United States Patent [19]

Fuller

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[54] **MARINE STEERING DEVICE**

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[52] **U.S. Cl.** **115/42;** 114/166

[51] **Int. Cl.** **B63h 5/14**

[58] **Field of Search** ..... 114/151, 148, 150, 166, 114/167; 115/39, 42, 12 R

[56] **References Cited**

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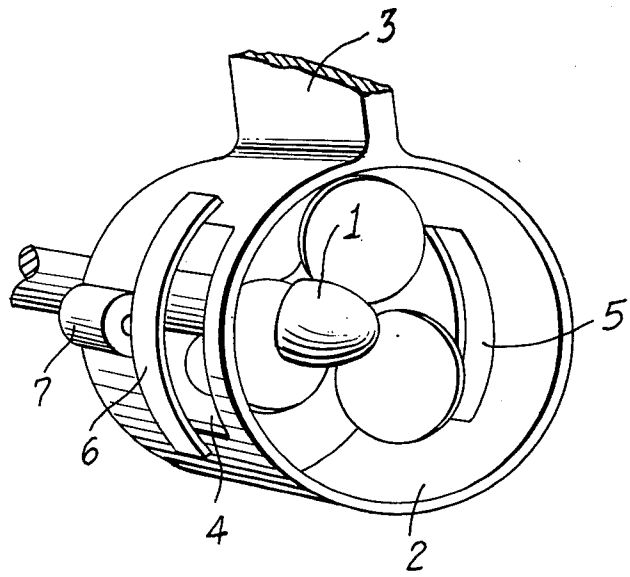
Primary Examiner—Duane A. Reger
Assistant Examiner—Stuart M. Goldstein

[57] **ABSTRACT**

A propeller duct or nozzle provided with controllable passageways and modulated for the purpose of developing a controllable athwartship thrust which may be used without rudder deflection or drag arising therefrom for the purpose of making minor directional changes necessary to keep a ship on course, and when used in conjunction with a rudder, to increase steering effectiveness at higher and full helm angles, with possible reduction in rudder area. The steering device also improves effectiveness when going astern or when manouvering alongside with a stopped ship. The device retains the improved propulsive efficiency characteristic of a ducted propeller whilst compensating for the increase in wetted area represented by the duct or nozzle.

9 Claims, 7 Drawing Figures



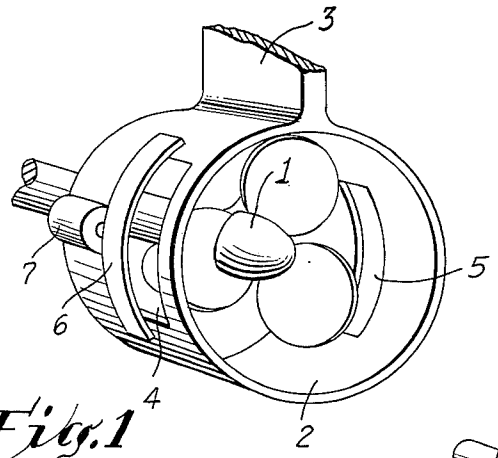


Fig. 1

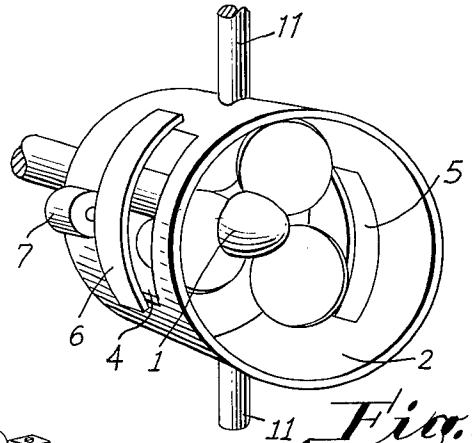


Fig. 3

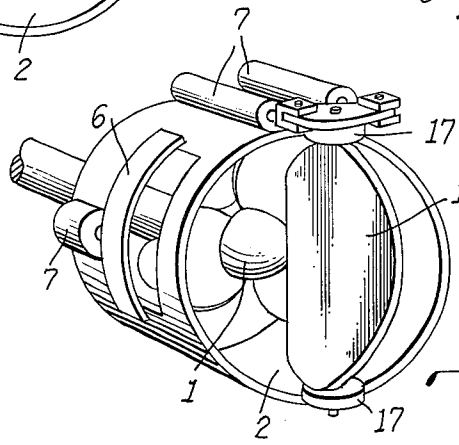


Fig. 2

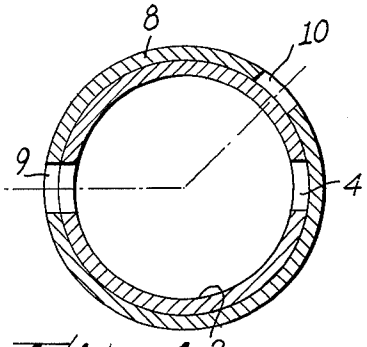


Fig. 4

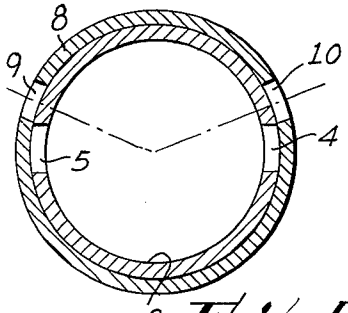


Fig. 5

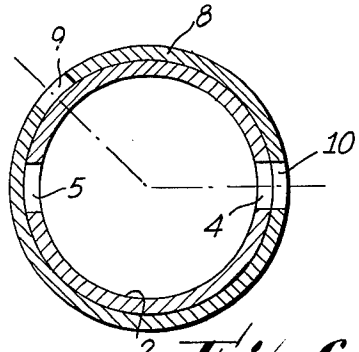


Fig. 6

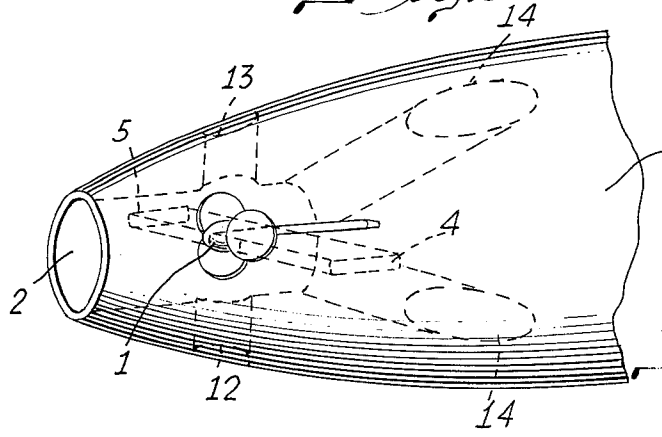


Fig. 7

MARINE STEERING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to a steering device applicable to screw propelled ships and more particularly to ducted propellers operating within and embraced by a shroud or nozzle.

The continuing search for efficiency represented by economical operation is increasingly favouring the use of ring propellers or propellers working within nozzles or shrouds which increase the velocity of fluid presented to the propeller, recapture slip energy otherwise lost to the wake, and in the case of a nozzle, may also recover thrust from the pressure differential generated by the nozzle profile. These advantages a normally offset in part by the increased surface area and friction losses arising from the nozzle and which is additional to that due to the rudder or other steering appendage losses.

For this and other reasons, nozzles have been largely confined to tugs and other specialised vessels where the advantages of increased bollard pull outweigh other considerations.

Large ships have now been developed to a stage where high block coefficients and length / breadth ratios increasingly tend to blanket the stern appendages essential to propulsion and steering to the extent that course correction at small helm angles is compromised necessitating the use of helm angles which impose unnecessary drag to the prejudice of efficiency and fuel consumption. The use of unshrouded propellers further aggravates this situation due to the necessity for correcting the sideways thrust resulting from the hydrostatic pressure differential across the top and bottom diameter of the propeller.

Accordingly, it is an object of this present invention to reduce or eliminate the drag inherent in steering a ship with conventional rudders, particularly at small helm angles, whilst improving propulsive efficiency and promoting fuel economy.

It is a further object of the invention to provide a steering device which will develop a controllable transverse thrust in a stopped ship.

It is a further object of the invention to provide a steering device which is effective ahead or astern.

It is a further object of the invention to minimise or eliminate "rudder slam" and to reduce the complexity and cost of mechanisms.

DRAWINGS

In the drawings which illustrate embodiments of the invention

FIG. 1 shows an embodiment having a duct in the form of a nozzle rigidly mounted to the hull of a vessel in such a manner that it embraces the propeller.

FIG. 2 shows another embodiment wherein a rudder is pivotedly mounted to the nozzle.

FIG. 3 shows a further embodiment wherein the nozzle is rotatably mounted about a vertical axis intersecting the propeller and shaft.

FIGS. 4, 5 and 6 are sectional views through a duct in the form of a nozzle illustrating one control means in the form of a sleeve rotatably mounted upon the nozzle.

FIG. 7 is a skeleton view of an embodiment wherein a duct forms an internal passageway within the hull of a vessel, the hull of a submersible being instanced.

The steering devices illustrated comprise a screw propeller 1 embraced by a duct or nozzle 2 pierced by passages 4 and 5. In the embodiment illustrated in FIG. 1 the nozzle is rigidly mounted to the hull of a vessel by bracket 3 and provision is made for modulating or closing passages 4 and 5 by sluice gates 6 traversed over the passages by means of hydraulic jacks 7. FIG. 2 illustrates an embodiment in which one or more vane rudders 16 are mounted to the nozzle 2 by pivots 17 the movement of said rudder or rudders being co-ordinated with the modulation of passages 4 and 5 such that passages 4 and 5 only may be used for very small helm angles determined by course keeping, and rudder helm with or without the assistance of passage 4 or 5 may be used for greater helm angles as for manouvering. The embodiment illustrated in FIG. 3 comprises a nozzle 2 rotatably mounted about a vertical axis on pivots 11 which are suitably supported by appendages carried on a vessels hull, and which enables the nozzle to be rotated around the propeller to direct the main thrust from the propeller for steering purposes with or without the assistance of passages 4 and 5 which same may be offset from the pivot axis such that the reaction created from the opening of either passage may be used as a servo for turning the nozzle to its desired position.

FIGS. 4, 5 and 6 show embodiments in which control of ports 4 and 5 is by means of a sleeve 8 pierced by passages 9 and 10 and rotatably mounted upon nozzle 2. FIG. 5 shows the sleeve in the mid or in-operative position wherein both passages 4 and 5 in nozzle 2 are closed by the interposition of sleeve 8 and all tangential slip energy from the propeller (not shown for sake of clarity) embraced by the nozzle is constrained into joining the main stream of fluid through the nozzle to augment the propulsive force. FIG. 4 shows the sleeve 8 rotated through an anticlockwise angle such that passages 9 and 5 are aligned and open whilst passage 4 remains closed by the interposition of sleeve 8. FIG. 6 shows sleeve 8 rotated through a clockwise angle such that passages 10 and 4 are aligned and open to the passage of fluid whilst passage 5 remains closed by the sleeve 8. It will be apparent that the sleeve 8 can be rotated to mid positions with respect to nozzle 2 such that either port may be part way opened or modulated at will for the purpose of controlling the reactive steering thrust available from the propeller slip stream.

FIG. 7 illustrates an embodiment in which the propeller 1 works within an internal duct 2 formed within the hull 15 of a vessel, one end of duct 2 terminates at the end of the hull 15 whereas the other end terminates at one or more openings through the skin as shown at 14. Passages 4 and 5 communicate between the duct 2 and the outside of hull 15 and are modulated by sluice valves or other suitable means which will be apparent to one versed in the art, for the purpose of controlling the steering thrust in a horizontal plane. Passages 12 and 13 communicate between duct 2 and the outside of hull 15 and are similarly modulated for the purpose of controlling the steering thrust in a vertical plane.

It will be apparent that other passages may be located at other angles around the hull as may be desirable to counter pitch or roll.

The steering device utilises the pressure gradient across the wall of the duct or nozzle, to develop a controlled reactive directional thrust by means of passages penetrating the walls of duct or nozzle at suitable points under the control of modulating means. The pressure

gradient across the wall may be augmented by a suitably shaped rudder, or rudders, which interrupt the nozzle exit at optimum helm angles.

The invention further resides in the combination, construction and arrangement of the parts illustrated in the accompanying drawings, and whilst there are shown five variants for the purpose of simplicity, it is to be understood that the same are merely illustrative of the invention and that the invention is capable of modification and change and comprehends other details of construction without departing from the spirit thereof or the scope of the appended claims.

What I claim is:

1. A marine steering device comprising a submerged duct, a propeller rotationally mounted on the axis within the duct and adapted to propel fluid through the duct, passages through both sides of the duct wall normal to the duct axis, means for selectively opening and closing, or partially opening and closing said passages through one side of the duct wall relative to the passages through the other side of the duct wall for the purpose of generating a pressure imbalance normal to the duct axis to thereby develop a steering force. Penetrating the walls of duct, one passage of each pair located in one side of the duct coequal about an axis intersecting the centerline of the duct, the other passage located in the other side of duct coequal about said axis intersecting the centerline of the duct, means for selectively opening and closing or partially opening and closing one passage of each pair of passages relative to the other passage of said pair to thereby produce a steering thrust.

2. A steering device as claimed in claim **1**, wherein the propelled fluid is utilised as a source of energy to assist the actuation of said opening and closing means.

3. A steering device as claimed in claim **1**, wherein the duct is pivotedly mounted on a vertical axis intersecting propeller.

4. A steering device as claimed in claim **1**, wherein passages penetrate the peripheral wall of the duct at other selected angles to the horizontal axis such that directional control can be excersized in any or all planes at will, by differential control of the respective passages.

5. A steering device as claimed in claim **1**, wherein the passages penetrating the wall of the duct are located on an axis other than that intersecting the propeller.

6. A steering device as claimed in claim **1** wherein said opening and closing means is a sleeve or sleeves moveably mounted to the duct whereby the passage or passages penetrating one side of the duct may be fully or partially exposed whilst the passage or passages penetrating the other side of the duct remain closed.

7. A steering device as claimed in claim **1** wherein one or more moveable deflector vanes or rudders are pivotedly mounted transverse the axial orifice of the duct with axes generally vertical.

8. A marine steering device as claimed in claim **1** wherein the said duct is a submerged nozzle rigidly united with the hull of a vessel such that the axis of the nozzle is parallel with the longitudinal axis of the vessel.

9. A marine steering device as claimed in claim **1** means for disturbing the pressure balance transverse a symmetrical propeller duct by destroying the symmetry of the duct geometry to thereby provide a steering thrust.

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