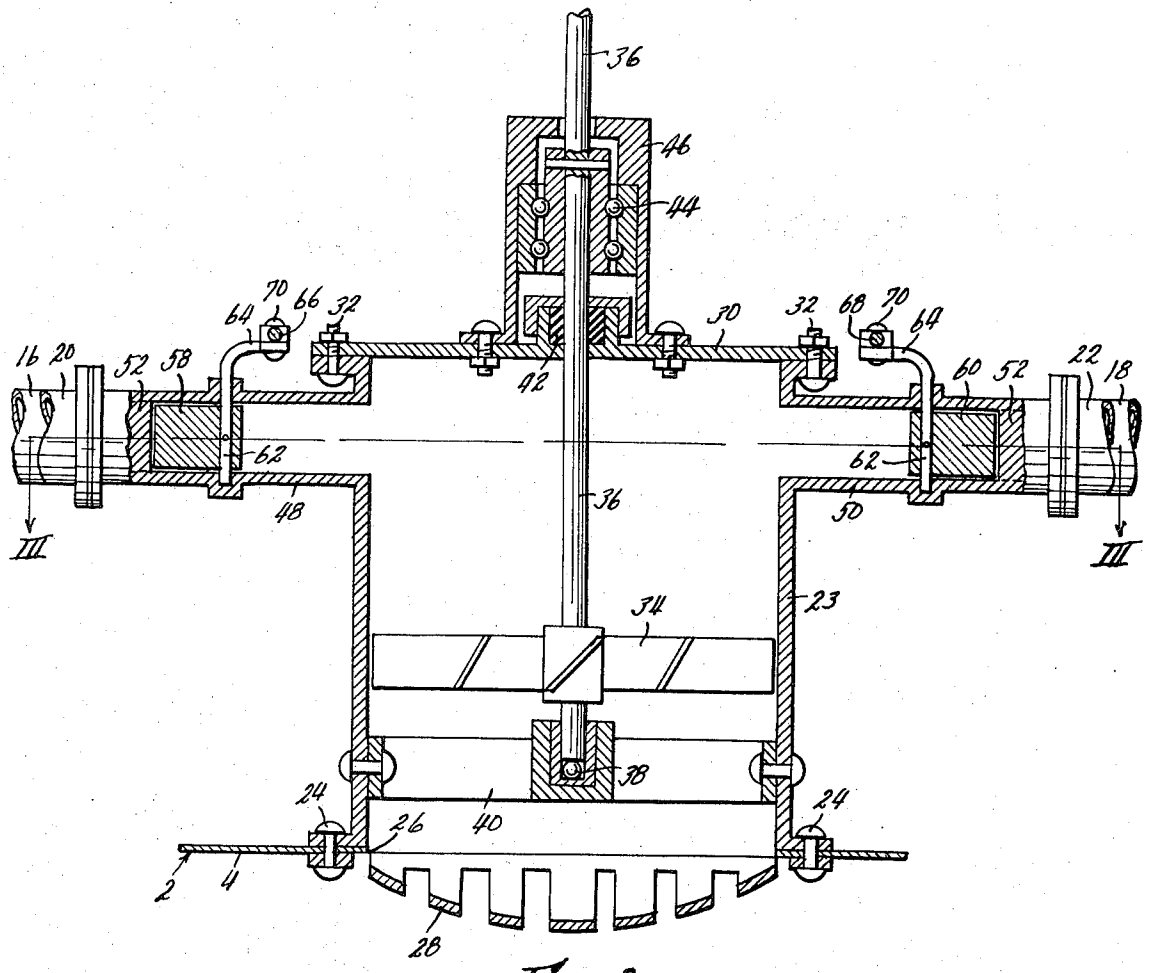
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Fig. 2

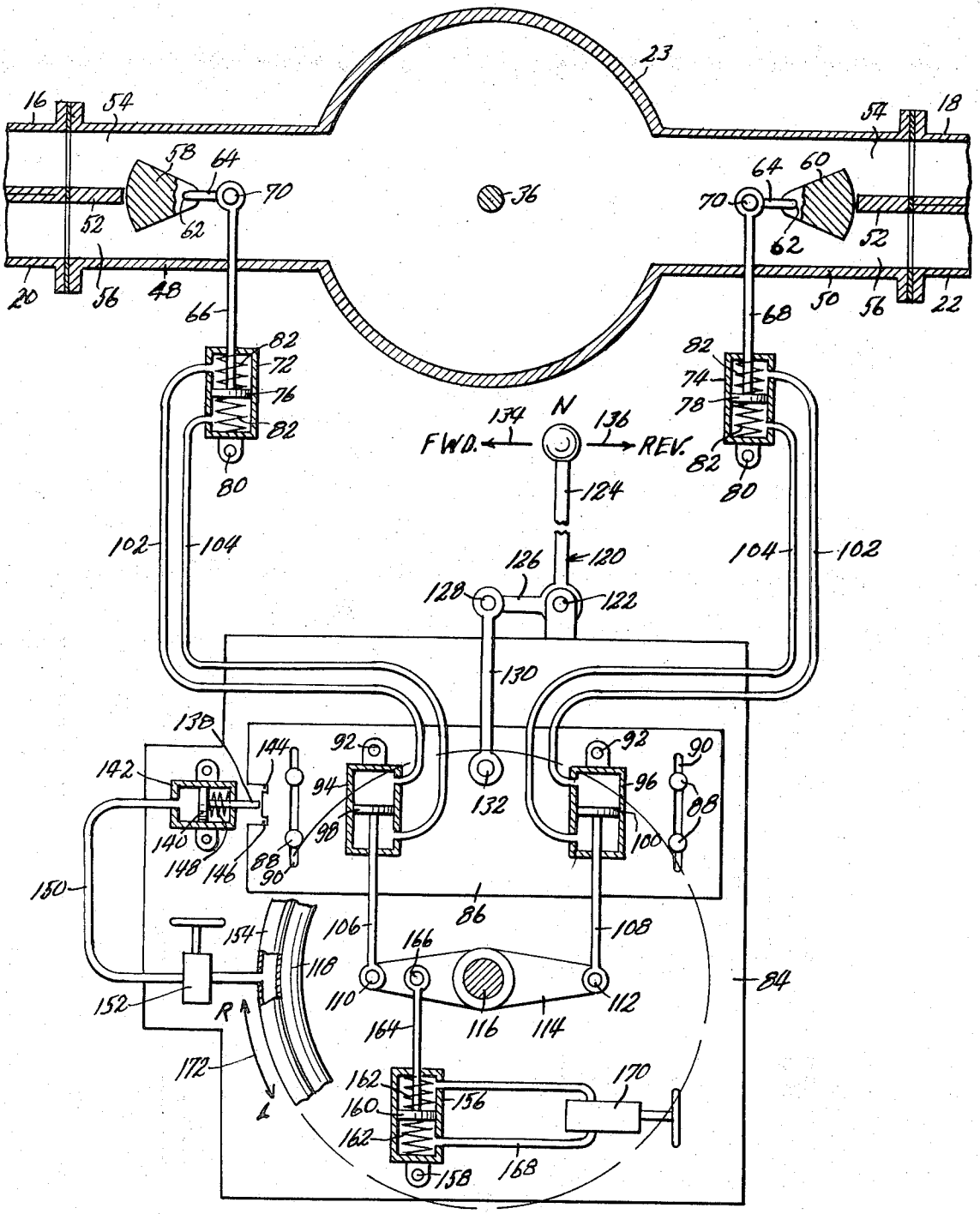
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Fig. 3

PROPULSION AND STEERING SYSTEM FOR BOATS

This invention relates to new and useful improvements in propulsion and steering systems for boats. It has been designed particularly for use in connection with small craft, but the principles thereof are applicable to boats of any size.

The principal object of the present invention is the provision of a propulsion and steering system in which the propulsion and steering are accomplished by the proportional control of water delivered to a set of jet nozzles carried by the boat hull and operable to direct jets outwardly from said hull beneath the water level. Specifically, there are provided two pairs of nozzles, one pair being disposed at each side of the boat midline, and the nozzles of each pair being directed respectively forwardly and rearwardly of the boat. By directing water primarily to the rearward nozzles, the boat is propelled forwardly. By then delivering water primarily to the forward jets, the boat is braked or stopped, and then reversed for backward travel. The converse is true for starting, braking, or stopping, and reversing backward travel. By increasing water delivery simultaneously to one forward nozzle and the opposite rearward nozzle, and decreasing delivery to the remaining nozzles, the boat may be steered in either direction.

Another object is the provision of a novel control system including a manual lever settable for forward or reverse travel, and an ordinary steering wheel for steering purposes.

A further object is the provision in a system of the character described of a safety device operable to bring the boat automatically to a stop in the event for any reason the boatman should leave the controls or fall overboard. Means are provided for overriding this safety device under special circumstances.

Other objects are relative simplicity and economy of construction, efficiency and dependability of operation, and ease, convenience and safety of use.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the accompanying partially schematic drawing, wherein:

FIG. 1 is an inverted plan view of a boat, with a propulsion and steering system embodying the present invention operatively incorporated therein,

FIG. 2 is an enlarged, fragmentary sectional view taken on line II—II of FIG. 1, and

FIG. 3 is a sectional view taken on line III—III of FIG. 2, and includes a schematic diagram of the control elements of the system.

Like reference numerals apply to similar parts throughout the several views, and the numeral 2 applies generally to a boat shown in inverted plan in FIG. 1. The bottom wall of the boat hull is indicated at 4, and its longitudinal midline at 6. According to the present invention, there are mounted beneath the boat hull a pair of forwardly directed jet nozzles 8 and 10 spaced equidistantly and respectively at the left and right sides of midline 6, and a pair of rearwardly directed nozzles 12 and 14 also spaced equidistantly and respectively at the left and right sides of midline 6. Water is delivered to said nozzles individually by pipes or conduits 16, 18, 20, and 22 respectively. Said pipes extend upwardly through the boat bottom to receive water for delivery to the nozzles, as will be described. The nozzles, and the portions of the pipes disposed beneath the boat hull, may be disposed in channels or tunnels 25 recessed upwardly into the hull, so that they form no projection beneath the hull.

Within the boat, a vertical cylindrical pressure housing 23 is fixed, as by rivets 24 or the like, to hull bottom 4, in sealed relation thereto, so as to communicate with a hole 26 formed in said bottom. Said hole forms the water intake for the system, and is covered by a strainer 28 to prevent the entry of foreign objects. Housing 23 is covered by a cover plate 30. The cover plate is preferably disposed above water level, and is affixed removably to the housing as by bolts 32, so that it may be removed to provide servicing access to the housing without removing the boat from the water. Disposed in the pressure housing is a water impeller wheel 34 fixed on a vertical shaft 36. Said shaft is journalled at its lower end in a bearing 38 carried by a spider fixture 40 fixed in the housing, and extends upwardly through a packing gland 42 carried by cover plate 30, and being journalled in a bearing 44 carried by a bearing housing 46 fixed on said cover plate. The shaft extends above housing 46, and it will be understood that said shaft is operatively connected to and driven by a prime mover, not shown, such as a gasoline engine or the like, the speed of which may be regulated by any standard means, such as a fuel throttle.

Depending on the speed of rotation of shaft 36, impeller wheel 34 draws variable quantities of water upwardly through strainer 28 and delivers it under pressure to a pair of opposite lateral left and right outlet tubes 48 and 50 interconnected into the upper portion of housing 23. Each of said outlet tubes has its outer portion divided by a vertical septum 52 into two passageways 54 and 56. Left nozzle pipes 16 and 20 are interconnected respectively with passageways 54 and 56 of the left outlet tube 48, and right nozzle pipes 18 and 22 are interconnected respectively with passageways 54 and 56 of right outlet tube 50.

A pair of pivotal diverter gates 58 and 60 are disposed respectively in outlet tubes 48 and 50 and have the function of dividing the water in their associated outlet tubes in variable proportions between the passageways 54 and 56 thereof. Each diverter gate is fixed on a vertical shaft 62 journalled in the walls of the associated outlet tube, and is horizontally segmental in shape, with shaft 62 at its apex, and with its arcuate edge closely adjacent the inner end of septum 52. Thus it will be seen that by turning shafts 62, gates 58 and 60 may be positioned to deliver water flowing outwardly through tubes 48 and 50 to both sides of the septums 52, but in variable proportions. Each diverter gate shaft 62 extends outwardly from its tube 48 or 50, and is provided externally of the tube with a transversely extending crank arm 64, by means of which the diverter gates may be controlled.

The control system for the diverter gates is illustrated diagrammatically in FIG. 3. A pair of rods 66 and 68 are pivoted respectively, as at 70, to the free ends of the control cranks 64 of the left and right diverter gates. Rods 66 and 68 extend axially and respectively into a pair of hydraulic slave cylinders 72 and 74, being affixed to the pistons 76 and 78 thereof. Each of said cylinders is pivoted, as at 80, to a fixed support. Each piston is at a midpoint in its cylinder when the diverter gate controlled thereby is at its midpoint of pivotal travel, so as to divert water equally to the associated passageways 54 and 56. Each slave cylinder piston is

constantly biased to its mid-position by a pair of centering springs **82** disposed at opposite sides thereof within its associated cylinder.

The control system also includes a rigidly mounted control panel **84,** which may be viewed as being vertically disposed, although its actual position is of course optional. Overlying panel **84** is a master cylinder plate **86** which is vertically slidable on the panel, as provided, for example, by pins **88** fixed in the panel and engaged in vertical slots **90** of the plate. Pivoted on plate **86,** each at **92,** are left and right master cylinders **94** and **96,** carrying pistons **98** and **100** respectively. The respective ends of each master cylinder **94** and **96** are interconnected with the corresponding ends of its associated slave cylinder **72** or **74** by a pair of flexible hoses **102** and **104.** The piston rods **106** and **108** of pistons **98** and **100** extend downwardly from the cylinders, and are pivoted at their lower ends, as at **110** and **112,** to the respectively opposite ends of a lever **114,** which in turn is pivotally mounted at its midpoint on a horizontal steering shaft **116** fixed in and projecting from control panel **84.** A steering wheel **118,** shown fragmentarily, is also rotatably mounted on shaft **116,** but is affixed to lever **114** so that the latter turns therewith. Master cylinder plate **86** may be moved vertically on the control panel by means of a bell-crank selector lever **120** pivoted at **122** to the control panel, arm **124** of said lever being manually movable, and arm **126** of said lever being pivoted at **128** to one end of a link **130** the opposite end of which is pivoted at **132** to plate **86.** Plate **86** may be lowered by pressing lever arm **124** in the direction of arrow **134,** or raised by moving said lever in the direction of arrow **136,** or left in a neutral mid-position, designated N, in which plate **86** is positioned to dispose pistons **98** and **100** at the midpoints of cylinders **94** and **96,** so long as lever **114** is level.

Cylinder plate **86** may be releasably secured in either its raised or lowered position by means of a detent pin **138** which is an extension of the piston rod of a piston **140** carried operatively in a cylinder **142** fixed on control panel **84,** said detent pin being selectively engagable with notches **144** and **146** formed in the cylinder plate. Said detent pin is normally urged out of engagement with the notches by a spring **148** in cylinder **142,** but the opposite end of the cylinder is connected by a flexible conduit **150,** through a manually operable closure valve **152,** to a flexible tube **154** which is mounted on the rim of steering wheel **118.** Said tube may extend around the entire periphery of the steering wheel, and is adapted to be compressed by the grip of the boatman's hands thereon. The entire tube **154,** as well as conduit **150** and cylinder **142** to piston **140,** is filled with hydraulic fluid. Thus, so long as the boatman grips the wheel with sufficient force (it need not be great) to advance piston **140** against spring **148,** the detent pin **138** will be biased outwardly, and will snap into engagement with notch **144** or notch **146** when the plate **86** is respectively lowered or raised by use of lever **120.**

A steering control cylinder **156** is pivoted to the control panel at **158,** and carries therein a piston **160** biased to a central position therein by centering springs **162.** The piston rod **164** of piston **160** extends outwardly from the cylinder, and its extended end is pivoted at **166** to lever **114** at a point spaced apart eccentrically from shaft **116.** The opposite ends of cylinder **156** are interconnected by a conduit **168,** in which is interposed a manually operable closure valve **170.** It will of course be understood that all of cylinders **72, 74,** 94, 96 and **156,** as well as conduits **102, 104,** and **168,** are completely filled with hydraulic fluid at all times.

In operation, manually operable valves **152** and **170** are normally left open at all times. Thus diverter gates **58** and **60** are moved to their central positions, as illustrated in FIG. **3,** by the centering springs **82** of slave cylinders **72** and **74,** the pistons **76** and **78** of the slave cylinders at the same time forcing fluid through hoses **102** and **104** to move cylinder plate **86** to its vertically centered position by centering master cylinders **94** and **96** on their pistons **98** and **100.** The cylinder plate **86** is free to move vertically so long as the boatman is not gripping steering wheel tube **154** and detent **138** is accordingly disengaged. Also, steering lever **114** is levelled to the position shown by the centering springs **162** of steering control cylinder **156,** so long as valve **170** is open.

To set the system in operation, the gasoline engine or the like which powers the system is started to turn shaft **36** to cause impeller wheel **34** to deliver water to pressure housing **23,** and thence through nozzle pipes **16,** 18, 20, and **22** to all of jet nozzles **8, 10, 12** and **14.** However, at this time the boat does not move at all, since an equal amount of water is being discharged from each of the four nozzles, and the net propulsion effect is of course zero.

To set the boat in forward motion, the operator, while grasping steering wheel tube **154** to bias detent pin **138** toward an engaging position, presses lever arm **124** in the direction of arrow **134.** This lowers master cylinder plate **86,** in which position it is secured by the engagement of detent **138** in plate notch **144.** The lowering of plate **86** lowers master cylinders **94** and **96** over their pistons **98** and **100,** whereby fluid from the upper ends of these cylinders is forced through conduits **102** to the upper ends of slave cylinders **72** and **74,** causing the pistons **76** and **78** thereof to be moved downwardly (as viewed in FIG. **3**) against the bias of centering springs **82.** These pistons thereby act through rods **66** and **68,** and cranks **64,** to position diverter gates **58** and **60** to direct a greater proportion of the water flowing through tubes **48** and **50** to rear jet nozzle pipes **20** and **22,** than to front jet nozzle pipes **16** and **18,** and the boat is of course thereby propelled forwardly. It is necessary that some small amount of water be delivered to the front jets even at this time, and that diverter gates **58** and **60** still have some freedom of movement in both directions, in order better to permit the steering function to be described. Conversely, as will be readily apparent, if lever arm **124** is moved in the direction of arrow **136** to elevate cylinder plate **86,** and the plate is secured in the elevated position by engagement of detent **138** in notch **146,** diverter gates **58** and **60** will be positioned to divert the greater proportion of water to front jet nozzle pipes **16** and **18,** and the boat will be propelled rearwardly.

The speed of travel of the boat is preferably regulated by the fuel throttle of the gasoline engine or other prime mover powering the system. It would of course be possible to control speed by changing the relative proportions of water delivered to the forward and rearward jet nozzles, by varying the degree to which lever arm **124** is moved in either direction, but this would require the engine to operate at maximum speed at all times, and is not considered to be practical.

By releasing tube **154** to disengage detent **138**, and allowing plate **86** to be returned to its neutral position by centering springs **82**, the propulsion effect is again reduced to zero, and the boat will come to a halt. By manipulating lever **120** to set the nozzle for reverse travel, while the boat is moving forwardly, a braking action is initiated and the boat can be brought to a very rapid stop.

Steering is provided by steering wheel **118**. If, for example, said wheel is turned to the right as indicated by arrow **172** in FIG. **3**, steering lever **114** is tilted to the right also. This causes rod **106** to raise piston **98** in cylinder **94**, and rod **108** to lower piston **100** in cylinder **96**. This in turn by flow of fluid in conduits **102** and **104**, causes piston **76** to be lowered in cylinder **72**, and piston **78** to be raised in cylinder **74**. This causes diverter gates **58** and **60** to be moved in relatively opposite directions, gate **58** causing proportionately more water to be delivered to left rear nozzle tube **20** than to left front nozzle tube **16**, while gate **60** causes proportionately more water to be delivered to right front nozzle tube **18** than to right rear nozzle tube **22**, and the boat turns to the right. The boat can be caused to turn in a very short radius or even to turn on its own vertical axis, if so desired. The boat is caused to turn to the left, in the same manner, if wheel **118** is turned to the left.

Steering control cylinder **156** is intended to dampen the free turning movement of the steering wheel **118**, and to change the force required to turn it, for example to adjust the steering tension to the individual preference of each boatman, and to prevent it from turning accidentally, as when the boat rocks in the water with the steering wheel free. This action is obtained by leaving valve **170** open, but variably restricted, in order to change the ease and speed with which fluid can move between the ends of cylinder **156**. If the steering wheel is released by the boatman, centering springs **162** return the boat to a straight course, which of course is a safety feature as well as an aid to convenient steering, since ordinarily it is desired that the steering should be centered if for any reason the boatman should release the wheel. However, after setting a desired course, either straight or curved, the boatman may, while holding the wheel, close valve **170** completely, and the steering will be locked.

As long as valves **152** and **170** are open, it will be seen that if for any reason the boatman releases the steering wheel, releasing his compressing grip on tube **154** attached to the wheel, detent **138** will be retracted from whichever of notches **144** or **146** in which it is then engaged, and the entire system will be returned to its original neutral position, the steering being centered by centering springs **162** of control cylinder **156**, the resultant levelling of steering lever **114** tending to center the master cylinder pistons, which in turn, together with the slave cylinder centering springs, returns diverter gates **58** and **60** to their centered positions. This causes equal delivery of water to all four of the jet nozzles, with a resultant zero propulsion effect, and the boat will come to a halt regardless of the rate of operation of the engine driving the system. This is a valuable safety feature, since if the boatman leaves the wheel for any reason with the boat being propelled, as could occur from pure carelessness, or from fainting or loss of consciousness, or as a result of the boatman falling overboard, the boat would otherwise continue in motion, and could collide with another craft, or crash on a shore or other obstruction, or in some cases even circle and "run over" its own operator if he is in the water. Nevertheless, the boatman may, under unusual circumstances, override this safety feature by closing valve **152** while still grasping wheel tube **154**. He may then release the wheel and detent **138** will remain engaged in either of notches **144** or **146**, and the boat will continue in motion at whatever speed it has been set while he is away from the wheel. Ordinarily, of course, valve **170** should also be closed to lock the steering whenever valve **152** is closed.

Thus it will be seen that a propulsion and steering system having several advantages has been produced. It provides great braking ability and a short turning radius, providing a high degree of maneuverability resulting in a high safety factor. The maneuverability is at least equal to that of a twin screw craft, but requires only one engine for power. The centered position of diverter gates **58** and **60** provides a stand-still effect without necessity of a clutch or transmission to disconnect the engine from the water impeller. The boat requires no rudder, and if the jet nozzles and pipes are contained in tunnels **25** recessed upwardly into the hull, there need be no underwater gear of any kind projecting below the hull, and the boat can be operated in very shallow water. This absence of underwater gear also holds down the cost of corrosion and electrolysis to a minimum.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention.

What I claim as new and desire to protect by Letters Patent is:

1. A boat propulsion and steering system comprising four jet nozzles carried by the boat hull beneath the water level and operable to direct water jets exteriorly of said hull, two of said nozzles being directed forwardly of the boat and two rearwardly, one forwardly and one rearwardly directed nozzles being disposed at each side of the midline of the boat, powered means operable to deliver water to all of said nozzles for ejection therefrom, the pair of nozzles at each side of the boat midline being supplied with water from a common conduit which is branched to supply water to the respective associated nozzles, and control means operable to deliver water to said nozzles in variable proportions, whereby to propel and steer said boat, said control means comprising:

a. a pair of diverter gates disposed movably in the respective common conduits and operable by movement thereof to direct proportionately more or less of the water flowing through said common conduit to either of the associated branch conduits,

b. a first diverter gate positioning means operable to position said diverter gates selectively to deliver proportionately more water to either forward nozzle and to the rear nozzle at the opposite side of the boat midline, and proportionately less water to the remaining two nozzles, whereby the boat is steered, and

c. a second diverter gate positioning means operable selectively to deliver proportionately more water either to the rearward nozzles or to the forward nozzles, whereby said boat is propelled respectively

either forwardly or rearwardly, said second diverter gate positioning means comprising:

1. a manually movable control member movable in either direction from a neutral position,
2. means responsive to movement of said control member to move said diverter gates, whereby when said control member is in its neutral position said diverter gates are positioned to direct equal amounts of water in total to the forward and rearward nozzles, whereby when said control member is moved in one direction from neutral said diverter gates are positioned to direct proportionately more water to the branch conduits interconnected with the rear nozzles and the boat is propelled forwardly, and whereby when said control member is moved in the other direction from neutral said diverter gates are positioned to direct proportionately more water to the branch conduits interconnected with the forward nozzles, and the boat is propelled rearwardly,
3. resilient means biasing said control member to its neutral position,
4. detent means operable to secure said control member in either its forward or its rearward propulsion position, and
5. manually operable detent control means.

2. A boat propulsion and steering system as recited in claim **1** wherein the boat steering system includes a manually operable steering wheel, and wherein said detent control system comprises:

a. resilient means biasing said detent to a released position, whereby said control member is released for return to its neutral position, and

b. pressure-sensitive means carried by said steering wheel and operable responsively to the pressure of the boatman's hands thereon to urge said detent to its operative position, whereby if the boatman releases the steering wheel, the detent releases, the control member returns to its neutral position to set the diverter gates to deliver water equally to the forward and rearward nozzles, and the boat comes to a halt.

3. A boat propulsion and steering system as recited in claim **2** with the addition of manually operable means for locking said detent in either of its engaged positions, whereby the boatman may release the steering wheel, when desired, leaving the control member locked by said detent in either forward or reverse propelling position.

4. A boat propulsion and steering system comprising four jet nozzles carried by the boat hull beneath the water level and operable to direct water jets exteriorly of said hull, two of said nozzles being directed forwardly of the boat and two rearwardly, one forwardly and one rearwardly directed nozzle being disposed at each side of the midline of the boat, powered means operable to deliver water to all of said nozzles for ejection therefrom, the pair of nozzles at each side of the boat midline being supplied with water from a common conduit which is branched to supply water to the respective associated nozzles, and control means operable to deliver water to said nozzles in variable proportions, whereby to propel and steer said boat, said control means comprising:

a. a pair of diverter gates disposed movably in the respective common conduits and operable by movement thereof to divert proportionately more or less of the water flowing through said common conduit to either of the associated branch conduits,

b. a first diverter gate positioning means operable to position said diverter gates selectively to deliver proportionately more water to either forward nozzle and to the rear nozzle at the opposite side of the boat midline, and proportionately less water to the remaining two nozzles, whereby the boat is steered, said first diverter gate positioning means comprising:

1. a steering wheel carried rotatably by a fixed support,
2. a steering lever carried by said wheel, being movable therewith and projecting oppositely from the axis thereof,
3. operating means interconnecting each end of said steering lever with one of said diverter gates, whereby said gates are moved in relatively opposite directions in response to the turning of said steering wheel in opposite directions,
4. a hydraulic cylinder carried by a fixed support and having a piston movable therein,
5. means connecting said piston to said steering lever eccentrically to the axis of said steering wheel, whereby said piston is moved in said cylinder by turning of said steering wheel,
6. centering springs operable to bias said piston and said steering lever yieldably to a position representing straight-line travel of said boat,
7. a conduit interconnecting the opposite ends of said cylinder, and
8. an adjustable throttling valve in said conduit and operable to vary adjustably the rate at which said piston may move in said cylinder, and

c. a second diverter gate positioning means operable selectively to deliver proportionately more water either to the rearward nozzles or to the forward nozzles, whereby said boat is propelled respectively either forwardly or rearwardly.

5. The structure as recited in claim **4** wherein said throttling valve may be closed completely to lock said piston and steering lever at any desired position.

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