Jan. 30, 1968 B. C. WOLFE 3,366,183

HYDRAULIC SHIP PROPELLER

Filed Sept. 8, 1966 2 Sheets-Sheet 1

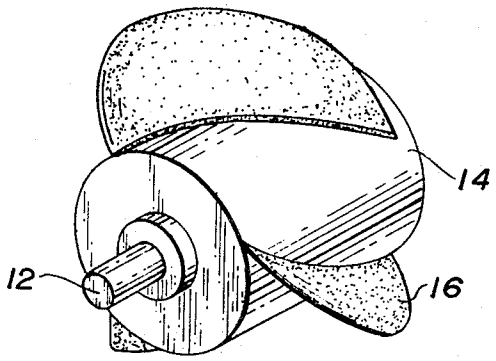


FIG. 1

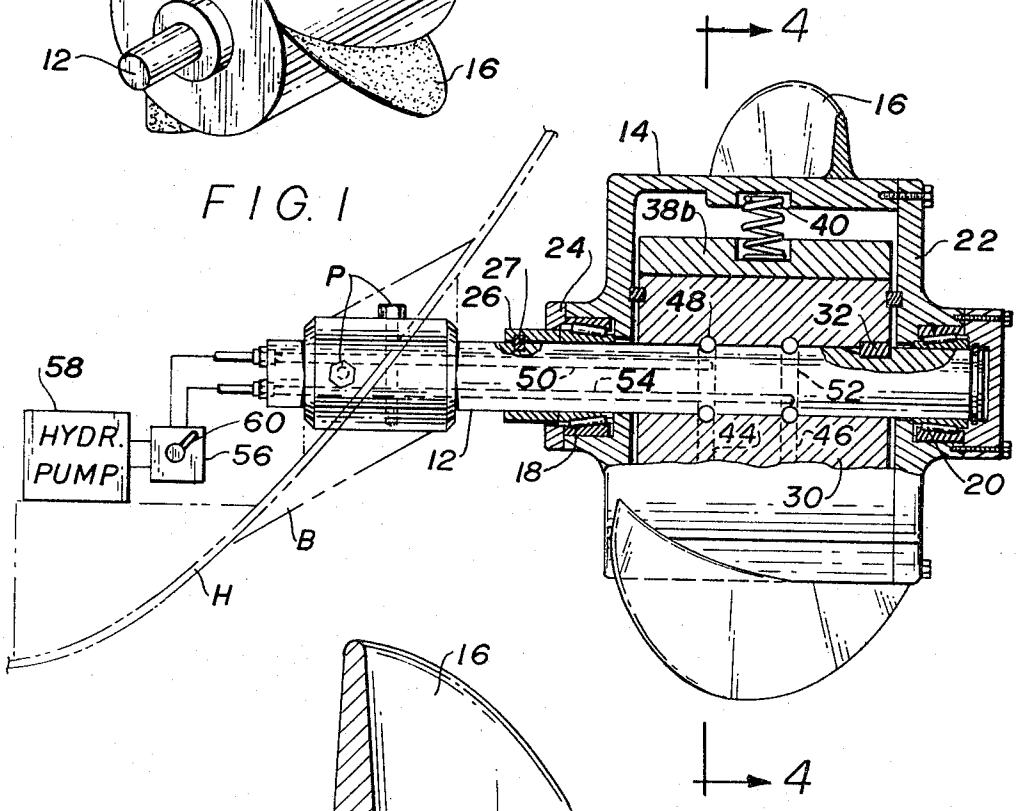


FIG. 3

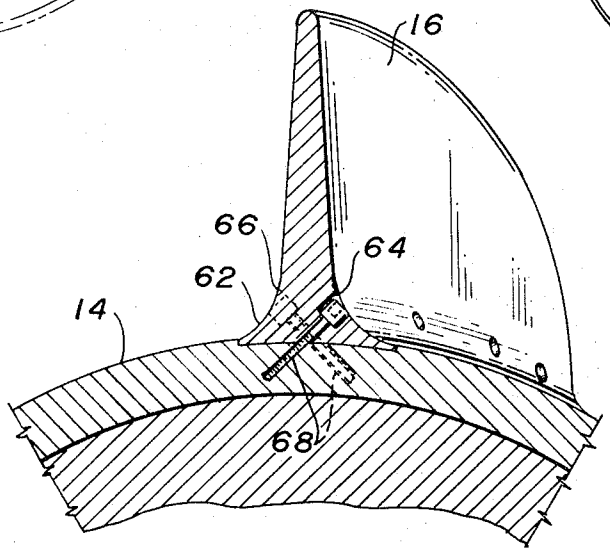


FIG. 2

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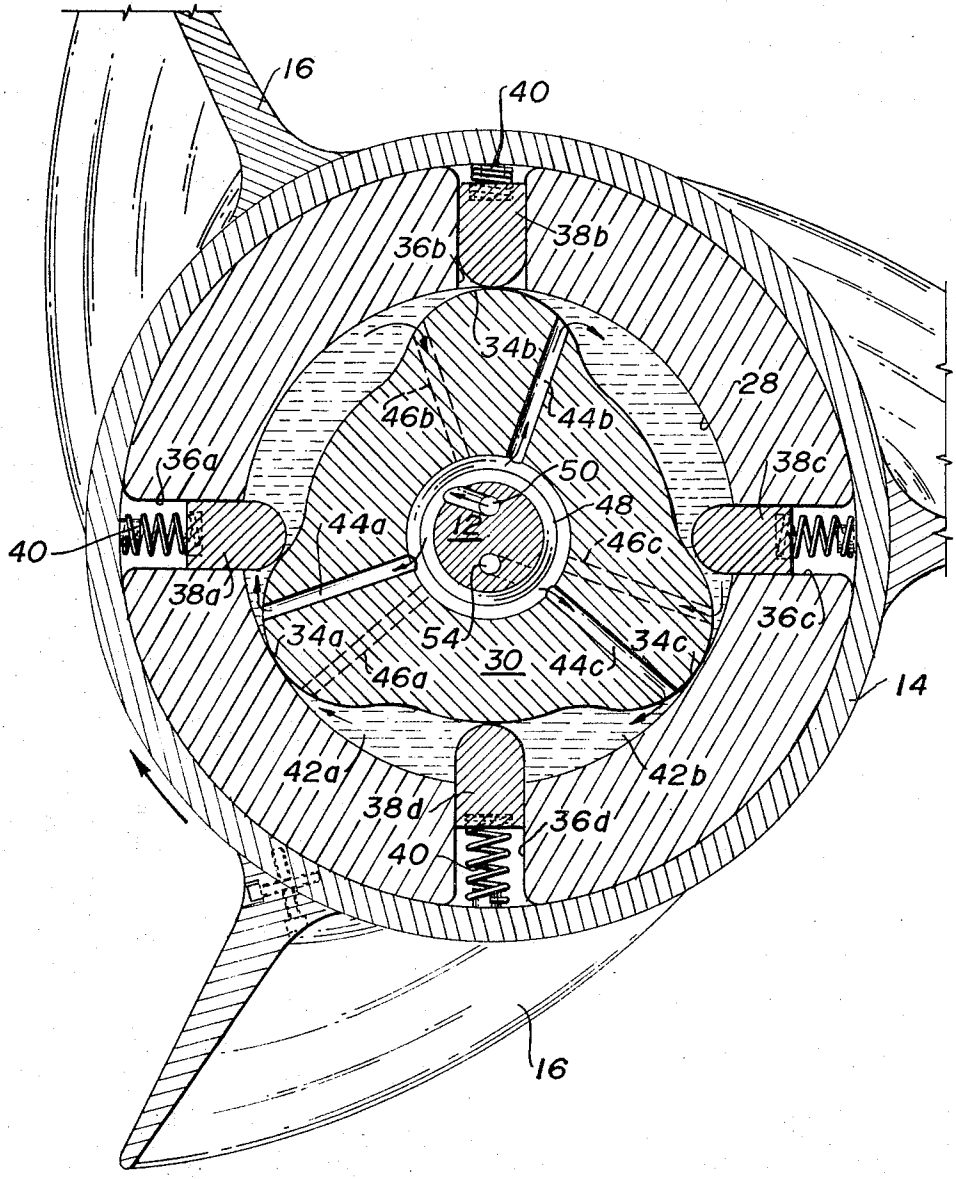


FIG. 4

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HYDRAULIC SHIP PROPELLER

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ABSTRACT OF THE DISCLOSURE

A hydraulically driven ship's propeller in which all moving parts are exterior of the hull. A hydraulic propeller in which all moving parts are symmetrical about a central axis. A hydraulically driven ship's propeller capable of operation in wide range of speeds and torque ratings.

This invention relates to a hydraulic driven propeller for fluid borne vessels such as ships.

Convention propeller drive mechanisms include a prime mover mounted in a ship's hull, a shaft extending from the prime mover and through the ship's hull into the water, and a propeller mounted on the end of the shaft. Such conventional systems require sophisticated and complex bushings or bearings for supporting the shaft at the point that it extends through the hull in order to avoid water leakage. Moreover, such systems require complex control gear for controlling the direction and speed of rotation of the propeller in steering the vessel.

The present invention provides a ship's propeller that is supported and driven exteriorly and rigidly relative the ship's hull thereby avoiding the need for complex water tight bearings or bushings. The propeller includes one or more blades mounted on the exterior surface of a casing that has a cylindric chamber therein. The ends of the cylindric chamber are closed and at one end a bearing is provided concentric with the cylindric axis of the chamber. A shaft, secured at one end thereof to the hull of the vessel, is fitted in the bearing to support the casing for rotation on the shaft. Fixed to the shaft within the cylindric chamber is a body having a lobed periphery so as to define one or more fluid compartments between adjacent lobes and the cylindric chamber. One or more vanes extending radially inwardly of the casing and into the cylindric chamber divide the fluid compartments into a power compartment and an exhaust compartment; application of pressurized fluid to the former and exhaust from the latter rotatively drive the casing and the blades mounted thereto.

The operative details of the hydraulic fluid conveying and controlling elements of the appartus are described in greater detail in my U.S. Patents Nos. 3,241,456 and 3,289,543, a division of the former patent. Such specific elements will, however, be described hereinafter insofar as is necessary for a full understanding of the present invention.

An object of this invention is to provide a propeller for a fluid-borne vessel that is capable of accurate, wide-range control without sacrificing efficiency and without requiring complicated gear changing mechanism. The present invention achieves this object by employing hydraulic fluid pressure as the energizing medium for the propeller and consequently permits utilization of well-known hydraulic fluid supply and control systems.

Another object is to provide a ship's propeller that substantially eliminates the necessity for water-tight bearings

or bushings. The shaft supporting apparatus of this invention is rigidly secured exterior of the hull and therefore presents no leakage problems whatsoever. The relatively moving parts of the apparatus that reside exterior of the hull and within the water contain hydraulic fluid under extremely high pressure interiorly thereof so as to prevent ingress of sea water. Additionally, even when the propeller apparatus is not moving, as when the vessel is standing by, sufficient hydraulic fluid pressure can be maintained in the structure to prevent ingress of sea water.

A feature and advantage of the propeller driving structure of the present invention is that virtually all wearing parts are mounted exterior of the hull, as a consequence of which the entire structure can be removed for servicing or replacement without necessitating access to the hull interior. Thus, hoisting equipment and related repair facilities of much less sophisticated nature than those presently necessary can be employed for servicing vessels provided with apparatus of the present invention.

Other objects, features and advantages will be more apparent after referring to the following specification and accompanying drawings in which:

FIG. 1 is a perspective view of a ship's propeller made according to the present invention;

FIG. 2 is a cross-sectional view showing a satisfactory expedient for securing a propeller blade to the driving apparatus of the present invention;

FIG. 3 is a cross-sectional view in elevation showing the driving apparatus mounted on the hull of a vessel; and

FIG. 4 is a cross-sectional view taken along line 4—4 of FIG. 3.

Referring more particularly to the drawings, reference numeral **12** indicates a shaft adapted for rigid attachment to the hull of a vessel which shaft is adapted to support a casing **14**, rotatively journalled on the shaft and within the water supporting the vessel. Mounted on the exterior of casing **14** is one or more propeller blades **16** which are designed in a more or less conventional manner to propel the vessel through the water as casing **14** and the propeller blades are rotatively driven.

Referring to FIG. 3, a vessel hull is shown fragmentarily at H and has affixed thereto a shaft mounting block B that supports shaft **12** rigidly of the hull. One or more cross pins P are provided for securing shaft **12** against rotation relative to the hull.

Supported on shaft **12** exterior of hull H is casing **14**, roller thrust bearings of conventional form **18** and **20** being provided for journalling the casing on the shaft. Casing **14** at the end thereof remote from the hull is provided with an end closure **22** which engages the outer race of bearing **20** and seals the interior of casing **14** against ingress of sea water. The opposite end of casing **14** includes a retaining ring **24** which in conjunction with a collar **26**, keyed at **27** to shaft **12**, supports thrust bearing **18** in operative position.

Referring to FIG. 4, casing **14** is formed with a cylindric surface **28** interior thereof, which surface is concentric with the axis of shaft **12**. A lobed body **30** is keyed to shaft **12** at **32** and has a plurality of lobes **34***a*, **34***b*, and **34***c* uniformly positioned about the periphery thereof. The outer peripheral extremities of the lobes cooperate with cylindric surface in substantially non-contacting, fluid-sealing relationship, by which is meant that the lobe extremities are spaced apart from the cylindric surface so as not to contact such surface, but are sufficiently close to

the cylindric surface to substantially preclude passage of hydraulic fluid from one side of the lobe to the other. As is understood by those versed in the hydraulic arts, the clearance between the radial extremity of the lobes **34** and cylindric surface **28** of about .0005 inch affords the desired relationship.

Casing **14** is provided with a plurality of radially extending slots **36***a*, **36***b*, **36***c*, and **36***d* which communicate with the cylindric chamber defined by cylindric surface **28** and which slidably support respective vanes **38***a*, **38***b*, **38***c*, and **38***d*. A compression spring **40** is provided in each slot **36** for resiliently biasing the associated vane **38** into contact with the peripheral surface of lobed body **30**. It can thus be seen in FIG. 4 with respect to vane **38***d* that on one side of the vane a compartment **42***a* is defined between the vane, cylindric surface **28** and the peripheral surface of lobed body **30**, whereas on the opposite side of the vane a compartment **42***b* is similarly formed.

Lobed body **30** is provided with a plurality of generally radially extending passages for communicating with the various compartments defined between the lobed body and cylindric surface **28**. Formed on one side of the individual lobes of lobed body **30** are passages **44***a*, **44***b* and **44***c*. Also associated with each lobe **34** is a second passage **46***a*, **46***b* and **46***c*, respectively. Each of the passages **44** and **46** terminates in one or more orifices on the periphery of disk **30**, the orifices communicating with passages **44** being located on one side, in the rotational sense, of lobes **34**, and the orifices associated with passages **46** terminating on the opposite side of the lobes.

Each passage **44** extends to a centrally disposed annular manifold chamber **48** which is in fluid communication with a conduit **50** formed within shaft **12** and extending longitudinally thereof to the interior of hull H. Passages **46** are connected through a similar manifold chamber **52** and conduit **54** to the hull interior. Interiorly of the hull conduits **50** and **54** are connected through a conventional hydraulic control valve **56** to a conventional hydraulic pump **58**, valve **56** being provided with a control lever **60**, manipulation of which affords alternate supplying of pressurized fluid to one of conduits **50** or **54** and exhaust of the fluid through the other conduit.

The operation of my invention can be discerned most clearly from FIG. 4 if it is assumed that hydraulic fluid under pressure is being supplied through conduit **50** and manifold chamber **48** to passages **44***a*, **44***b* and **44***c* and is being exhausted through passages **46***a*, **46***b* and **46***c* and conduit **54**. Referring to passage **44***a*, it can be seen that pressurized fluid supplied therefrom is applied to the compartment defined between lobe **34***a*, vane **38***a* and cylindric surface **28** and that such action produces a clockwise force on vane **38**. Such clockwise force on vane **38***a* causes corresponding clockwise movement of casing **14** and propeller blades **16** secured thereto, as a consequence of which hull H is propelled through the water. As vane **38***a* so moves, the compartment forwardly thereof and in communication with passage **46***b* is exhausted through the passage and through conduit **54** to be returned to the hydraulic pump **58**. Correspondingly torque is delivered to the casing **14** through vane **38***c* in response to inflow of fluid through passage **44***b*. The compartment between vane **38***c* and passage **44***b*, in the phase of operation shown in FIG. 4, is nearing the end of its torque producing period. When the casing **14** has rotated approximately 15° clockwise of the position shown in FIG. 4, vane **38***b* will be in such position as to receive fluid pressure from passage **44***b* so as to contribute to rotative movement of casing **14**. Torque is also delivered to casing **14**, when the casing is in the position depicted in FIG. 4, through vane **38***d*, which vane is in an intermediate stage between lobe **34***c*, lobe **34***a*. Thus fluid pressure exists on the right side of vane **38***d* as viewed in the figure because of the inflow of pressurized fluid through passage **44***c*, and fluid is exhausted from the left side of vane **38***d* through fluid passage **46***a*. From the foregoing it will be apparent that as casing **14** rotates around lobed body **30** the various compartments between the periphery of the lobed body and cylindric surface **28** go through, in sequence, power phases and exhaust phases. Because the number of vanes **38** exceeds the number of lobes **34**, at least one of the vanes is active to deliver torque to casing **14** at all times. Accordingly, there are no dead spots in the operation of the apparatus.

Moreover, reversal of the direction of rotation of casing **14** relative shaft **12** is effected by manipulating valve **56** so that pressurized fluid is supplied through conduit **54** and exhausted through conduit **50**. Such simplified reversal is possible because lobed body **30** and housing **14** are symmetrical relative the axis of shaft **12**.

When it is desired to terminate rotation of casing **14**, control valve **56** is moved to a position at which pressurized fluid is supplied equally to conduits **50** and **54**. Accordingly, the pressure on each side of vanes **38** is equalized to stop rotation of the casing and a positive pressure exists at collar **26** to prevent ingress of sea water to the hydraulic system.

Although the blades **16** can be secured to casing **14** by any one of a number of conventional techniques, it has been found that the expedient depicted in FIG. 2 is satisfactory in that the blades can be individually replaced. For this purpose the blade at the base thereof is provided with a smoothly flared portion **62** in which portion are formed a first row of sloped holes **64** and a second row of sloped holes **66** spaced intermediate hole **64**. A bolt **68** is passed through each hole and is threadedly engaged in casing **14**, thus securing blade **16** to the housing. Thus the blades can be replaced individually, or should the hydraulic drive system wear before the blades, the blades can be reused by an attachment thereof to a new casing **14** and related wearing components.

It will thus be seen that the present invention provides a driving mechanism for fluid-borne vessels which overcomes many of the problems present in prior art structures and which is capable of simplified directional and speed control without necessity for complicated gear changing apparatus as required in known prior art vessel propelling systems. Additionally, apparatus according to the present invention is so arranged that it can be conveniently removed from the vessel for repair and the like without necessity for expensive hoisting and/or docking facilities.

Although one embodiment of the invention has been shown and described it will be obvious that other adaptations and modifications can be made without departing from the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for driving a vessel through water and the like comprising a shaft adapted to be secured against rotation relative said vessel, a lobed body fixed to said shaft exterior of the vessel, said body having a plurality of uniformly spaced lobes therearound that are formed symmetrically relative the axis of said shaft, a casing enclosing said body and journalled for rotation on said shaft, said casing having a cylindrical internal surface in fluid tight sliding relation to the periphery of said lobed body to define at least one compartment bounded by two adjacent lobes and said cylindric surfaces, a plurality of vanes mounted in said casing symmetrically thereof for slidable movement radially of said cylindric surface, means for biasing said vanes into sliding contact with the peripheral surface of said lobed body and into said compartment, means for defining a first fluid passage through said shaft and said lobed body terminating on the periphery of said lobed body, means for defining a second fluid passage through said shaft and said lobed body terminating on the periphery of said lobed body, means for supplying fluid to one said passage at a pressure exceeding that of the water and exhausting fluid pressure from the other said passage so as to effect rotary movement of said casing, and a plurality of blades mounted

on said casing for imparting motive force to the vessel through the water in response to rotation of said casing.

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