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HYDRAULIC PROPULSION SYSTEM FOR BOATS

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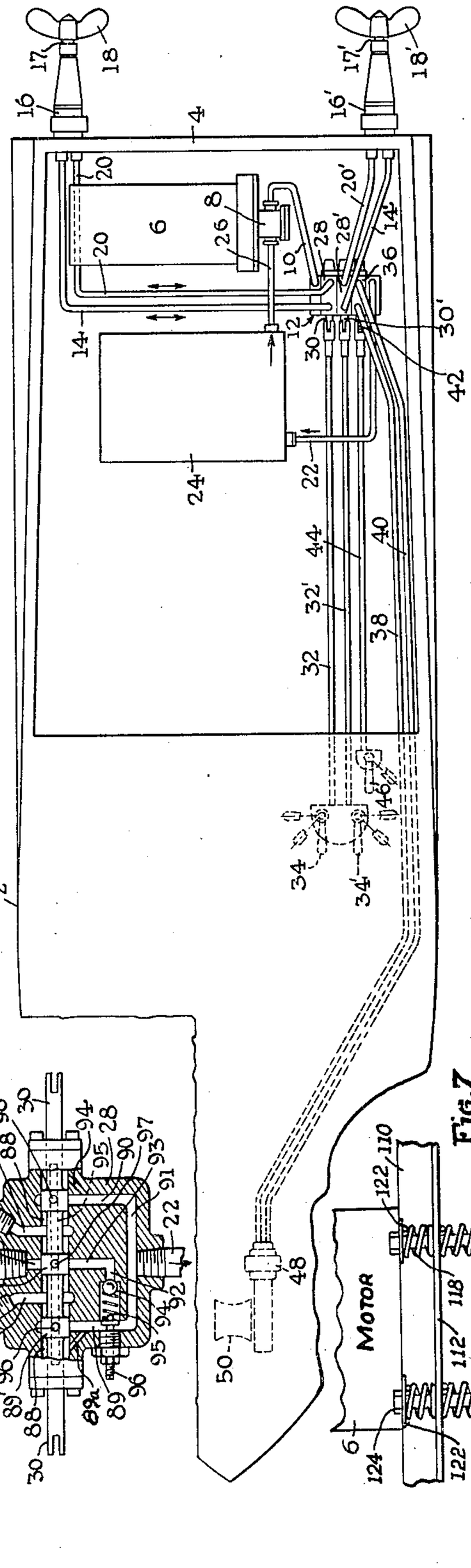

Fig. 1

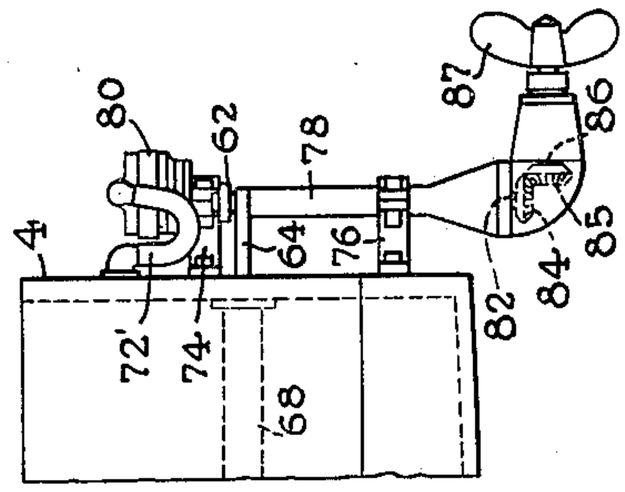

Fig. 5

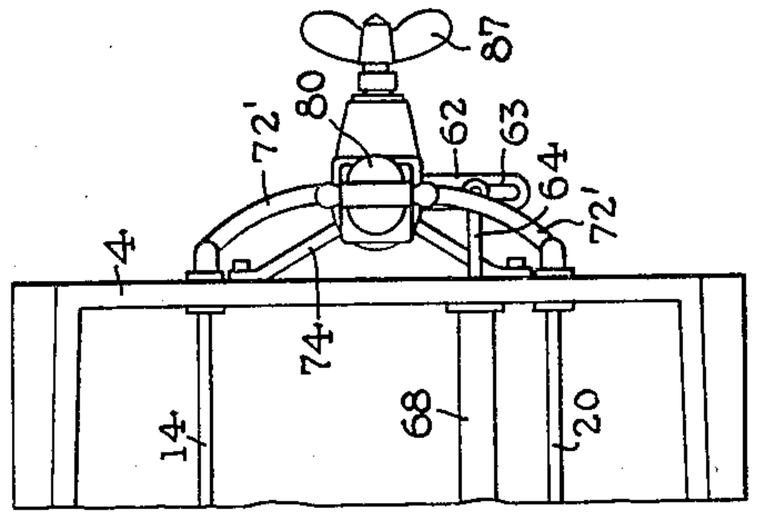

Fig. 4

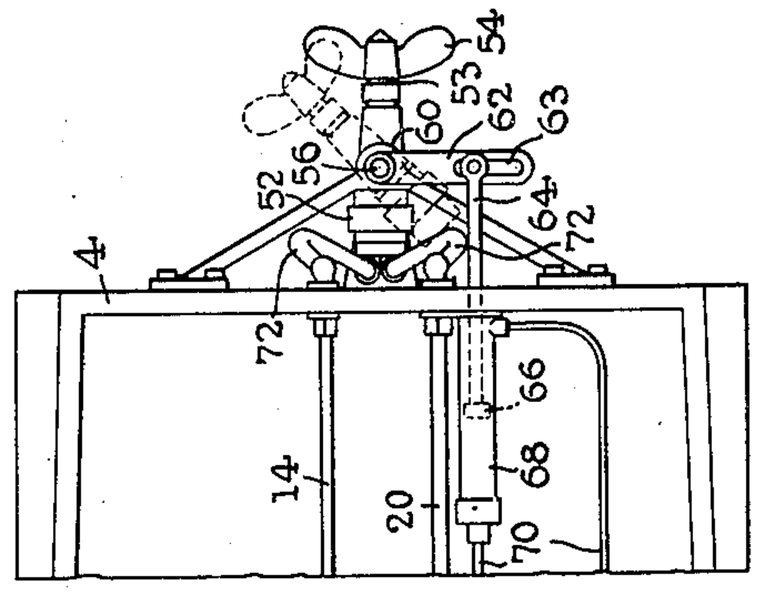

Fig. 3

Fig. 6

Fig. 7

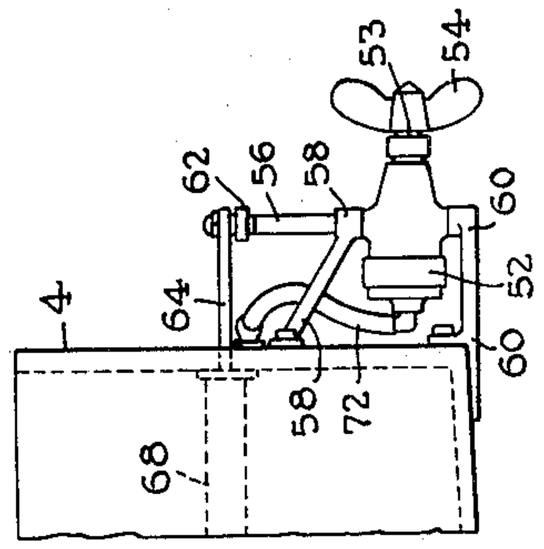

Fig. 2

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HYDRAULIC PROPULSION SYSTEM FOR BOATS

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This invention is a hydraulic propulsion system for boats, especially for smaller, power driven boats, such as launches, motor boats, and the like.

With the usual screw propelled boat, the engine is generally in the stern of the boat and drives a propeller shaft, sloping diagonally and rearwardly through the bottom of the boat. Such engine must be carefully aligned with the propeller shaft, and the propeller shaft passes through a bearing which must be tight enough to keep out the water, and must be adequately lubricated. The mounting of the engine and the propeller shaft as just described, requires a considerable degree of skill and adds considerably to the cost of manufacture of the boat.

One of the most important features of the present invention is to eliminate the usual propeller shaft passing through the bottom of the boat, thereby, of course, eliminating the expense of the shaft, the expense of installing it, and the use of lubricated bearings and packings for accommodating such shaft.

The engine of a motor boat also is rigidly mounted in the hull, as it must be to keep its alignment with the propeller shaft. With such a rigid mounting, the vibration of the engine, especially with high powered engines, is considerable, and is communicated to the hull of the boat.

Another important feature of the invention is to mount the engine on a resilient shock absorbing and vibration absorbing base, so that the vibration from the engine is not communicated to the hull of the boat, with the result that the operation of the boat is quiet and smooth, as compared with one where the engine is rigidly mounted in the usual way.

With the usual motor boat, the engine is generally in the center of the boat and sometimes is very much in the way. Another important feature of this invention is that the engine need not be mounted in the center of the boat in alignment with the propeller shaft, but may be mounted in any convenient place, and may even extend transversely of the hull, rather than longitudinally, if such arrangement is desired.

The foregoing and other advantages are achieved by this invention, wherein the propeller is not mechanically connected to the engine but is driven by a hydraulic motor, the fluid pressure for actuating the motor coming from a pump driven by the engine. The pressure pump is connected to the hydraulic motor by metallic pipes or by nonmetallic hose, such pressure pipes or hose extending from the pump, located in the

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boat, to the hydraulic motor located outboard of the boat, these pipes extending over the gunwale at the stern or through the stern above or below the water line, or even through the bottom of the boat.

Another valuable feature of the invention, resulting from the use of the hydraulic drive, is a graded control of the propeller speed and ready reversibility of the propeller, both achieved by manually operated valve means controlling the amount of pressure fluid supplied to the hydraulic motor. Gradual movement of the valve gradually varies the pressure and amount of the pressure fluid, to gradually vary the speed of the propeller. The fluid flow to the hydraulic motor may readily be reversed by the valve, thereby reversing the propeller. The described controls of the propeller may be effected without changing the speed or direction of rotation of the engine or pump, and without the use of gears or clutches, which are used to achieve similar results with a mechanical drive.

Another important feature of the invention is that the boat may be steered by pivoting the propeller so as to be moved to port or starboard about a vertical axis, thereby eliminating the use of a rudder. This pivotal movement may be effected manually, or by hydraulic means, as will be described.

Still another important feature of the invention is the provision of the expansion reservoir for the pressure fluid. Oil is preferred as the pressure fluid and the term oil will hereinafter be used, but it should be understood that any desired pressure fluid may be used instead of oil. In hydraulic systems under pressure, especially where the driving motor is operating continuously, the oil tends to increase rapidly in pressure and temperature, even in normal operation, and especially if the hydraulic motor should jam. Increase of pressure is taken care of by an overload by-pass valve, and increase of temperature is taken care of by the expansion reservoir, of a capacity to allow the oil to cool, and wherein it drops to atmospheric pressure.

The oil under pressure may also be connected to drive other mechanism on the boat, such as one or more winches, for raising the anchor, etc.

Further advantages of construction and operation will be described by reference to the accompanying drawing wherein:

Fig. 1 is a diagrammatic plan view of a boat provided with the hydraulic propulsion system of this invention.

Fig. 2 is a side view of a modification.

Fig. 3 is a plan view of the structure of Fig. 2.

Figs. 4 and 5 are plan and side views of another modification.

Fig. 6 is a vertical cross section through a unit of the control valve.

Fig. 7 is a side view of a preferred mounting for the motor.

Referring now to these drawings, **2** indicates the hull of a small boat, having the usual stern **4**. An internal combustion engine or other prime mover **6** is mounted on a suitable resilient base of any desired type, such as springs, a thick block of rubber, or on rubber mountings, as is well understood in the art of mounting machinery. In a typical mounting, motor **6** is mounted on a plurality of angle irons **110**, having horizontal webs **112**, through which mounting bolts **114**, affixed at one end in boat bottom **120**, are passed. Compression springs **116** are placed between boat bottom **120** and horizontal webs **112**, and additional compression springs **118** are located between horizontal webs **112** and washers **122** which are held in a desirable position by nuts **124**. The motor drives an oil pump **8**, connected to the pressure pipe **10** which leads oil under pressure to a multiple direction control and overload valve assembly **12**, which normally sends the pressure oil to pipe **14**, which passes through or over the stern **4**, and delivers the pressure oil to a hydraulic motor **16** of the conventional reversible type, directly connected to drive the shaft **17** of propeller **18**. Engine **6** and pump **8** are mounted inboard. Motor **16** could be mounted inboard or outboard, as desired. The propellers could be fixed, as shown in Fig. 1, and steering effected by separate control of the propellers, as will be described in connection with Figs. 2–5. However, a conventional rudder could be used, if desired, or one or both propellers could be mounted to move about vertical axes, as shown in Figs. 2–5, for steering purposes.

After the oil leaves the motor **16**, it enters pipe **20** which leads it back to the valve **12**, which in turn delivers it into pipe **22** and thence into expansion reservoir **24**, which in turn is connected by pipe **26** to the suction side of the pump, thus completing the oil circuit. Reservoir **24** is open to atmospheric pressure and so permits expansion and cooling of the oil.

A similar set of pipes, **14'** and **20'**, leads oil to and from the second motor **16'** connected to the driving shaft **17'** of propeller **18'**, the returning oil being passed by the multi-way valve **12** to pipe **22** and thence to the expansion reservoir **24**.

One unit of valve **12**, such as **28**, delivers oil under pressure to either pipe **14** or **20**, so that the propeller can be driven in either direction, in accordance with the oil supply. In other words, where pipe **14** is under pressure, pipe **20** is the oil return pipe, and where **20** is under pressure, **14** is the oil return pipe. Valve unit **28** is controlled by a piston **30**, connected to rod **32**, in turn controlled by a manually operated handle **34**, swinging movement of which reciprocates piston **30** back and forth, to supply oil under pressure to either pipe **14** or **20**, to drive the propeller **18** forward or backward, intermediate positioning of handle **34** serving to place piston **30** in various intermediate positions, corresponding to various intermediate speeds forward or reverse.

A second and similar unit of valve **12**, such as **28'**, controlled by piston **30'**, rod **32'** and handle **34'**, effects a similar control of motor **16'** and propeller **18'**.

Excess pressure from any cause, such as stoppage of the motor or propeller, is taken care of by a by-pass overload valve, which is preferably incorporated as part of the valve assembly **28**, to be described in more detail later.

The control of motors **16** and **16'** is independent, so that steering is readily effected by driving the motors at different speeds, or in different directions, for a sharp turn.

A third unit of valve **12**, shown at **36**, connected to pipes **38** and **40**, and controlled by piston **42**, rod **44** and handle **46**, delivers oil in either direction to a hydraulic motor **48**, directly connected to a winch or other power mechanism **50**, so that it may readily be driven in either direction, for raising or lowering the anchor, for example.

Referring now to the modification shown in Fig. 2, where the motor and propeller are pivoted for steering, a hydraulic motor **52**, connected to drive shaft **53** of propeller **54**, is mounted at the stern on a vertical rod **56**, pivoted to turn on a vertical axis in upper and lower brackets **58** and **60**, secured to the hull. Turning of this motor about its vertical axis will evidently steer the boat. Such turning could be done manually, or by oil pressure. Where oil pressure is used, rod **56** is provided with a laterally extending arm **62** secured thereto, the outer end of which is slotted at **63** and connected by the slot to an actuating arm **64**, which arm is moved back and forth by piston **66** working in a hydraulic cylinder **68**, oil under pressure being supplied to either side of the piston by pipes **70**, controlled by a simple reversing valve like **28**, Fig. 1, for supplying oil under pressure to either side of the piston, for steering the boat as desired.

Oil under pressure is supplied to the motor **52** by pipes **14** and **20**, controlled by valves like **28** and **34**, as in Fig. 1. Pipes **14** and **20** are connected to the motor by flexible hose **72**.

Referring now to the modification shown in Figs. 4 and 5, where the hydraulic motor is above the water line, upper and lower brackets **74** and **76** secured to the hull support a vertical housing **78**, so that the housing can turn in said brackets about a vertical axis. The hydraulic motor **80** is carried by the upper end of the housing and drives a vertical drive shaft **82**, at the lower end of which is a bevel gear **84** driving the bevel gear **85**, connected to shaft **86** of propeller **87**.

Housing **78** could be turned manually about its vertical axis for steering, or it could be hydraulically controlled by a piston operated arm **64**, as already described in Fig. 3. Oil is supplied in either direction to motor **80** by flexible hose **72'** as described in Fig. 3, to drive it forwardly or in reverse.

The control valve assembly **12** is preferably composed of a number of similar units, like the unit **28** shown in detail in Fig. 6. This unit is provided with a main oil passage **88**, communicating by passages **10'**, **14'** and **20'**, with pressure pipe **10**, and pipes **14** and **20**, respectively. The main oil passage **88** is connectible with passages **89** and **90** forming part of a U-shaped exhaust or return passage **91**, connected to the oil return pipe **22** for leading oil back to reservoir **24**.

The valve body is also provided with a pressure relief passage **92**, communicating with passage **93** and so with main passage **88**, and opening at its other end into exhaust passage **91**. A

pressure overload relief valve 94, loaded by a spring 95, the pressure of which on the valve can be varied as desired by the variably positionable threaded shaft 96, relieves excess pressure in the system and serves to by-pass pressure oil to passage 91 if for any reason the oil pressure becomes excessive. One overload relief valve is sufficient for the valve assembly 12.

The flow of oil through the valve is controlled by piston 30, already described which is provided with three enlarged heads 89', 90' and 93', for opening and closing passages 89, 90 and 93, respectively. Passages 89*a* equalize the pressure on both sides of heads 89' and 90' and so balance the piston 30.

Piston 30 is also provided with a central passage 95, in communication with lateral holes 96, 97 and 98, drilled in heads 89', 93' and 90', respectively.

The valve operates as follows:

With the parts in neutral position as in Fig. 6, oil under pressure from 10 passes into hole 97, flows both ways in 95, out thru holes 96 and 98 into exhaust passage 91 and so no oil would be supplied to the corresponding hydraulic motor.

To go forward, piston 30 is moved to the left, oil under pressure passing from pipe 10, thru that part of passage 88 to the right of head 93', out 14' to pipe 14 to the motor. Head 93' shuts off oil flow to 20' and passage 89. Oil returning from the motor comes in thru pipe 20 and passes thru part of 88 and out passage 89 to exhaust passage 91.

To reverse the motor to back the boat, piston 30 is moved to the right, oil under pressure passing from pipe 10, thru that part of passage 88 to the left of head 93', out 20' to pipe 20 to the motor. Head 93' shuts off oil flow to 14' and passage 90. Oil returning from the motor comes in thru pipe 14 and passes thru a part of 88 and part 90 to exhaust passage 91.

Intermediate positioning of piston 30 between the forward and reverse positions gives corresponding intermediate propeller speeds forward and reverse.

There has thus been described a hydraulic drive for a boat, wherein one or more propellers can be driven in either direction at any desired speed without using mechanical clutches and gear shifts, and wherein steering can be effected by driving two propellers at different speeds, or by using one propeller and pivoting it to move about a vertical axis. This steering can also be done simply by manipulating a reversing valve. The entire installation is smooth and quiet, because the motor is mounted on a resilient, shock absorbing base, and so engine vibration is not transmitted to the hull. The usual propeller shaft, directly connected to the prime mover, is entirely eliminated, and the expense of its installation and upkeep is of course eliminated.

A particularly important advantage of the installation is that either the engine or propeller can very readily be disconnected for replacement or repair, simply by disconnecting the oil pipes and a few mounting bolts.

The provision of the expansion and cooling reservoir 24 is also important for allowing the oil to drop to atmospheric pressure and to cool off, thereby avoiding overheating of the oil, which is a serious problem, especially with more powerful engines.

While I have described the preferred ways of carrying out my invention, it should be understood that the invention is not to be limited to the details illustrated, but may be carried out in other ways.

I claim as my invention:

1. Propulsion mechanism for a boat, comprising an engine, resilient, vibration absorbing means for mounting said engine, a fluid pressure pump driven by said engine, both mounted inboard of the hull; a hydraulic motor, and a propeller driven thereby, bracket means for mounting said motor and propeller outboard of the hull; pipes operatively connecting said pump and said hydraulic motor; and valve means for controlling the supply of pressure fluid to said hydraulic motor.

2. Propulsion mechanism for a boat, comprising an engine, a fluid pressure pump driven by said engine, both mounted inboard of the hull; an expansion reservoir mounted inboard of the hull; a hydraulic motor, and a propeller driven thereby, bracket means for mounting said motor and propeller outboard of the hull; pipes for leading fluid under pressure from the pump to the motor, thence to said reservoir, and thence to the suction side of the pump, and valve means for controlling the supply of pressure fluid in said pipes.

3. Propulsion mechanism for a boat, comprising an engine, resilient, vibration absorbing means for mounting said engine, a fluid pressure pump driven by said engine, both mounted inboard of the hull; an expansion reservoir mounted inboard of the hull; a hydraulic motor, and a propeller driven thereby, mounted outboard of the hull; pipes for leading fluid under pressure from the pump to the motor, thence to said reservoir, and thence to the suction side of the pump, and valve means for controlling the supply of pressure fluid in said pipes.

4. Propulsion mechanism for a boat, comprising an engine, a fluid pressure pump driven by said engine, both mounted inboard of the hull; a unitary assembly of a hydraulic motor and a propeller driven thereby, both mounted outboard of the hull; bracket means for said assembly of motor and propeller, mounted outboard of the hull, including means for pivotally mounting said assembly in said bracket means, to move about a vertical axis for steering purposes; pipes for operatively connecting said pump and said hydraulic motor, and valve means for controlling the flow of pressure fluid to the hydraulic motor.

5. Propulsion mechanism for a boat, comprising an engine, a fluid pressure pump driven by said engine, both mounted inboard of the hull; a unitary assembly of a hydraulic motor and a propeller driven thereby, both mounted outboard of the hull; bracket means for said assembly of motor and propeller, mounted outboard of the hull, including means for pivotally mounting said assembly in said bracket means, to move about a vertical axis for steering purposes, means, operated by pressure fluid from the pump, for effecting such pivotal steering movement of said assembly, pipes for operatively connecting said pump and said hydraulic motor, and valve means for controlling the flow of pressure fluid to the hydraulic motor.

6. Propulsion mechanism for a boat, comprising an engine, resilient, vibration absorbing means for mounting said engine, both mounted inboard of the hull; a unitary assembly of a hydraulic motor and a propeller driven thereby, both mounted outboard of the hull; bracket means for said assembly of motor and propeller, mounted outboard of the hull, including means for pivotally

mounting said assembly in said bracket means, to move about a vertical axis for steering purposes, means, operated by pressure fluid from the pump, for effecting such pivotal steering movement of the assembly, pipes for operatively connecting said pump and said hydraulic motor, and valve means for controlling the flow of pressure fluid to the hydraulic motor.

7. Propulsion mechanism for a boat, comprising an engine, and a fluid pressure pump driven thereby, both mounted inboard of the hull; an expansion reservoir mounted inboard of the hull; a unitary assembly of a hydraulic motor and a propeller driven thereby; bracket means for said assembly of motor and propeller, for mounting said assembly outboard of the hull, including means for pivotally mounting said assembly in said bracket means to move about a vertical axis for steering purposes; means, operated by pressure fluid from the pump, for effecting such pivotal steering movement of the assembly, pipes for leading pressure fluid from the

pump to the hydraulic motor, thence to the expansion reservoir and thence to the suction side of the pump; and valve means for controlling the flow of pressure fluid as described.

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