600227

FORM 1

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

We, OUTBOARD MARINE CORPORATION

of 100 SEA-HORSE DRIVE
WAUKEGAN
ILLINOIS 60085
USA

hereby apply for the grant of a standard patent for an invention entitled:

MARINE PROPULSION DEVICE HYDRAULIC SYSTEM

which is described in the accompanying complete specification

This application is made under the provisions of Section 51 as a divisional of Australian patent application 61900/86 by Outboard Marine Corporation.

Our address for service is care of GRIFFITH HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne 3004, Victoria, Australia.

DATED this 29th day of November 1988

OUTBOARD MARINE CORPORATION

GRIFFITH HACK & CO.

TO: The Commissioner of Patents

ACCEPTED AND AMENDMENTS ALLOWED 1.2.91

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Forms 7 and 8

AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

Name(s) of Applicant(s)

In support of the application made by OUTBOARD MARINE CORPORATION

for a patent for an invention entitled MARINE PROPULSION DEVICE HYDRAULIC SYSTEM

Title

I/We, R. Warren Comstock,
Outboard Marine Corporation,
100 Sea-Horse Drive, Waukegan, Illinois 60085, U.S.A.

Name(s) and address(es) of person(s) making declaration

do solemnly and sincerely declare as follows:—

1. I am~~/we are the applicant(s) for the patent,~~ or authorised by the abovementioned applicant to make this declaration on its behalf.

2. ~~The basic application(s) as defined by Section 141 of the Act was/were made in the following~~ country or countries on the following date(s) by the following applicant(s) namely:-

Country, filing date and name of Applicant for the or each basic application

In _____ on _____ 19 ____
by _____
In _____ on _____ 19 ____
by _____

3. The ~~said~~ basic application(s) was/were the first application(s) made in a Convention country ~~in respect of the invention the subject of the application.~~

4. The actual inventor(s) of the said invention is/~~are~~

Name(s) and address(es) of the or each actual inventor

Arthur R. Ferguson, 1620 Ferndale, Northbrook, Illinois 60062, U.S.A.

5. The facts upon which the applicant(~~s~~) is/~~are~~ entitled to make this application are as follows:-

See reverse side of this form for guidance in completing this part

The applicant is the assignee of the actual inventor.

DECLARED at Waukegan, IL this 16th day of December 19 88

OUTBOARD MARINE CORPORATION

R Warren Comstock

R. Warren Comstock, Asst. Secretary

This form may be completed and filed after the filing of a patent application but the form must not be signed until after it has been completely filled in as indicated by the marginal notes. The place and date of signing must be filled in. Company stamps or seals should not be used.
No legalisation is necessary.

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(54) Title
MARINE PROPULSION DEVICE HYDRAULIC SYSTEM

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(56) Prior Art Documents
US 3910044
US 3898810
US 3799102

(57) Claim

1. A marine propulsion device comprising a propulsion unit adapted to be pivotally mounted on the transom of a boat for pivotal movement relative to the transom about a steering axis, said propulsion unit including a rotatably mounted propeller, an engine, and a shiftable transmission drivingly connecting said engine to said propeller and including shift means, hydraulic steering means connected to said propulsion unit for causing pivotal movement of said propulsion unit about said steering axis, hydraulic shift assist means connected to said shift means for actuation thereof, a hydraulic fluid reservoir, a first pump housing defining a first pump chamber communicating with said reservoir, first supply conduit means communicating between said first pump chamber and said steering means, first return conduit means communicating between said steering means

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and said reservoir, a second pump housing defining a second pump chamber communicating with said reservoir, second supply conduit means communicating between said second pump chamber and said shift assist means, and second return conduit means communicating between said shift assist means and said reservoir.

2. A marine propulsion device comprising a propulsion unit adapted to be pivotally mounted on the transom of a boat for pivotal movement relative to the transom about a steering axis, said propulsion unit including a rotatably mounted propeller, and an engine drivingly connected to said propeller and including throttle means, hydraulic steering means connected to said propulsion unit for causing pivotal movement of said propulsion unit about said steering axis, hydraulic throttle assist means connected to said throttle means for actuation thereof, a hydraulic fluid reservoir, a first pump housing defining a first pump chamber communicating with said reservoir, first supply conduit means communicating between said first pump chamber and said steering means, first return conduit means communicating between said steering means and said reservoir, a second pump housing defining a second pump chamber communicating with said reservoir, second supply conduit means communicating between said second pump chamber and said throttle assist means, and second return conduit means communicating between said throttle assist means and said reservoir.

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PATENTS ACT 1952

Form 10

COMPLETE SPECIFICATION

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Related Art:

This document contains the amendments made under Section 49 and is correct for printing.

TO BE COMPLETED BY APPLICANT

Name of Applicant: OUTBOARD MARINE CORPORATION

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USA

Actual Inventor:

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Melbourne, Victoria 3004,
Australia.

Complete Specification for the invention entitled:

MARINE PROPULSION DEVICE HYDRAULIC SYSTEM

The following statement is a full description of this invention including the best method of performing it known to me:-

MARINE PROPULSION DEVICE HYDRAULIC SYSTEM

BACKGROUND OF THE INVENTION

The invention relates to marine propulsion device hydraulic systems, and more particularly to such hydraulic systems including hydraulic power steering, hydraulic shift assist, and hydraulic throttle assist. Still more particularly, the invention relates to pump assemblies used in marine propulsion device hydraulic systems.

Attention is directed to the following U.S. Patents:

Smith	1,692,473	Nov. 20, 1928
Dusevoir	2,462,732	Feb. 22, 1949
Dinnison, et al.	2,902,935	Sept. 8, 1959
Doble	3,014,429	Dec. 26, 1961
Scognamillo	3,344,745	Oct. 3, 1967
Brundage	3,551,081	Dec. 29, 1970
Goodwin	3,590,798	July 6, 1971
Young	3,740,954	June 26, 1973
Grob, et al.	3,884,196	May 20, 1975
Ohba, et al.	3,898,810	Aug. 12, 1975
Symmank	3,910,044	Oct. 7, 1975
Barton	3,916,767	Nov. 4, 1975
Barto	4,386,894	June 7, 1983

SUMMARY OF THE INVENTION

The invention provides a marine propulsion device comprising a propulsion unit adapted to be pivotally mounted on the transom of a boat for pivotal movement relative to the transom about a steering axis, said propulsion unit including a rotatably mounted propeller, an engine, and a shiftable transmission drivingly connecting said engine to said propeller and

including shift means, hydraulic steering means connected to said propulsion unit for causing pivotal movement of said propulsion unit about said steering axis, hydraulic shift assist means connected to said shift means for actuation thereof, a hydraulic fluid reservoir, a first pump housing defining a first pump chamber communicating with said reservoir, first supply conduit means communicating between said first pump chamber and said steering means, first return conduit means communicating between said steering means and said reservoir, a second pump housing defining a second pump chamber communicating with said reservoir, second supply conduit means communicating between said second pump chamber and said shift assist means, and second return conduit means communicating between said shift assist means and said reservoir.

In one embodiment the steering means includes first valve means, wherein said shift assist means includes second valve means, wherein said first supply conduit means communicates between said first pump chamber and said first valve means, wherein said first return conduit means communicates between said first valve means and said reservoir, wherein said second supply conduit means communicates between said second pump chamber and said second valve means, and wherein said second return conduit means communicates between said second valve means and said reservoir.

The invention provides a marine propulsion device comprising a propulsion unit adapted to be pivotally mounted on the transom of a boat for pivotal movement relative to the transom about a steering axis, said propulsion unit including a rotatably mounted propeller, and an engine drivingly connected to said propeller and including throttle means, hydraulic steering means connected to said propulsion unit for causing pivotal movement of said propulsion unit about

said steering axis, hydraulic throttle assist means connected to said throttle means for actuation thereof, a hydraulic fluid reservoir, a first pump housing defining a first pump chamber communicating with said reservoir, first supply conduit means communicating between said first pump chamber and said steering means, first return conduit means communicating between said steering means and said reservoir, a second pump housing defining a second pump chamber communicating with said reservoir, second supply conduit means communicating between said second pump chamber and said throttle assist means, and second return conduit means communicating between said throttle assist means and said reservoir.

In one embodiment the steering means includes first valve means, wherein said throttle assist means includes second valve means, wherein said first supply conduit means communicates between said first pump chamber and said first valve means, wherein said first return conduit means communicates between said first valve means and said reservoir, wherein said second supply conduit means communicates between said second pump chamber and said second valve means, and wherein said second return conduit means communicates between said second valve means and said reservoir.

It is preferred that the marine propulsion device further comprises first check valve means for permitting flow from said first return conduit means to said first supply conduit means and for preventing flow from said first supply conduit means to said first return conduit means, first relief valve means for permitting flow from said first supply conduit means to said first return conduit means when the pressure in said first supply conduit means reaches a predetermined value, second check valve means for permitting flow from said second return conduit means to said second supply conduit means and for preventing flow from said second supply

conduit means to said second return conduit means, and second relief valve means for permitting flow from said second supply conduit means to said second return conduit means when the pressure in said second supply conduit means reaches a predetermined value.

It is preferred that the marine propulsion device further comprises means communicating with said first return conduit means for cooling the fluid therein.

It is preferred that the marine propulsion device further comprises filter means communicating with said first return conduit means.

In one embodiment the first pump chamber has therein a first pumping element, wherein said second pump chamber has therein a second pumping element, and wherein said marine propulsion device further comprises a pump assembly including said reservoir, said first pump housing, said second pump housing, and a drive shaft having mounted thereon said first pumping element and said second pumping element.

Features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims, and drawings.

DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side elevational view of a marine propulsion device embodying the invention.

Fig. 2 is an enlarged side elevational view, partially cut away, of the marine propulsion device.

Fig. 3 is an enlarged top view, partially cut away, of the marine propulsion device.

Fig. 4 is an enlarged, cross-sectional view of the pump assembly shown in Fig. 3.

Fig. 5 is a partially schematic, partially cross-sectional view of the shift assist and throttle assist of the marine propulsion device.

Fig. 6 is a partial top view of the power steering means.

Fig. 7 is a schematic diagram of the hydraulic system of the marine propulsion device.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A marine propulsion device 10 embodying the invention is illustrated in the drawings. As best shown in Fig. 1, the marine propulsion device 10 comprises a mounting assembly 12 fixedly attached to the transom 14 of a boat. In the preferred embodiment, the mounting assembly 12 includes a transom bracket 16 fixedly attached to the transom 14, and a swivel bracket 18 pivotally mounted on the transom bracket 16 for pivotal movement of the swivel bracket 18 relative to the transom 14 about a generally horizontal tilt axis 20.

The marine propulsion device 10 also comprises a propulsion unit 22 pivotally mounted on the swivel bracket 18 for pivotal movement of the propulsion unit 22 relative to the swivel bracket 18 about a generally vertical steering axis 24. The propulsion unit 22 includes a lower unit 26 including a propeller 28 mounted on a rotatably mounted propeller shaft 29, and an internal combustion engine 30 mounted on the lower unit 26. In the preferred embodiment, the engine 30 includes an engine block 32 (shown in outline in Figs. 2 and 3), and a generally vertical crankshaft 34 (Fig. 2) rotatably mounted in

the engine block 32 and having an upper end extending upwardly from the engine block 32, and a lower end drivingly connected to the propeller 28 by a drive train 36. The engine 30 also includes a flywheel 38 mounted on the upper end of the crankshaft 34, a conventional throttle lever or means 40 (shown schematically in Fig. 5), and a water jacket 42 (shown schematically in Fig. 3). The marine propulsion device 10 further comprises a housing surrounding the engine and including upper and lower covers 44 and 46, respectively.

In the preferred embodiment, the drive train 36 includes a generally vertical drive shaft 48 having an upper end driven by the crankshaft 34, and a lower end having thereon a drive gear 50. The drive train 36 also includes a shiftable or reversible transmission 52 drivingly connecting the drive gear 50 to the propeller shaft 29. While any suitable transmission can be used, in the preferred embodiment, the transmission 52 includes (see Fig. 1) a pair of axially spaced bevel gears 54 which are mounted for rotation coaxially with and independently of the propeller shaft 29 and which mesh with the drive gear 50. The transmission 52 also includes a shiftable clutch dog 56 which is carried on the

propeller shaft 29 between the bevel gears 54. As is known in the art, the clutch dog 56 is movable axially relative to the propeller shaft 29 between neutral, forward drive, and reverse drive positions. The transmission 52 also includes shift means including a shift actuator 58 operably connected to the clutch dog 56, and a control or actuating rod 60 supported in the propulsion unit 22 for generally reciprocal vertical movement. The lower end of the actuating rod 60 is operably connected to the shift actuator 58 to effect axial movement of the clutch dog 56 relative to the propeller shaft 29 in response to vertical movement of the actuating rod 60. The upper end of the actuating rod 60 is pivotally connected to an arm 62 fixedly attached to a shift lever 64 rotatably mounted on the propulsion unit 22. Pivotal movement of the shift lever 64 causes pivotal movement of the arm 62, which in turn causes reciprocal vertical movement of the actuating rod 60.

The marine propulsion device 10 also comprises hydraulic shift assist means connected between a remotely located shift actuator or device such as a single lever remote control 66 (see Fig. 5) and the shift lever 64 for actuation of the shift lever 64. The remote control 66 is connected to the

shift assist means by a push-pull cable assembly 68. In the illustrated construction, as best shown in Fig. 5, the shift assist means is wholly supported on the propulsion unit 22 and includes a hydraulic cylinder-piston assembly 70 which is connected between the end of the push-pull cable 68 and the shift lever 64 and which, when it extends or retracts, effects pivotal movement of the shift lever 64.

The hydraulic cylinder-piston assembly 70 includes a cylinder 72 having a fixed, longitudinal axis, and a piston 74 mounted inside the cylinder 72 for axial reciprocative movement. The piston 74 divides the cylinder 72 into opposite sides or first and second pressure chambers 76 and 78.

One end of the cylinder 72 is closed by an end wall 80 including a central aperture. The opposite end of the cylinder 72 is pivotally connected to the shift lever 64 for effecting movement of the shift lever 64 in response to axial movement of the cylinder 72. The inner end of a piston rod 82 slidably extends through the end wall aperture and is fixedly connected to the piston 74, and the outer end of the piston rod 82 extends outwardly from the cylinder 72 and is pivotally

connected to the propulsion unit 22 against axial movement of the piston rod 82.

The piston 74 is moved relative to the cylinder 72 (actually, the cylinder 72 moves and the piston 74 is fixed) by pressurized hydraulic fluid.

The shift assist means also includes control means for selectively controlling the flow of hydraulic fluid to and from the first and second pressure chambers 76 and 78 of the cylinder 72 to extend and retract the piston rod 82. In the illustrated construction, the control means includes an open-center control valve 84 including a valve housing 86 and a spool valve 88 movable relative to each other. The spool valve 88 is connected to the push-pull cable 68 and is axially movable relative to the valve housing 86 in response to movement of the push-pull cable 68. The valve housing 86 is fixedly connected to the cylinder 72 for common movement therewith.

The valve housing 86 has two return ports 90 communicating with an outlet passage 92, and an inlet port 94 communicating with an inlet passage 96. The housing 86 also has first and second control ports 98 and 100 communicating respectively with the first and second pressure chambers 76 and 78.

The spool valve 88 is mounted in the valve housing 86 for axial movement between a first position and a second position on opposite sides of a third, center, or no-change position. In the illustrated construction, the spool valve 88 is tubular and has lands. Since the control valve 84 is open-centered, the lands do not close the inlet port 94 and return ports 90 when the spool valve 88 is in the no-change position. Instead, the ports are partially open allowing constant fluid flow in through the inlet port 94 and out through both return ports 90. The spool valve 88 also has shoulder means for engaging the opposite ends of the valve housing 86 to facilitate manual shifting in the event the shift assist means fails. In the illustrated construction, the shoulder means includes snap rings 104 on the opposite ends of the spool valve 88.

The marine propulsion device 10 also comprises throttle assist means connected between a remotely located throttle actuator such as the above-mentioned single lever remote control 66 for actuating the throttle lever 40. The remote control 66 is connected to the throttle assist means by a push-pull cable assembly 106. The throttle assist

means is wholly supported on the propulsion unit 22 and is substantially identical to the shift assist means. Accordingly, the throttle assist means includes (see Fig. 5) a hydraulic cylinder-piston assembly 108 which is connected between the end of the push-pull cable 106 and the throttle lever 40 and which, when it extends or retracts, effects pivotal movement of the throttle lever 40. The throttle assist means also includes an open-center control valve 110 for selectively extending and retracting the assembly 108 in response to actuation of the single lever remote control 66 and in response to the resultant axial movement of the push-pull cable 106. The control valve 110 includes an inlet passage 111, and an outlet passage 113.

The marine propulsion device 10 further comprises (see Figs. 1 and 6) hydraulic power steering means connected between the propulsion unit 22 and the swivel bracket 18 for causing pivotal steering movement of the propulsion unit 22 about the steering axis 24. While various suitable power steering means can be used, in the preferred embodiment, the power steering means includes a first hydraulic assembly 112 including an actuating assembly 114 connected to the swivel bracket 18 and

controlled by a remote helm (not shown), and a spool valve assembly 116 connected to a steering arm 118 fixedly attached to the propulsion unit 22. The spool valve assembly 116 is actuated by the actuating assembly 114. The power steering means also includes a second hydraulic assembly 120 connected between the swivel bracket 18 and the steering arm 118 for causing pivotal steering movement of the propulsion unit 22. The power steering means further includes hydraulic fluid conduits 122 communicating between the spool valve assembly 116 and the second hydraulic assembly 120 for actuation thereof. An example of such a power steering means is described in greater detail in U.S. ~~Ferguson~~ Patent 4,592,732, ~~614,815, filed May 29, 1984,~~ which is incorporated herein by reference.

The marine propulsion device 10 further comprises a pump assembly 124 for supplying hydraulic fluid or oil to the power steering means, the shift assist means, and the throttle assist means. In the preferred embodiment, the pump assembly 124 is removably mounted on the side of the engine block 32.

The pump assembly 124 comprises (see Fig. 4) a housing assembly including a reservoir housing 126 defining a reservoir 128, and a first pump housing 130 mounted on the reservoir housing 126

and defining a first pump chamber 132 communicating with the reservoir 128. The housing assembly further includes a second pump housing 134 mounted on the first pump housing 130 and defining a second pump chamber 136. In the preferred embodiment, each of the reservoir housing 126 and the first pump housing 130 has an underside, and the first pump housing 130 is mounted on the underside of the reservoir housing 126, and the second pump housing 134 is mounted on the underside of the first pump housing 130.

The housing assembly further includes a passage 137 communicating between the reservoir 128 and the second pump chamber 136 and being located in the first pump housing 130, and first and second outlets 138 and 140 located in the second pump housing 134. The housing assembly further includes a first outlet passage 142 communicating between the first pump chamber 132 and the first outlet 138 and being located in the second pump housing 134, and a second outlet passage 144 communicating between the second pump chamber 136 and the second outlet 140 and being located in the second pump housing 134. The housing assembly further includes first and second inlets 146 and 148 both communicating with the reservoir 128.

The pump assembly 124 further comprises a first pumping element 150 located in the first pump chamber 132, a second pumping element 152 located in the second pump chamber 136, and a drive shaft 154 rotatably supported in the housing assembly by upper and lower bearings 156 and 157, respectively, and having mounted thereon the first and second pumping elements 150 and 152. In the preferred embodiment, the first and second pumping elements 150 and 152 are conventional gerotors, although they can be any suitable pumping element, e.g., a sliding vane impeller.

In the preferred embodiment, the passage 137 communicating between the reservoir 128 and the second pump chamber 136 also communicates with the first pump chamber 132. Additionally, the first outlet passage 142 is located in the first pump housing 130 as well as in the second pump housing 134.

In the preferred embodiment, as best shown in Figs. 3 and 4, the upper end of the drive shaft 154 has a drive pulley 158 mounted thereon, the engine 30 further includes a power takeoff pulley 160, and the marine propulsion device 10 further comprises belt means 162 drivingly connecting the power takeoff pulley 160 to the drive pulley 158. While various suitable power takeoff pulleys can be

employed, in the illustrated construction, the power takeoff pulley 160 is an annular pulley mounted on the underside of the flywheel 38. Such an arrangement is disclosed in greater detail in U.S. ~~Ferguson~~ Patent 4,689,025 ~~Application Serial No. 752,362, filed July 3, 1985, and~~ titled "Marine Propulsion Device Power Steering System," (Attorney Docket No. 72014/1360-0) which is incorporated herein by reference.

If desired, the marine propulsion device 10 can further comprise an idler pulley (not shown) rotatably mounted for rotation about a generally vertical axis, with the belt means 162 extending around the power takeoff pulley 160, the drive pulley 158, and the idler pulley.

The marine propulsion device 10 further comprises (see Figs. 2, 3 and 7) a hydraulic steering circuit including first supply conduit means 164 communicating between the first outlet 138 and an inlet 165 in the spool valve assembly 116 for supplying hydraulic fluid to the steering means, and first return conduit means 166 communicating between an outlet 167 in the spool valve assembly 116 and the first reservoir inlet 146. The marine propulsion device 10 further comprises (see Figs. 2, 5 and 7) a

hydraulic shift/throttle circuit including second supply conduit means 168 communicating between the second outlet 140 and the shift control valve inlet passage 96, third supply conduit means 170 communicating between the shift control valve outlet passage 92 and the throttle control valve inlet passage 111, and second return conduit means 172 communicating between the throttle control valve outlet passage 113 and the second inlet 148.

It should be understood that in alternative embodiments the positions of the shift assist means and throttle assist means can be reversed, with the second supply conduit means 168 communicating between the second outlet 140 and the throttle assist means, with the third supply conduit means 170 communicating between the throttle assist means and the shift assist means, and with the second return conduit means 172 communicating between the shift assist means and the second inlet 148. This reversal is possible because the shift and throttle control valves 84 and 110 are open-centered, and because the shift assist means and throttle assist means operate sequentially.

As best shown in Figs. 1 and 3, the first supply conduit means 164 extends around the

rear of the engine 30 from the first outlet 138 and through the lower motor cover 46 on the port side of the engine 30, and then between the propulsion unit 22 and the swivel bracket 18 to the starboard side of the engine 30 where it communicates with the spool valve assembly 116. The first return conduit means 166 extends from the spool valve assembly 116 to the first inlet 146 along a path parallel to the path of the first supply conduit means 164.

In the preferred embodiment, the flow and pressure requirements of the steering means are substantially greater than the flow and pressure requirements of the shift and throttle means. Accordingly, the first pump chamber 132 is substantially larger than the second pump chamber 136.

The marine propulsion device 10 further comprises means communicating with the first return conduit means 166 for cooling the fluid therein. Because all of the hydraulic fluid flows into a common reservoir, sufficient cooling of the hydraulic fluid is obtained by cooling only the fluid flowing through the high-flow steering circuit. While various suitable cooling means can be used, in the preferred embodiment, the cooling means includes (see Fig. 2) a hydraulic fluid or oil cooler 174

communicating with the first return conduit means 166. Preferably, the fluid cooler 174 includes a fluid chamber or passage (not shown) communicating with the first return conduit means 166, and a plurality of water passages (not shown) extending through the fluid chamber and communicating with a source of cooling water. Preferably, the fluid cooler 174 is mounted on the side of the engine block 32, as best shown in Fig. 2.

In the preferred embodiment, as best shown in Figs. 2 and 3, the source of cooling water includes a conduit 176 communicating between the water jacket 42 and the fluid cooler water passages for providing cooling water to the fluid cooler 174. Water is discharged from the fluid cooler 174 via a conduit 178 having an inlet end communicating with the fluid cooler 174, and an outlet end extending through a grommet 180 seated in an opening in the lower motor cover 46. Thus, the conduit 178 provides what is known in the art as a telltale discharge.

The marine propulsion device 10 further comprises filter means communicating with the first return conduit means 166. While various suitable filter means can be employed, in the illustrated construction, the filter means includes (see Fig. 2)

a fluid or oil filter 182 communicating with the first return conduit means 166 between the cooler 174 and the first inlet 146.

In the preferred embodiment, the marine propulsion device 10 further comprises (see Fig. 7) first check valve means 184 for permitting flow from the first return conduit means 166 to the first supply conduit means 164 and for preventing flow from the first supply conduit means 164 to the first return conduit means 166, and first relief valve means 186 for permitting flow from the first supply conduit means 164 to the first return conduit means 166 when the pressure in the first supply conduit means 164 reaches a predetermined value. The marine propulsion device 10 preferably further comprises (see Figs. 5 and 7) second check valve means 188 for permitting flow from the second return conduit means 172 to the second supply conduit means 168 and for preventing flow from the second supply conduit means 168 to the second return conduit means 172, and second relief valve means 190 for permitting flow from the second supply conduit means 168 to the second return conduit means 172 when the pressure in the second supply conduit means 168 reaches a predetermined value.

The first and second check valve means 184 and 188 allow bypass of the pump assembly 124 so that, if the pump assembly 124 fails and manual steering, shifting, or throttling is performed, hydraulic fluid does not have to pass through the failed pump assembly 124. In the preferred embodiment, the first predetermined value is greater than the second predetermined value so that the power steering means is operated at a greater pressure than the shift and throttle means.

Various features and advantages of the invention are set forth in the following claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A marine propulsion device comprising a propulsion unit adapted to be pivotally mounted on the transom of a boat for pivotal movement relative to the transom about a steering axis, said propulsion unit including a rotatably mounted propeller, an engine, and a shiftable transmission drivingly connecting said engine to said propeller and including shift means, hydraulic steering means connected to said propulsion unit for causing pivotal movement of said propulsion unit about said steering axis, hydraulic shift assist means connected to said shift means for actuation thereof, a hydraulic fluid reservoir, a first pump housing defining a first pump chamber communicating with said reservoir, first supply conduit means communicating between said first pump chamber and said steering means, first return conduit means communicating between said steering means and said reservoir, a second pump housing defining a second pump chamber communicating with said reservoir, second supply conduit means communicating between said second pump chamber and said shift assist means, and second return conduit means communicating between said shift assist means and said reservoir.

2. A marine propulsion device comprising a propulsion unit adapted to be pivotally mounted on the transom of a boat for pivotal movement relative to the transom about a steering axis, said propulsion unit including a rotatably mounted propeller, and an engine drivingly connected to said propeller and including throttle means, hydraulic steering means connected to said propulsion unit for causing pivotal movement of said propulsion unit about said steering axis, hydraulic throttle assist means connected to said throttle means for actuation thereof, a hydraulic fluid reservoir, a first pump housing defining a first pump chamber communicating with said reservoir, first supply conduit

means communicating between said first pump chamber and said steering means, first return conduit means communicating between said steering means and said reservoir, a second pump housing defining a second pump chamber communicating with said reservoir, second supply conduit means communicating between said second pump chamber and said throttle assist means, and second return conduit means communicating between said throttle assist means and said reservoir.

3. A marine propulsion device as set forth in Claim 1 wherein said steering means includes first ~~steering means includes first~~ valve means, wherein said shift assist means includes second valve means, wherein said first supply conduit means communicates between said first pump chamber and said first valve means, wherein said first return conduit means communicates between said first valve means and said reservoir, wherein said second supply conduit means communicates between said second pump chamber and said second valve means, and wherein said second return conduit means communicates between said second valve means and said reservoir.

4. A marine propulsion device as set forth in Claim 2, wherein said steering means includes first valve means, wherein said throttle assist means includes second valve means, wherein said first supply conduit means communicates between said first pump chamber and said first valve means, wherein said first return conduit means communicates between said first valve means and said reservoir, wherein said second supply conduit means communicates between said second pump chamber and said second valve means, and wherein said second return conduit means communicates between said second valve means and said reservoir.

5. A marine propulsion device as set forth in Claim 1 or Claim 2 and further comprising first check valve means for permitting flow from said first return

conduit means to said first supply conduit means and for preventing flow from said first supply conduit means to said first return conduit means, first relief valve means for permitting flow from said first supply conduit means to said first return conduit means when the pressure in said first supply conduit means reaches a predetermined value, second check valve means for permitting flow from said second return conduit means to said second supply conduit means and for preventing flow from said second supply conduit means to said second return conduit means, and second relief valve means for permitting flow from said second supply conduit means to said second return conduit means when the pressure in said second supply conduit means reaches a predetermined value.

6. A marine propulsion device as set forth in Claim 1 or Claim 2 and further comprising means communicating with said first return conduit means for cooling the fluid therein.

7. A marine propulsion device as set forth in Claim 1 or Claim 2 and further comprising filter means communicating with said first return conduit means.

8. A marine propulsion device as set forth in Claim 1 or Claim 2 wherein said first pump chamber has therein a first pumping element, wherein said second pump chamber has therein a second pumping element, and wherein said marine propulsion device further comprises a pump assembly including said reservoir, said first pump housing, said second pump housing, and a drive shaft having mounted thereon said first pumping element and said second pumping element.

9. A marine propulsion device as set forth in Claim 8 wherein said pump assembly further includes a housing assembly including said first pump housing, said second pump housing, and a reservoir housing defining said reservoir, a first outlet communicating with said first pump chamber, and a second outlet communicating

with said second pump chamber, wherein said first pump housing is mounted on said reservoir housing, wherein said second pump housing is mounted on said first pump housing, wherein said first pumping element is located in said first pump chamber, wherein said second pumping element is located in said second pump chamber, and wherein said drive shaft is rotatably supported in said housing assembly.

10. A marine propulsion device as set forth in Claim 9 wherein said drive shaft has an upper end extending upwardly from said reservoir housing, and a lower end extending into said second pump housing and having said second pumping element mounted thereon, and wherein said first pumping element is mounted on said drive shaft intermediate said upper and lower ends.

11. A marine propulsion device as set forth in Claim 10 wherein said upper end of said drive shaft has mounted thereon a drive pulley.

12. A marine propulsion device as set forth in Claim 11, wherein said engine includes a power takeoff pulley, and wherein said device further comprises belt means drivingly connecting said power takeoff pulley to said drive pulley.

13. A marine propulsion device as set forth in Claim 9 wherein said pump assembly further comprises a passage communicating between said reservoir and said second pump chamber and being located in said first pump housing, a first outlet passage communicating between said first pump chamber and said first outlet and being located in said second pump housing, and a second outlet passage communicating between said second pump chamber and said second outlet and being located in said second pump housing.

14. A marine propulsion device as set forth in Claim 9 wherein said housing assembly further includes a first inlet and a second inlet both communicating with said reservoir.

Dated this 29th day of November, 1988

OUTBOARD MARINE CORPORATION
By Its Patent Attorneys

GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.

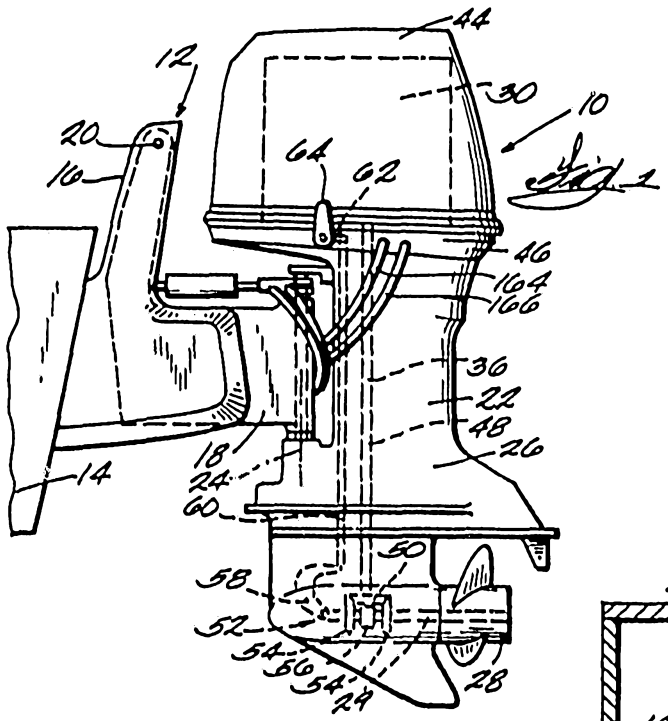

Fig. 1

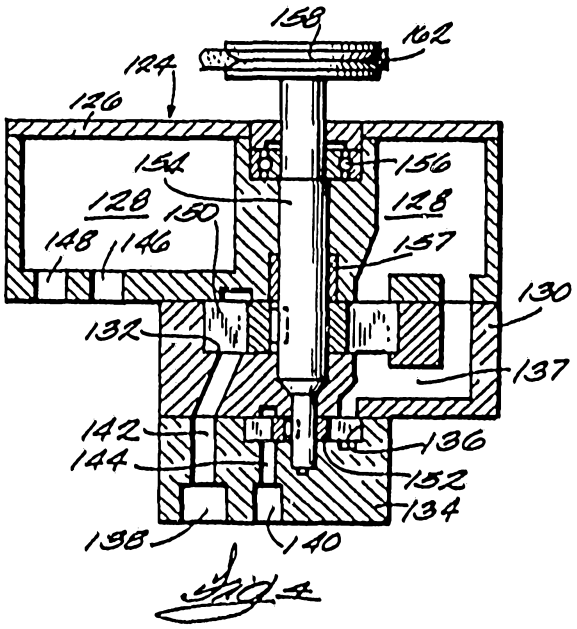

Fig. 4

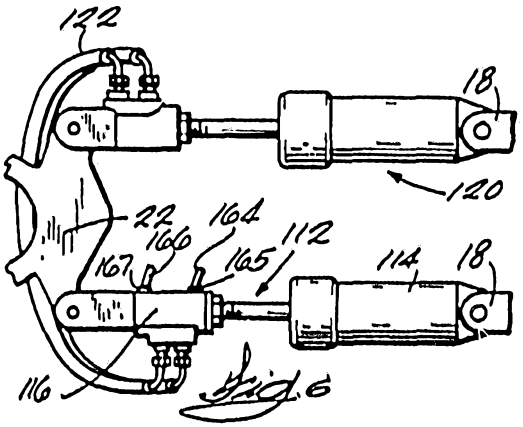

Fig. 6

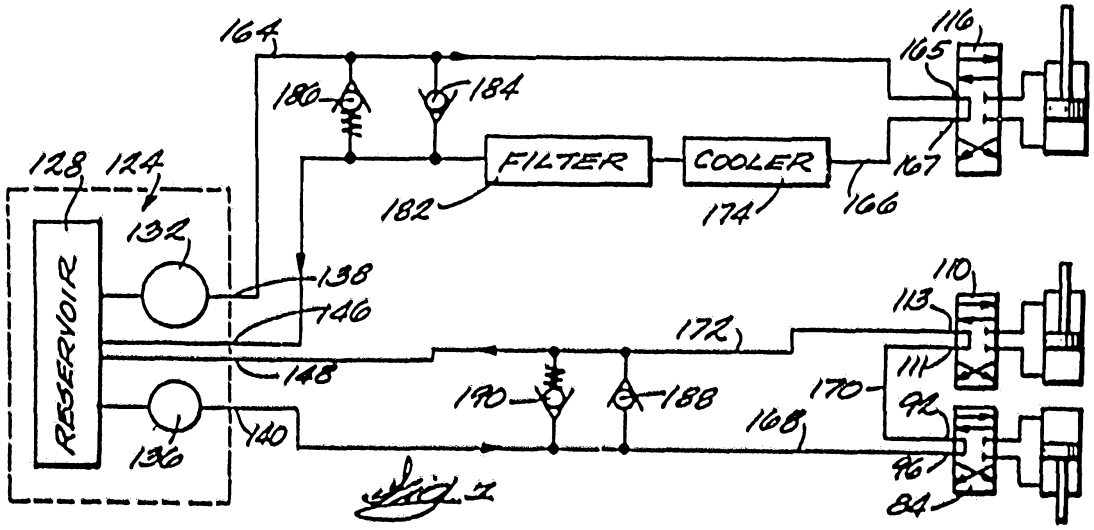

Fig. 7

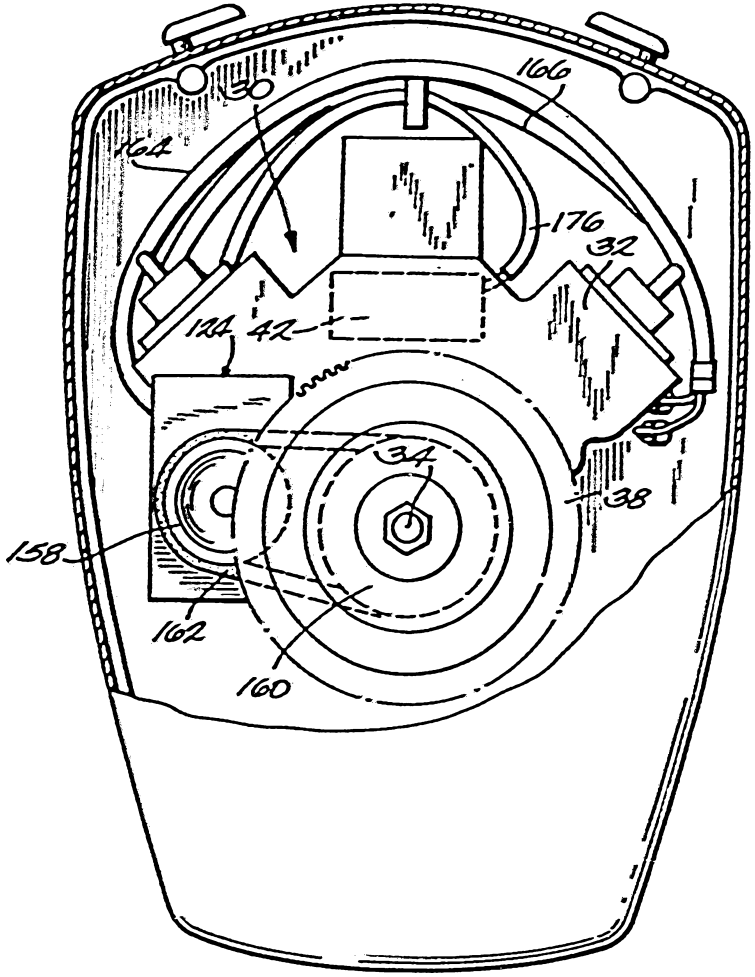
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Fig. 3

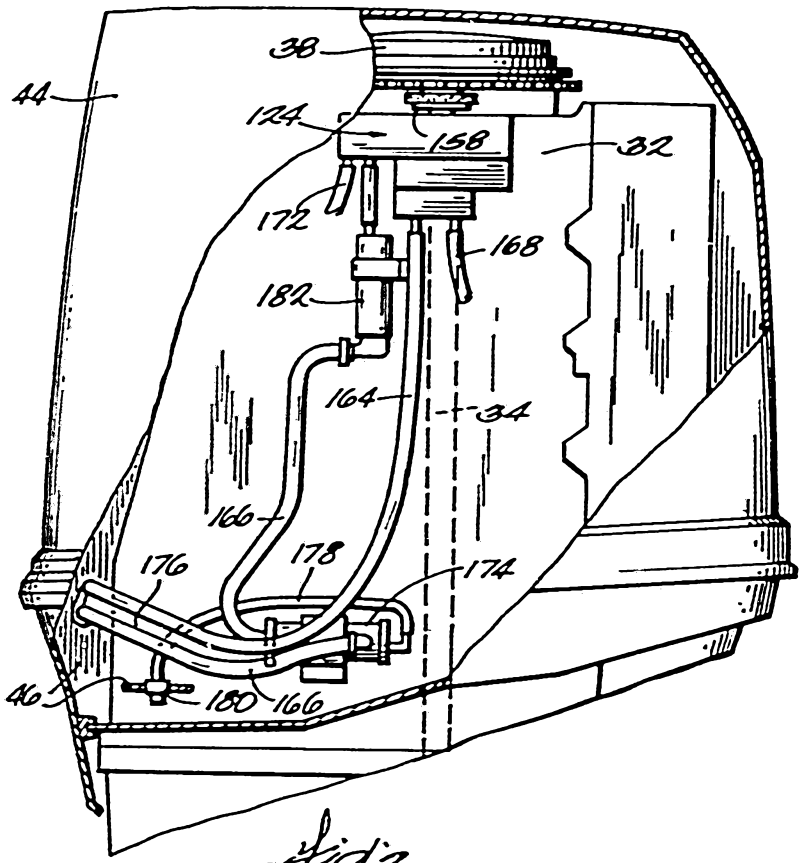
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Fig. 2

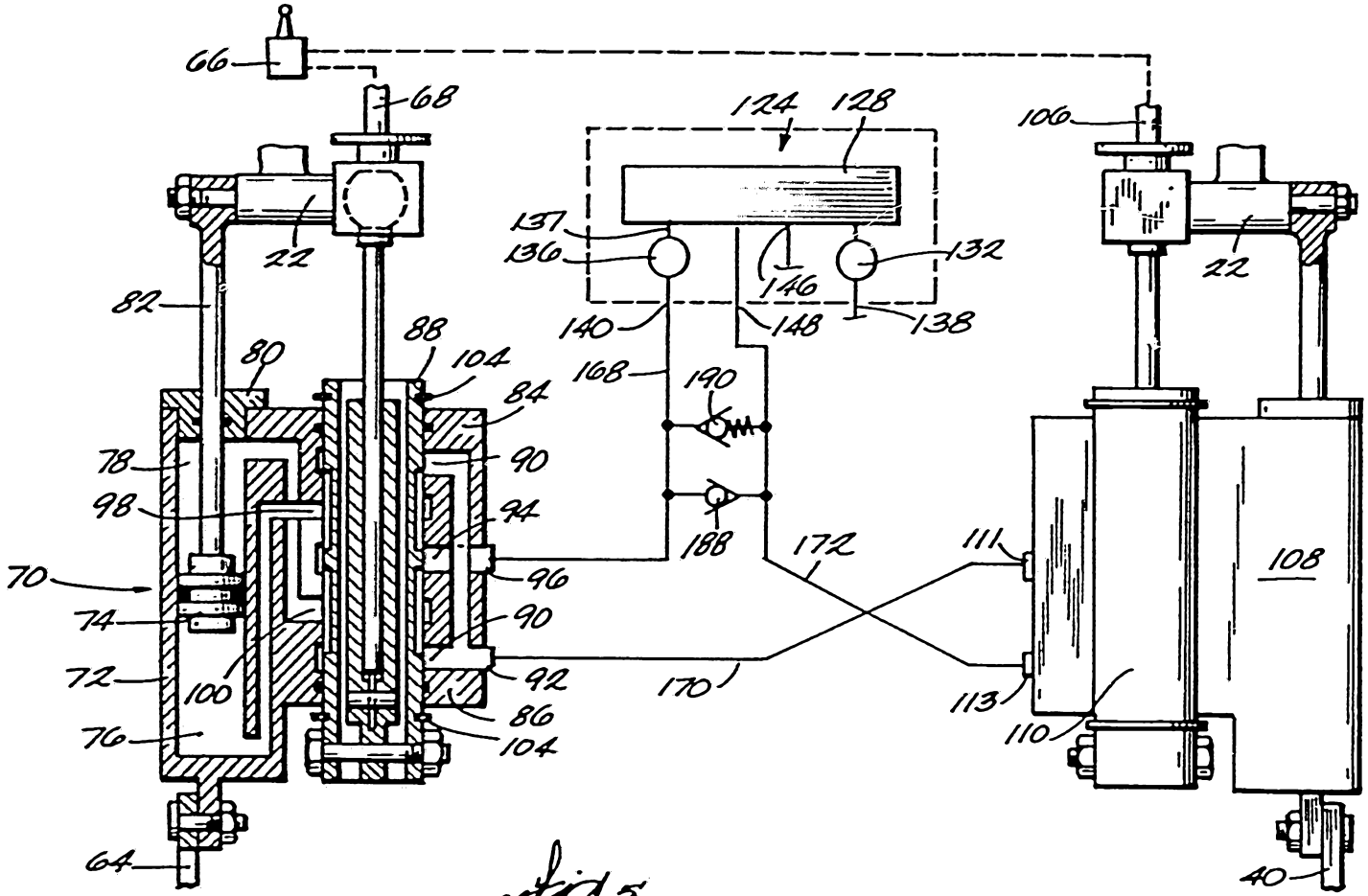
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Fig. 5