April 16, 1968 S. B. FIELD 3,377,975

PASSIVE FIN SHIP STABILIZER

Filed March 31, 1966 2 Sheets-Sheet 1

Fig. 1

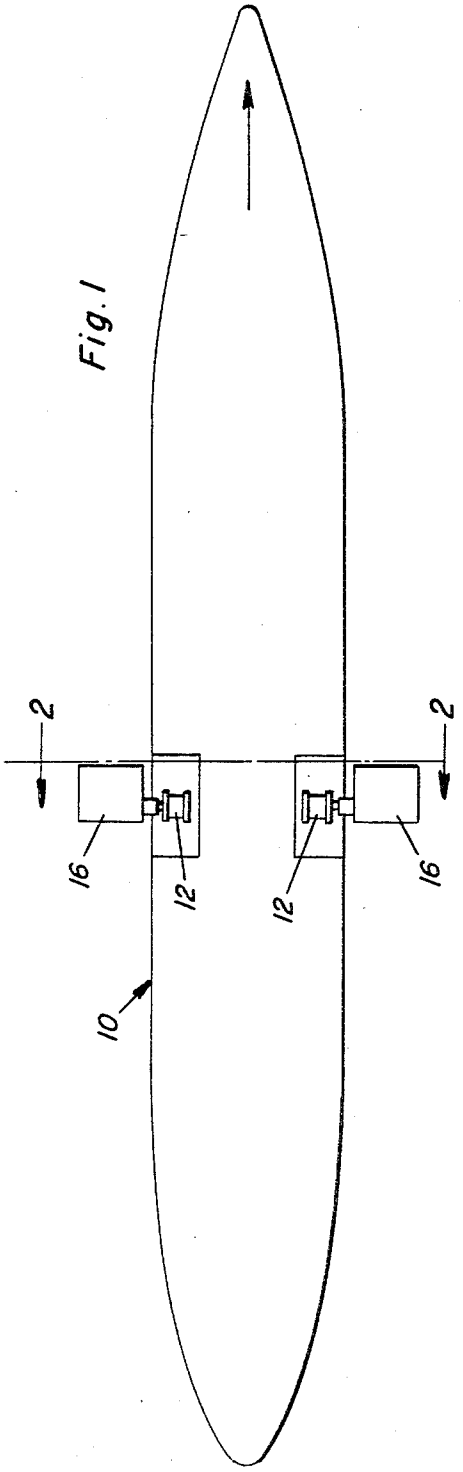
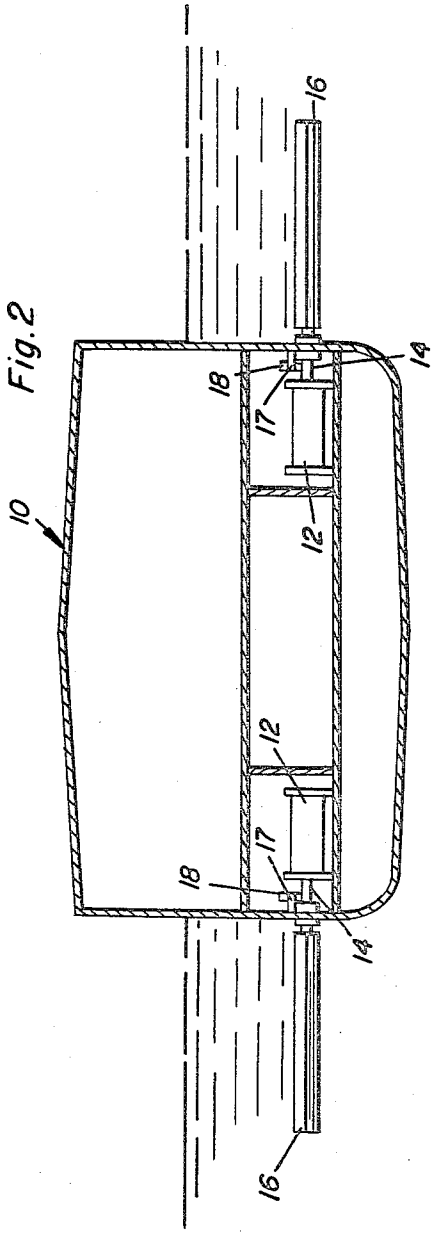


Fig. 2



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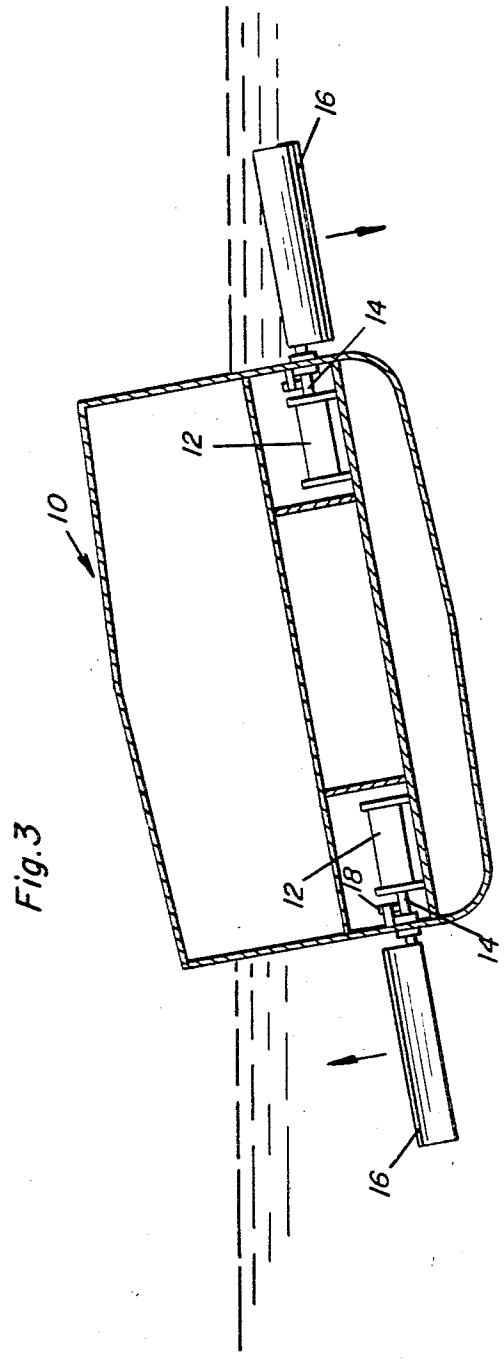


Fig. 3

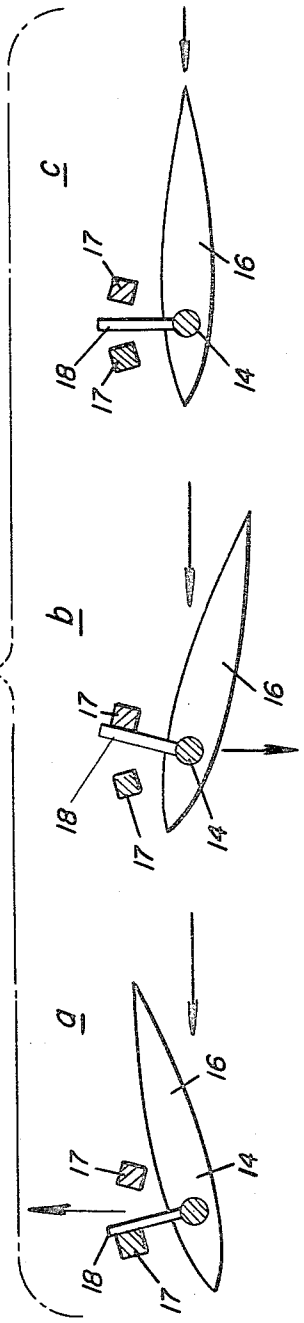


Fig. 4

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United States Patent Office 3,377,975 Patented Apr. 16, 1968

3,377,975

PASSIVE FIN SHIP STABILIZER

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Filed Mar. 31, 1966, Ser. No. 539,209
1 Claim. (Cl. 114—126)

ABSTRACT OF THE DISCLOSURE

A passive fin roll stabilization system for ships including a pair of fins transversely aligned generally at the pitching axis of the ship and on opposite sides of the hull beneath the water line. Each fin is rotatably mounted to the hull side by an axis defining hydraulic hinge which biases the fin to a neutral position. Each fin has a surface area configuration such that the fin assumes a positive angle of attack to produce stabilizing lift when the ship is moving forward and rolling such that the fin axis is lowering and a negative angle of attack to produce a stabilizing downward force when the ship is moving forward and rolling such that the axis is rising. Stops are provided to limit the fin angle of attack in the positive and negative directions.

The present invention relates to a ship stabilizer and more particularly to a roll stabilization system including passive fins arranged on opposite sides of the hull of the ship.

It is known to use hydraulically operated fins mounted on opposite sides of the hull of the ship for the purpose of stabilizing the ship in the roll plane. But these prior systems require complicated and expensive sensing and control servo-mechanisms for varying the angular position of the fin in order to produce the proper moment in opposition to the roll of the ship.

It is an object of the present invention to provide a pair of fins rotatably mounted to the opposite sides of the hull, the operation of which is passive or automatically responsive to the roll condition of the forward moving ship.

In an example of one preferred embodiment of the present invention, a hinge is provided on each side of the hull with a shaft extending outwardly through the hull at a position below the water line and preferably at the pitch axis of the ship. A streamlined stabilizing fin is mounted to the outer end of the shaft in such a way that the surface area of the fin forward of the shaft is greater than the surface area of the fin aft of the shaft. The shaft is outfitted with positive stops to limit the rotation of the fin, and the hinge stores energy to bias the fin to a zero or equilibrium position when the ship is not rolling. As the ship rolls, the fins are passively but automatically given the proper positive or negative angle of attack relative to the water medium and the appropriate stabilizing moment is imparted to the ship.

It is therefore another object of the present invention to provide a passive fin stabilization system for a ship which is inexpensive to incorporate and which is automatically operated without complicated sensing and control equipment.

Other and further objects of the present invention will become apparent with the following detailed description when taken in view of the appended drawings in which:

FIGURE 1 is a top plan view diagrammatically illustrating the ship with the present invention mounted therein,

FIGURE 2 is a transverse sectional view taken along line 2—2 of FIGURE 1,

FIGURE 3 is a view similar to FIGURE 2 showing the positions of the fins during one part of the roll cycle of the vessel, and

FIGURES 4*a* through 4*c* are side elevations of one of the fins illustrating how various forces are developed by the fins. The view is taken looking outboard with the hull removed for clarity.

With reference to the drawings in detail, a ship according to the present invention is fitted with a pair of Hydrautorque Hinge units **12** which are aligned athwart ship and positioned below the waterline. Each hinge **12** is mounted adjacent the outside of the hull of ship **10** and the stationary part can be secured to the ship by any suitable means, such as welded plates, girders, braces, brackets or the like. These Hydrautorque Hinges **12** are standard pieces of marine equipment and can be purchased in the United States under the trade name Hydrautorque Hinge, manufactured by Gotaverken Engineering Company of Sweden.

A shaft **14** extends axially with each hinge **12** and outwardly through the hull of ship **10**. The hull side should be suitably reinforced in order to receive vertical forces from shaft **14** in a manner described below. The inboard end of shaft **14** is coupled to the rotating part of hinge **12** to provide the relative rotation with the stationary part of said hinge. In order to limit the rotation of shaft **14**, a projection or stop **18** is provided thereon to engage blocks **17** which are suitably connected to the hull. Blocks **17** are positioned to limit equally the shaft rotation in the clockwise and counterclockwise directions.

Each Hydrautorque Hinge **12** comprises a cylinder containing fluid, the loading of which is related to the angular position of shaft **14**. Consequently, if shaft **14** is at a zero position, the hinge is in a state of equilibrium. However, if shaft **14** is rotated in either direction, the cylinder pressure builds up proportionally and the potential energy therein biases shaft **14** back toward the equilibrium position. Thus, the hydraulic action of hinge **12** acts in the nature of a coil spring, always biasing shaft **14** back to a zero or equilibrium position.

According to the invention, fin **16** has its back part mounted to the outside of shaft **14**, and as better seen in FIGURES 4*a* through 4*c*, fin **16** is streamlined with a zero lift profile. Although fin **16** is shown with a rectangular platform, it could be sweptback, sweptforward, or any other suitable design. Shaft **14** extends through the aft part of fin **16** and is preferably perpendicular to the fore and aft direction of the fin. Thus, the major part or area of fin **16** extends forward of its rotating shaft **14**.

In operation, ship **10** is propelled forward, and under no-roll conditions, ship **10** assumes the attitude shown in FIGURE 2 and the relative motion of the water medium is that shown by the arrow in FIGURE 4*c*. Under this condition, hinges **12** maintain fins **16** in the equilibrium positions and consequently fins **16** impart no vertical forces to the hull of the ship.

However, as ship **10** rolls, for example in the direction shown in FIGURE 3, the lowering of shaft **14** introduces a positive angle of attack to fin **16** relative to the medium. For the same reason, the rising of the opposite side of ship **10** causes shaft **14** on that side to rise, and consequently the fin **16** on that shaft is given a negative angle of attack relative to the medium. In this way, fins **16** develop upward and downward forces which are imparted through shafts **14** to the hull sides of ship **10** so that a stabilizing moment is imparted to the ship in opposition to the roll thereof.

As the ship rights itself, hinges **12** return fins **16** to their zero positions so that the fin angle of attack is again zero, and no vertical forces are produced. As the ship rolls past the horizontal in the opposite direction to that shown in FIGURE 3, the fins are again given an angle of attack, opposite to that shown in

FIGURE 3, so that a stabilizing moment is again imparted to ship **10**. Upon returning to a no-roll attitude. hinges **12** again bring fins to a zero angle of attack position. This action continues as long as the ship is moving forward.

It should be understood that as long as the ship is at a roll angle the pressure stored in hinge **12** is insufficient to bring the fin to a zero angle of attack. Thus, only when the ship is moving to an upright attitude can hinge **12** rotate shaft **14** and fin **16** to the equilibrium position.

Thus, there is disclosed herein an inexpensive, passive, fully automatic stabilizer using fins to selectively impart stabilizing moments to a ship under roll conditions. It should be understood that various modifications can be made to the herein disclosed embodiment without departing from the spirit and scope of the present invention.

What is claimed is:

1. A passive ship stabilizer for stabilizing a forward moving ship, comprising a pair of fins, each arranged on opposite sides of the ship's hull and extending outwardly therefrom, means connected to the hull for rotatably mounting each fin to the respective hull side, said means defining an independent axis of rotation for each fin, said axes located below the waterline and extending outwardly from the hull sides, said means including stop means for limiting the rotation of each fin in the positive and negative directions, each fin having a surface forward of said rotational axis and a surface area aft of said rotational axis so that each fin is rotated by the relative movement of the water ambient to a positive angle of attack to produce stabilizing lift when the ship is moving forward and rolling such that the axis is lowering and a negative angle of attack to produce a stabilizing downward force when the ship is moving forward and rolling such that the axis is rising, and means connected to the hull biasing each fin toward a rotational position of equlilibrium in which the fins impart no stabilizing force to the hull, and wherein the surface area of each fin forward of its axis is greater than the surface area aft of its axis, said axes being transversely aligned and located approximately along the pitching axis of the ship, said means for rotatably mounting each fin to a hull side comprising a hinge having a stationary part and a rotating part, a shaft having its inner end connected to the rotating part and having its outer end connected to said fin along the rotational axis thereof, said stationary part being connected to the hull, and wherein said means biasing each fin comprises a cylinder containing fluid, the pressure of which is proportional to the angular position of its associated fin relative to its position of equilibrium, and said cylinder comprising means responsive to said pressure to urge said fin back to its angular position of equilibrium whenever the fin is rotated therefrom.

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