United States Patent [19]

Buddrus

[11] **3,847,107**

[45] **Nov. 12, 1974**

[54] **HYDRAULIC MARINE PROPULSION AND GUIDANCE SYSTEM**

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[21] Appl. No.: **333,301**

[52] **U.S. Cl.** ..... **115/35,** 114/144 R, 285/131, 285/137 R

[51] **Int. Cl.** **B63h 25/42**

[58] **Field of Search** ..... 115/34 A, 34 R, 35, 41 HT, 115/12 A, 18 R; 114/144 R, 144 A; 285/131, 132, 182, 190, 137 R

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3,596,626	8/1971	Buddrus	115/34 A
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Assistant Examiner—Edward R. Kazenske
Attorney, Agent, or Firm—Staas, Halsey & Gable

[57] **ABSTRACT**

A hydraulic propulsion and guidance system for a marine vessel consisting of a fluid pressure generating system and a helm pressure generating unit located within the vessel, a tilting fluid actuator mounted to the transom of the vessel, a lift clevis operatively connected to the shaft of the tilting actuator, a rotary fluid actuator mounted within the lift clevis, a steering clevis operatively connected to the shaft of the rotary fluid actuator, a fluid motor-propeller assembly secured to the steering clevis, an additional fluid pump located within the vessel and fluid conduit operatively connecting same to the tilting actuator such that as the pump is operated the shaft of the tilting actuator rotates the lift clevis in turn tilting the fluid motor-propeller assembly, further fluid conduit operatively connecting the helm pressure generating unit and the rotary actuator such that as the helm pressure generating unit is operated the shaft of the rotary actuator rotates the steering clevis and the fluid motor-propeller assembly, the fluid conduit including single passage oscillating swivels mounted to the transom along a common axis defining the center of rotation of the lift clevis, still further fluid conduit connecting the fluid pressure generating system and the fluid motor including a multiple passage oscillating swivel operatively mounted to the steering clevis and aligned with respect to the axis of rotation of the steering clevis, the aforementioned swivels permitting the use of rigid fluid connections throughout.

10 Claims, 10 Drawing Figures

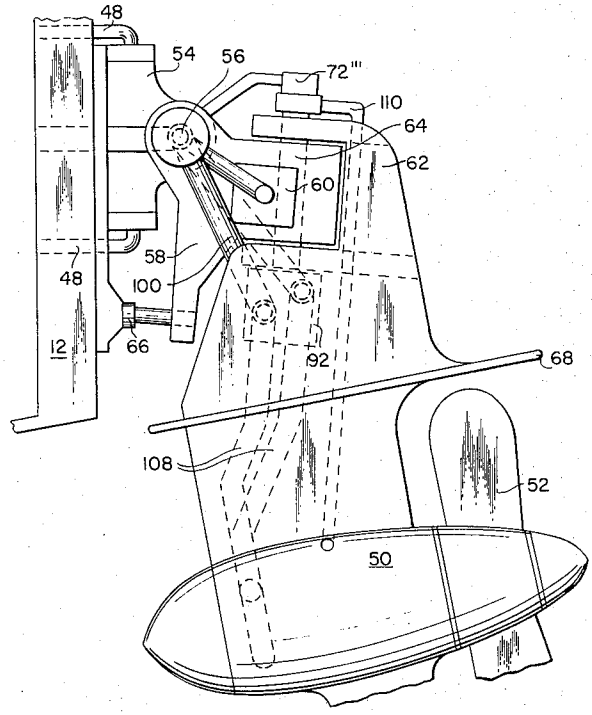


FIG. 2

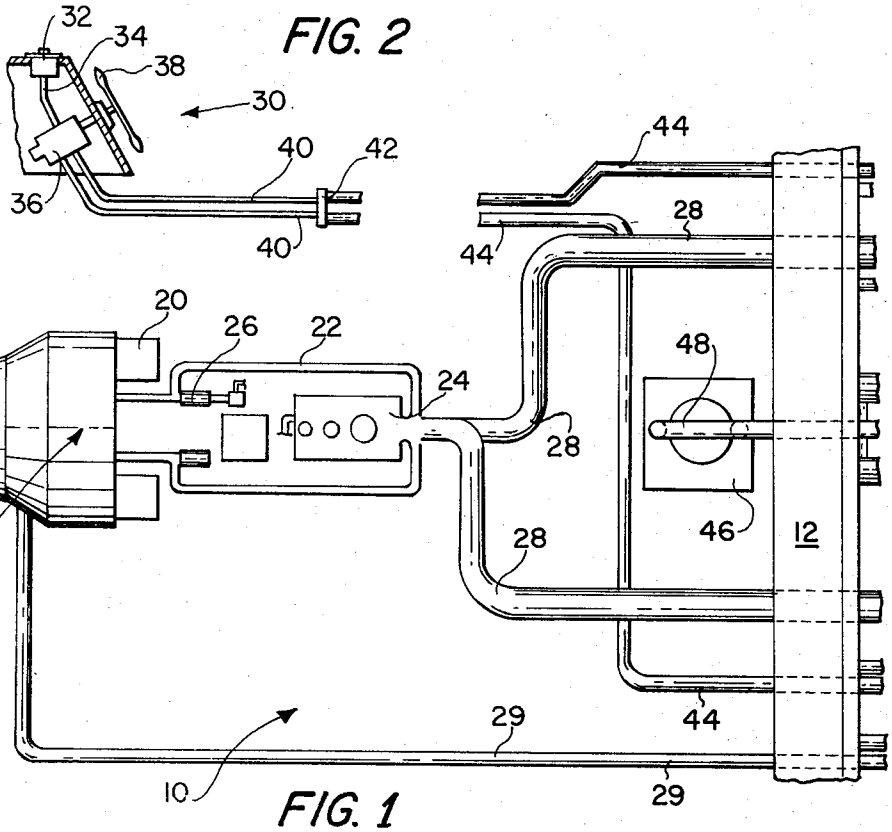


FIG. 1

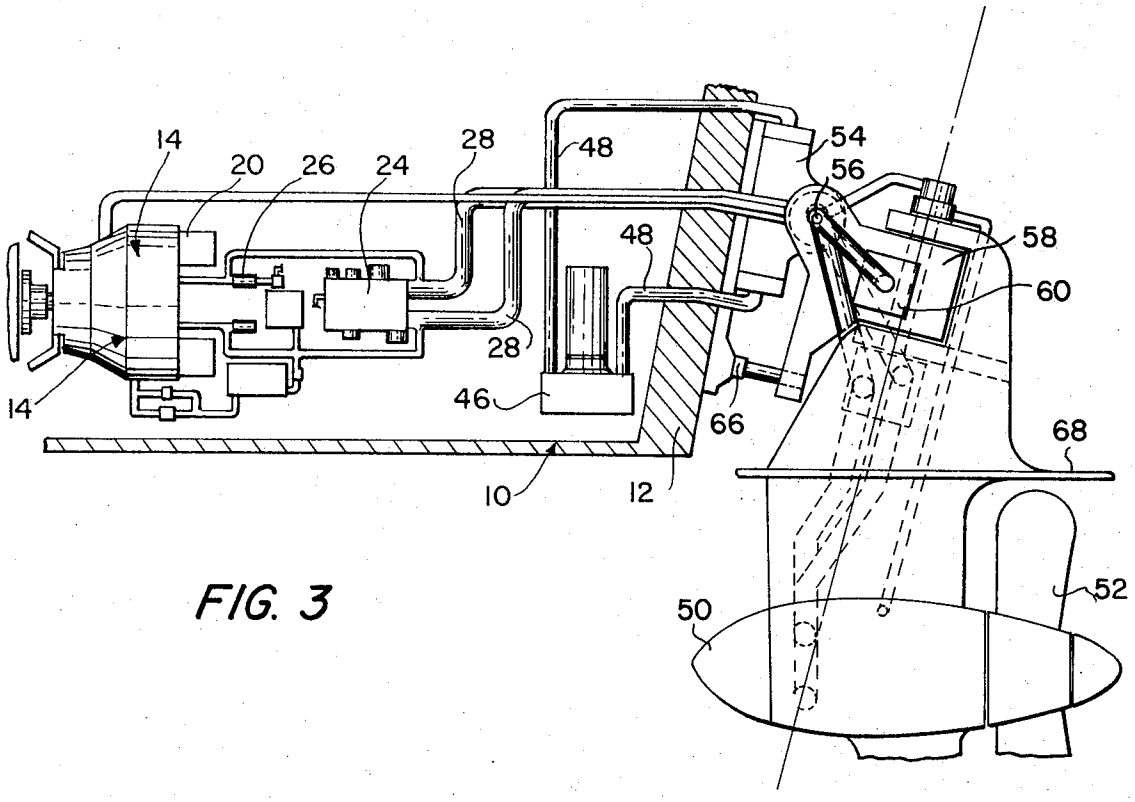
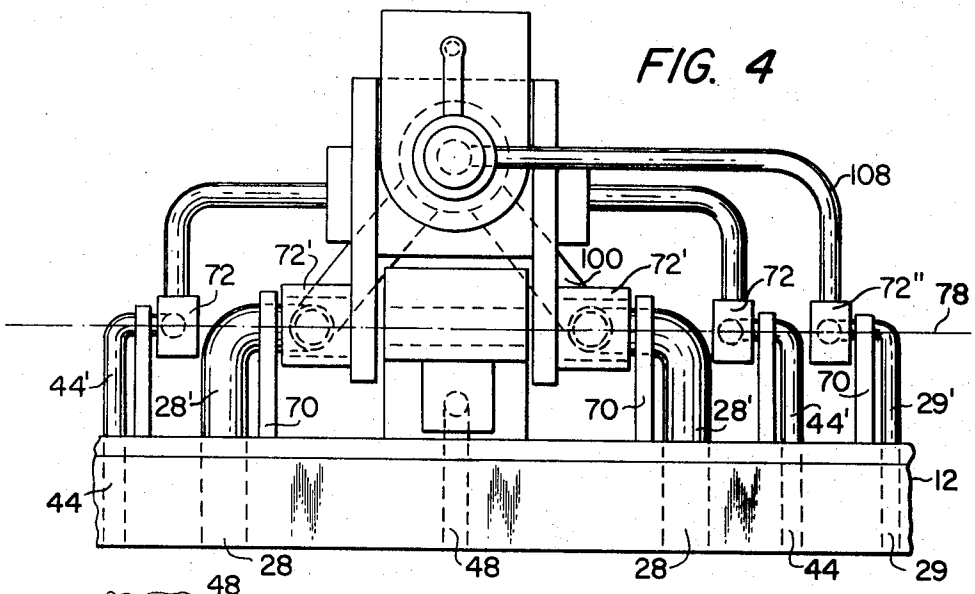


FIG. 3

FIG. 4


108
72'
72
100
72'
72
72"
78
44'
28'
70
70
28'
70
44'
29'
12
44
28
48
28
44
29

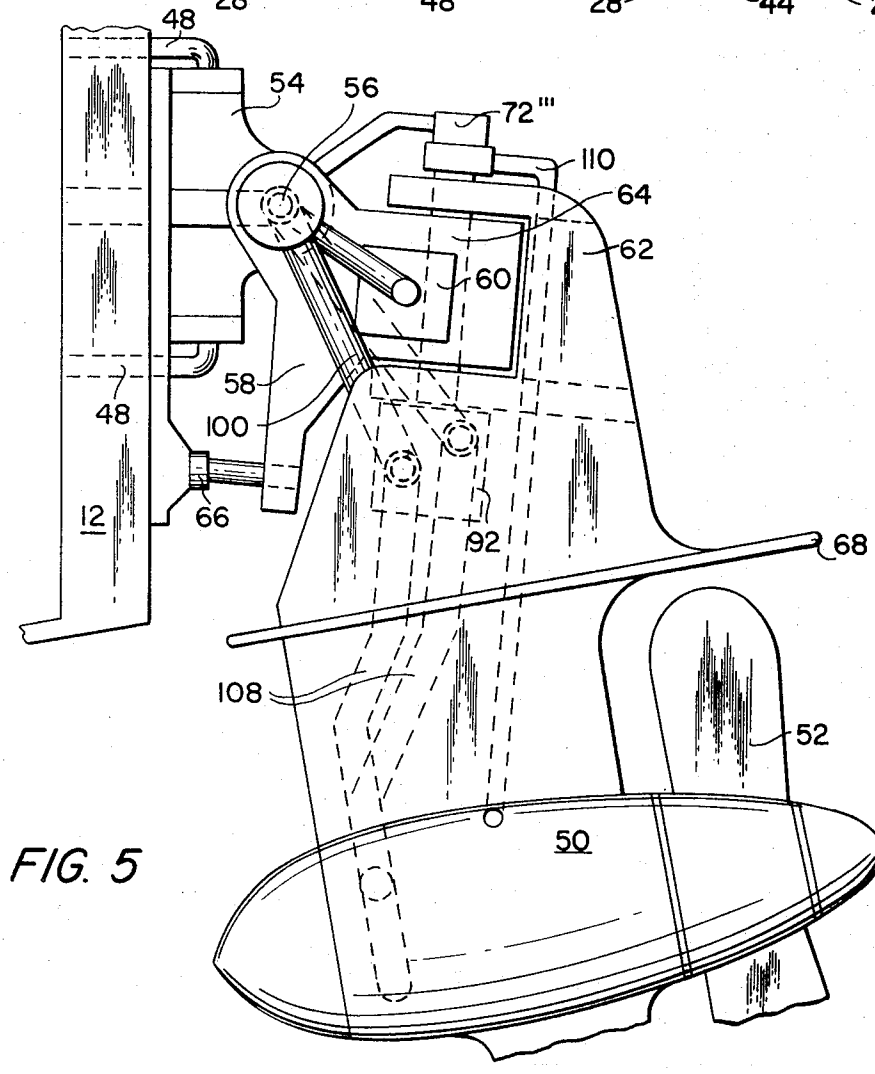

48
54
56
72'''
110
64
62
60
58
100
48
12
66
92
68
108
52
50

FIG. 5

FIG. 6

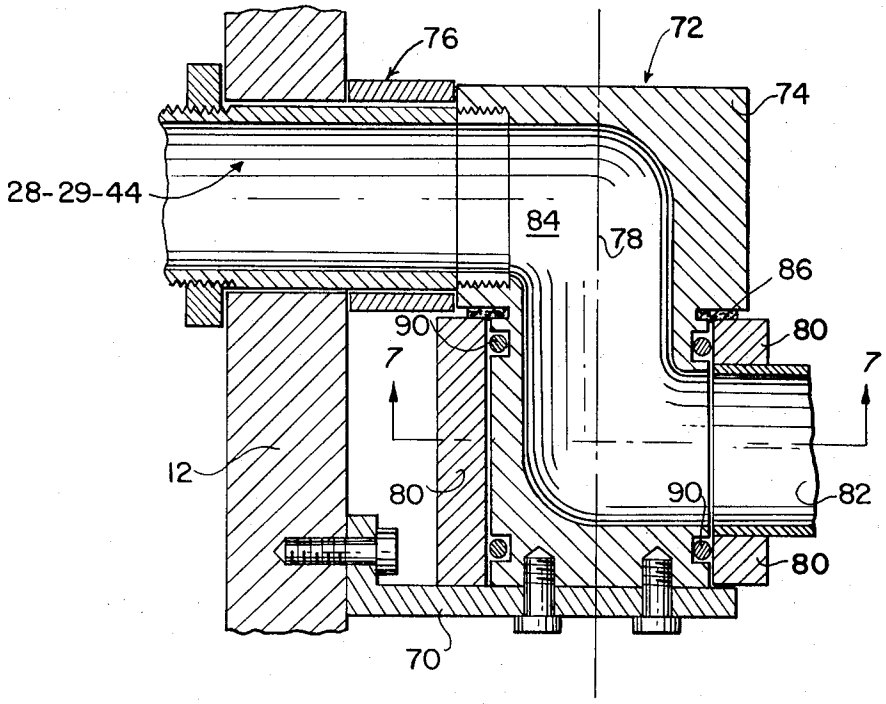
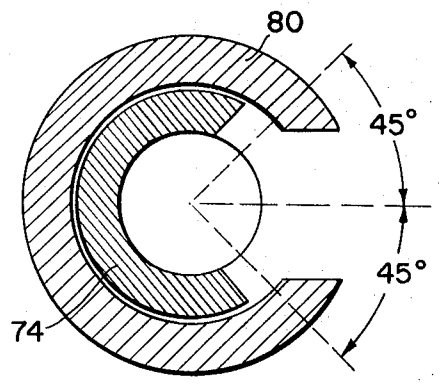


FIG. 7



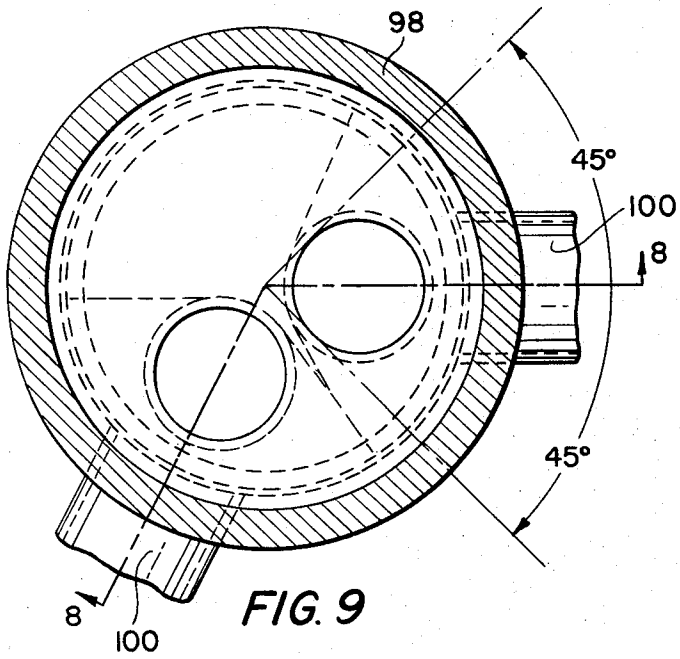

98
45°
100
8
45°
8
100

FIG. 9

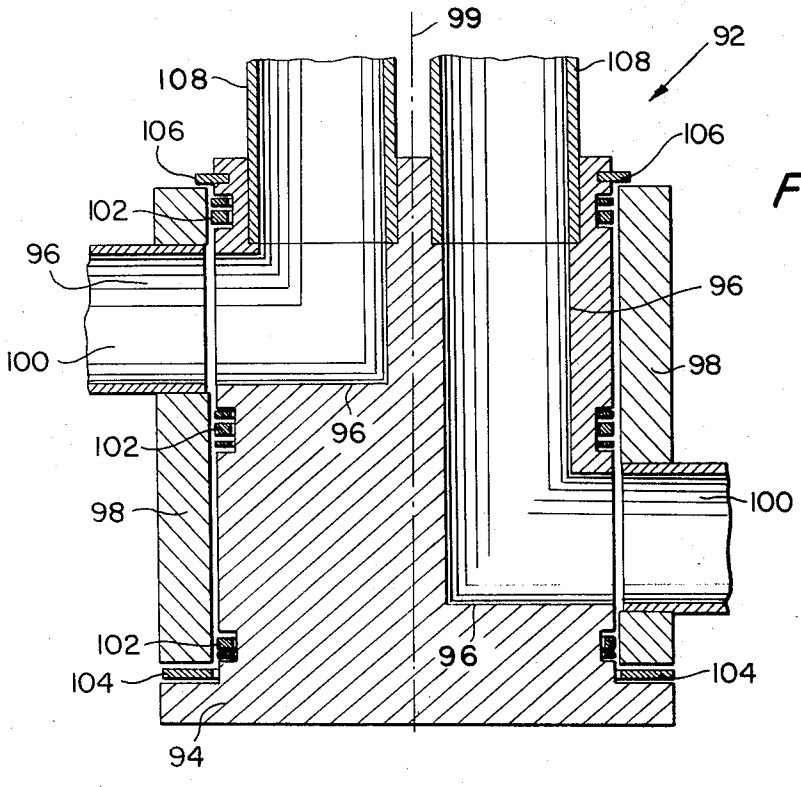
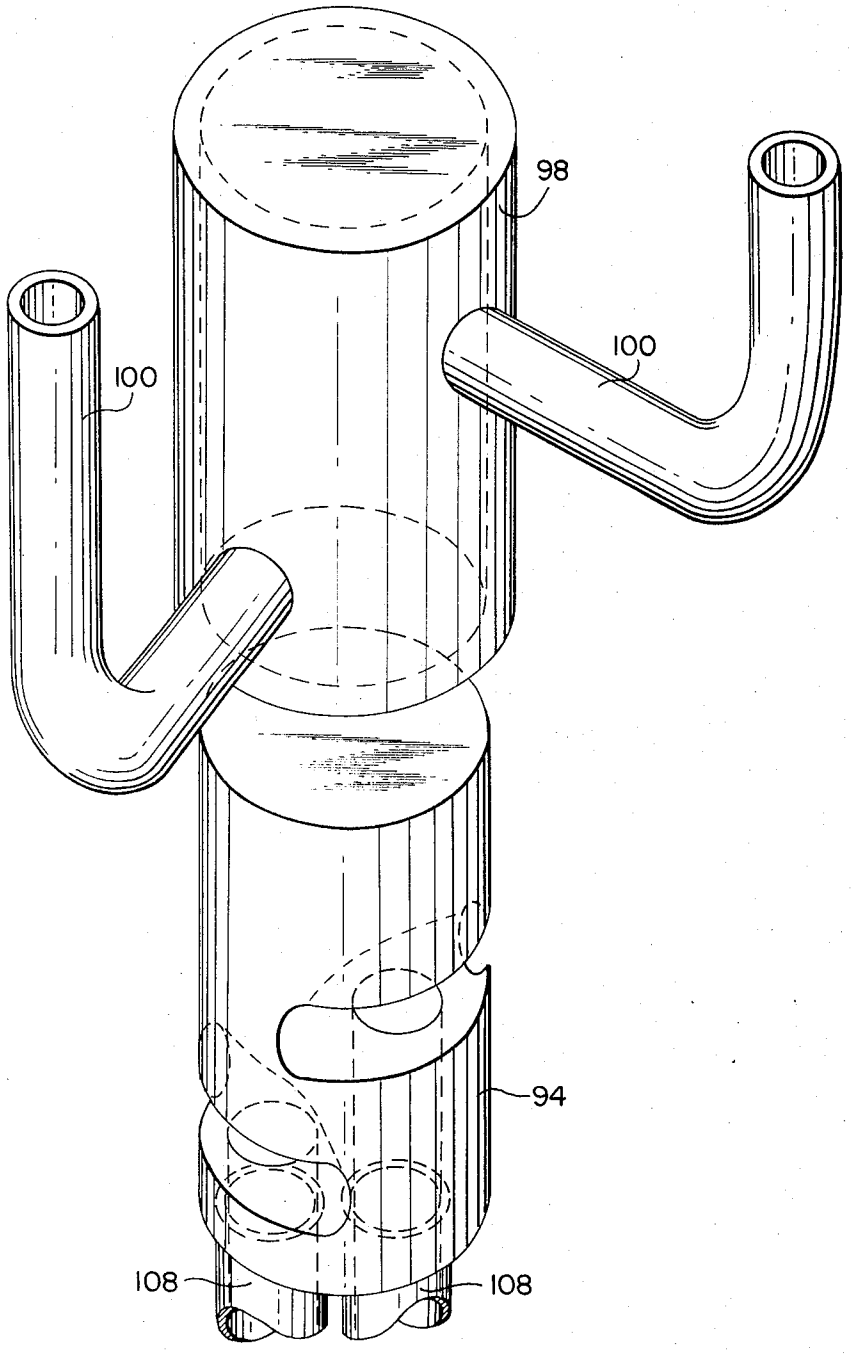

99
92
108
108
106
106
102
96
96
100
98
102
96
98
100
102
96
104
104
94

FIG. 8

FIG. 10



HYDRAULIC MARINE PROPULSION AND GUIDANCE SYSTEM

BACKGROUND OF THE INVENTION

In U.S. Pat. No. 3,587,511 there is disclosed a hydraulic marine propulsion system featuring an inboard power plant operatively connected to a fluid pressure generating system and an outboard fluid driving system. The inboard pressure generating system disclosed in U.S. Pat. No. 3,587,511 is a reversible variable displacement axial piston pump provided with a lever-operated servosystem, appropriate speed control, charge pump and valve manifold units. The outboard fluid-driving system consists of a fixed displacement axial piston fluid motor and propeller.

In U.S. Pat. No. 3,596,626 there is disclosed a steering and tilting system applicable for use with a basic hydraulic propulsion system of U.S. Pat. No. 3,587,511, the steering and tilting system featuring the use of hydraulic actuators. Specifically, the steering system disclosed in U.S. Pat. No. 3,596,626 consists of two self-contained units comprising a helm pressure generating assembly positioned as desired within the vessel and a hydraulic rotary actuator assembly suitably mounted to the vessel guidance system. The tilting system disclosed in U.S. Pat. No. 3,587,511 likewise consists of two self-contained units comprising a first motor driven hydraulic pump positioned as desired within the vessel and a second hydraulic actuator assembly suitably mounted to the underwater propulsion system.

Development of the hydraulic marine propulsion system disclosed in U.S. Pat. No. 3,587,511 and the steering - tilting system disclosed in U.S. Pat. No. 3,596,626 has demonstrated the desirability of rigid fluid conduits connecting the equipment within the vessel to the outdrive unit.

The use of non-rigid conduits is impractical. Such flexible conduits, being subject to fatigue, have limited use in connecting the components of hydraulic motors wherein the high pressure fluid flow frequently reaches 5,000 psi. There are significant pressure losses in conventional rubber conduits and resistance against bending eventually occurs. It is further apparent that salt water deteriorates most flexible materials. In general it may be said that rigid fluid connections are essential to the successful commercialization of high pressure fluid marine propulsion-guidance systems.

SUMMARY OF THE INVENTION

The present invention in its broader sense relates to an entire hydraulic propulsion and guidance system for marine vessels. The system disclosed herein includes as an essential component both single passage and multiple passage oscillating swivels appropriately mounted to the transom of the vessel and the steering clevis permitting the inboard pressure generating system and the outdrive fluid motor to be connected by rigid elements. In like manner, the fluid conduits operatively connecting the helm pressure generating unit and the steering system and the pumping system and the tilting mechanism are also rigid. Thus, an overall hydraulic marine propulsion and guidance system capable of practical commercial application is achieved with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top view illustrating the basic fluid pressure generating system located within the vessel and the fluid conduits leading to the transom of the vessel;

FIG. **2** is a side view partly in section illustrating the helm pressure generating unit of the steering system and the double-lock valve system associated therewith;

FIG. **3** is a side view partly in section illustrating the basic fluid pressure generating system within the vessel, the pump for operating an actuator for tilting the outdrive unit (not shown) and certain of the fluid lines running through the transom;

FIG. **4** is a top plan view of the transom of the vessel and the outdrive unit, illustrating in particular the fluid connections and swivel assemblies connecting the inboard pressure generating system with the outdrive unit, the helm pressure generating unit with the hydraulic actuator for steering and the pump with the hydraulic actuator for tilting;

FIG. **5** is a side elevational view illustrating the transom of the vessel and the outdrive unit, illustrating in particular the lift clevis, the steering clevis, the fluid connections and swivel assemblies;

FIG. **6** is a cross sectional view of one of the single oscillating swivels permitting the transfer of high pressure fluid through rigid connections;

FIG. **7** is a cross sectional view taken along lines **7—7** of FIG. **6** illustrating in particular oscillation of 45° on either side of the slotted inlet portion of the core member;

FIG. **8** is a cross sectional view of the dual passage swivel taken along line **8—8** of FIG. **9** through which pass the fluids connecting the inboard pressure generating system and the outdrive unit;

FIG. **9** is a cross sectional view of the dual passage swivel; and

FIG. **10** is a perspective view of the dual passage swivel and fluid connections extending therefrom.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. **1** and **3**, the reference numeral **10** designates generally a marine vessel terminating in transom **12.** Within the vessel **10** is appropriately mounted a fluid pressure generating system **14** such as disclosed in U.S. Pat. No. 3,587,511, incorporated herein by reference, which may be a reversible variable displacement axial piston pump provided with an input shaft **16,** flywheel not shown and servo cylinders **20.** Appropriate fluid connections, designated generally by reference numeral **22,** connect the pump **14,** the high pressure manifold valve assembly **24** and the check valves **26.** Finally, the reference numeral **28** designates the main fluid circuit lines leading to and through the transom, eventually to the outdrive unit as explained in detail hereinafter.

Turning now to FIG. **2,** the reference numeral **30** designates generally the inboard helm pressure generating unit which consists of an atmospheric pressure fluid reservoir **32** connected by way of conduit **34** to a conventional fluid radial piston pump **36** operated by the helm wheel **36.**

Fluid lines **40** connect the housing of radial piston pump **36** to a double locking valve assembly **42.** For further information regarding the construction and operation of such helm pressure generating units and locking valve assemblies, reference is made to U.S. Pat.

No. 3,596,626, incorporated herein. As will be further apparent from FIGS. 1 – 2, the fluid lines **44** lead to and pass through the transom **12** of the vessel **10.**

The reference numeral **46** designates an electric pump of conventional design mounted within the vessel and provided with fluid lines **48** leading to and passing through the transom **12** of the vessel **10.**

Turning now to FIGS. **4** – **5**, the reference numeral **50** designates the fluid motor, which as indicated in U.S. Pat. No. 3,587,511 may be a fixed displacement axial piston fluid motor, to which the propeller **52** is attached.

Mounted to the outside of the transom **12** is the tilting actuator **54.** The construction and operation of the hydraulic rotary actuator **54** is disclosed in U.S. Pat. No. 3,596,626 and consists generally of a cylinder within which are mounted pistons each being integral with a rack engaging a pinion through which the shaft **56** is mounted.

The shaft **56** of the tilting actuator **54** is keyed to the lift clevis **58.** Mounted within the lift clevis **58** is the steering actuator **60,** also a hydraulic rotary actuator as disclosed in U.S. Pat. No. 3,596,626. The reference numeral **62** designates the steering clevis which is formed as a part of the outdrive assembly. The shaft **64** is keyed to the steering clevis **62** and is rotated by the steering actuator **60.**

The reference numeral **66** designates an adjusting screw for changing the angle of the cavitation plate **68.**

The fluid lines **28, 29, 44** and **48** pass through the transom **12** and emerge via the conduits **28', 29', 44'** and **48',** as illustrated in FIG. **4.** Spaced outwardly from the transom **12** and supported from struts **70** are a series of single passage limited rotational swivels designated generally by the reference numeral **72.**

The construction of the swivels **72** is illustrated in FIGS. **6** – **7** wherein it will be apparent that the reference numeral **74** designates a stationary core connected to the conduits **28', 29', 44', 48'.** The center line **78** of each core **74** coincides with the axis of the shaft **56** of the tilting actuator **54.** Mounted for rotation about each core **74** is a sleeve **80** provided with an inlet port **82.** The sleeve **80** is permitted to oscillate 45° to either side of the center of the inlet port **84** of the core **74,** as illustrated in FIG. **7.** A fiber thrust and space washer **86** is positioned between the core **74** and the sleeve **80** while leakage of oil is prevented by the seals **90,** as illustrated in FIG. **6.** The reference numeral **70** designates an adjustable brace for connecting the core **74** to the transom while an adjustable spacer **76** is provided to hold the swivel center line parallel to the tilt axis.

As illustrated in FIGS. **4** – **5,** a multiple passage swivel designated by the reference numeral **92** is used to transmit fluid between the fluid motor **50** and the swivels **72'** in such a manner that the steering clevis **62** may be freely rotated.

The construction of the swivel **92** is illustrated in FIGS. **8** – **10** wherein it will be apparent that the reference numeral **94** designates a rotatably mounted core provided with two separate passages **96.** The centerline **99** of the core **94** coincides with the axis of the shaft **64.** Mounted about the core **94** is the outer sleeve **98** provided with rigid fluid conduits **100.** Oil seals **102,** a fiber thrust washer **104** and a snap ring **106** are employed in the swivel **92.** As will be apparent from FIG. **9,** oscillation of the core **94** is 90°.

As illustrated in FIGS. **8** and **10,** the fluid conduits **108** connect the passages **96** within the core **94** of the swivel **92** with the fluid motor **50.** In similar manner, the fluid conduits **100** connect the openings within the rotating sleeve **98** with the swivels **72'.** These connections are further illustrated in FIGS. **4** – **5.**

As will be further apparent from FIGS. **1, 4** and **5,** the freeflow fluid line **29** directly connects the fluid pressure generating system **14** and the fluid motor **50.** In this direct connection, fluid passes through the swivel **72''**, conduit **108,** the swivel **72'''** mounted above the steering clevis **62** and in alignment with the shaft **64** and the conduit **110.**

Finally, it is not necessary to employ either of the swivels **72** or **92** in connecting the pump **46** and tilting actuator **54** since the latter is rigidly secured to the transom **12,** as illustrated in FIG. **5.**

As will now be apparent, operation of the pump **46** causes the shaft **56** of the tilting actuator **54** to rotate in turn rotating the lift clevis **58** so as to tilt the fluid motor **50** and propeller **52.** Movement of the helm wheel **38** operates radial piston pump **36** causing the steering actuator **60** to rotate the shaft **64** in turn rotating the steering clevis **62** so as to turn the fluid motor **50** and propeller **52.** During all times, the connection between the fluid pressure generating system **14** and the fluid motor **50** is maintained through the single passage swivels **72'** and the dual passage swivel **92.** Thus, all fluid connections are rigid avoiding the previously described disadvantages of employing flexible hydraulic lines.

I claim:

1. A hydraulic propulsion and guidance system for a marine vessel having a transom, comprising:

a fluid pressure generating system within the vessel;

a clevis, means mounting said clevis to the outside of the transom of the vessel and permitting said clevis to rotate in a generally vertical plane about a first axis;

a fluid motor carried by said clevis, means permitting said motor to rotate from side to side with respect to said clevis about a second axis;

dual passage swivel means operatively mounted for movement along said second axis;

single passage swivel means operatively mounted for movement along said first axis; and

rigid fluid conduit means operatively connecting said fluid motor to said dual passage swivel means, fluid conduit means operatively connecting said fluid pressure generating system to said single passage swivel means, and rigid fluid conduit means operatively connecting said single passage swivel means to said dual passage swivel means.

2. A hydraulic propulsion and guidance system as in claim **1,** wherein said second axis about which said fluid motor rotates is positioned at an acute angle with respect to vertical and slopes downwardly towards the vessel.

3. A hydraulic propulsion and guidance system as in claim **1,** including a helm pressure generating system within the vessel, a first hydraulic actuator, means mounting said first actuator to said clevis to rotate said fluid motor with respect to said clevis about said second axis and fluid conduit means operatively connect-

ing said helm pressure generating system and said first hydraulic actuator.

4. A hydraulic propulsion and guidance system as in claim **1**, wherein said means permitting said clevis to rotate about said first axis includes a second hydraulic actuator mounted to the transom of the vessel and means operatively connecting said second hydraulic actuator to said clevis to rotate said clevis about said first axis; a pressure generating system; and fluid conduit means operatively connecting said pressure generating system and said second hydraulic actuator.

5. A hydraulic propulsion and guidance system for a marine vessel as in claim **1**, wherein said dual passage swivel means comprises a core mounted for rotation about an axis coinciding with said second axis about which said fluid motor rotates, two passages provided within said core to which said rigid fluid conduit means are connected, a sleeve having two openings to which said fluid conduit means are connected, said core mounted within said sleeve and arranged to oscillate 90° therein.

6. A hydraulic propulsion and guidance system for a marine vessel as in claim **1**, wherein said single passage swivel means comprises two swivels each of which comprises a stationary core having its axis coinciding with said first axis about which said clevis rotates, a passage provided within said core and terminating in an opening to which one of said rigid fluid conduit means is connected, a sleeve mounted for rotation about said core, said sleeve provided with an opening to which the other of said rigid fluid conduit means is connected, said sleeve arranged to oscillate 45° on each side of said passage within said core.

7. In a hydraulic propulsion and guidance system for a marine vessel including a main fluid pressure generating system and a fluid motor operatively mounted to rotate about a first axis with respect to a clevis that is operatively mounted to the vessel to rotate about a second axis, the improvement comprising a hydraulic actuator mounted to rotate said fluid motor about said first axis, single passage swivel means operatively mounted for movement along said second axis, dual passage swivel means operatively mounted for movement along said first axis, said dual passage swivel means comprising a core mounted for rotation about said first axis, two passages provided within said core, a sleeve having two openings, said core mounted within said sleeve and arranged to oscillate 90° therein, rigid fluid conduit means operatively connecting said two passages provided within said core and said fluid motor, rigid fluid conduit means operatively connecting said two openings of said sleeve of said dual passage swivel means and to said single passage swivel means, and rigid fluid conduit means operatively connecting said single passage swivel means to said main fluid pressure generating system within the vessel.

8. In a hydraulic propulsion and guidance system as in claim **7**, including a helm pressure generating system within the vessel, additional single passage swivel means operatively mounted for movement along said second axis, rigid fluid conduit means operatively connecting said helm pressure generating system to said additional single passage swivel means, and rigid fluid conduit means operatively connecting said additional single passage swivel means to said hydraulic actuator.

9. A hydraulic propulsion and guidance system for a marine vessel having a transom, comprising:

a fluid pressure generating system within the vessel;

a clevis;

first actuator means mounted to the transom of the vessel and connected to said clevis supporting said clevis from the transom and permitting said clevis to rotate about a first axis;

a fluid motor;

a second actuator means mounted upon said clevis and operatively connected to said motor to rotate said motor with respect to said clevis about a second axis;

dual passage swivel means operatively mounted to said clevis and said fluid motor along said second axis; and

rigid fluid conduit means operatively connecting said fluid motor to said dual passage swivel means, and fluid conduit means operatively connecting said fluid pressure generating system to said dual passage swivel means.

10. A hydraulic propulsion and guidance system as in claim **9**, wherein said second axis about which said fluid motor rotates is positioned at an acute angle with respect to vertical and slopes downwardly towards the vessel.

* * * * *