Jan. 24, 1961 J. V. FOLL 2,969,035

SHIP STABILIZERS

Filed June 19, 1959 2 Sheets-Sheet 1

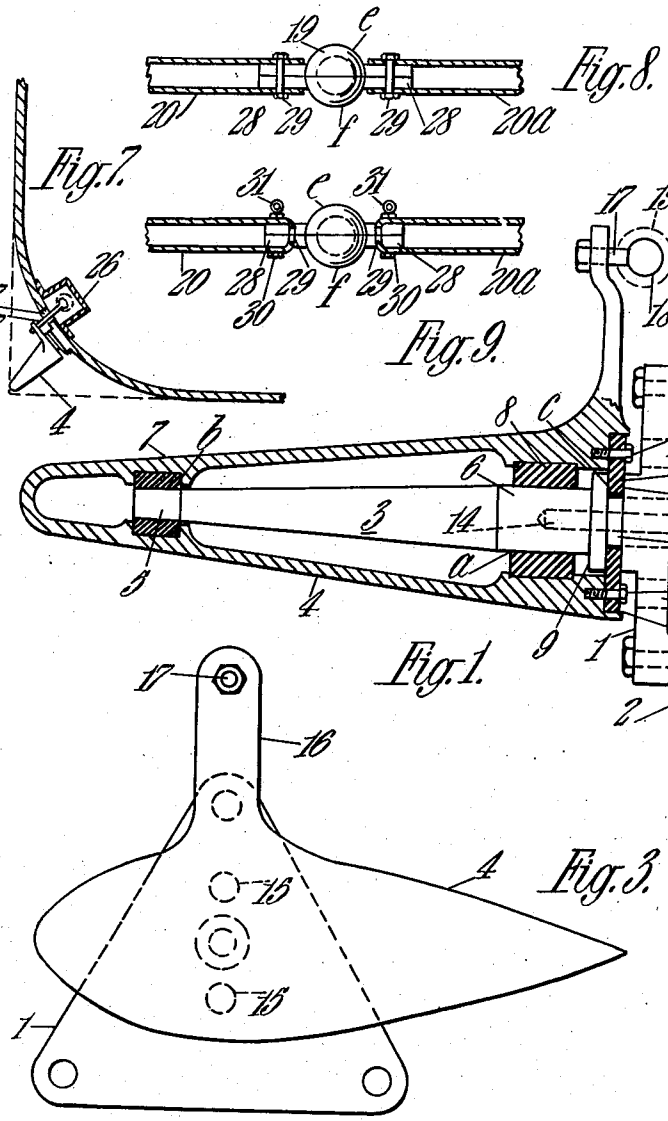


Fig. 8.

Fig. 7.

Fig. 9.

Fig. 1.

Fig. 3.

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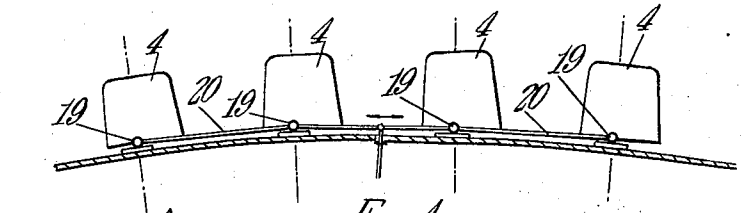


Fig. 4.

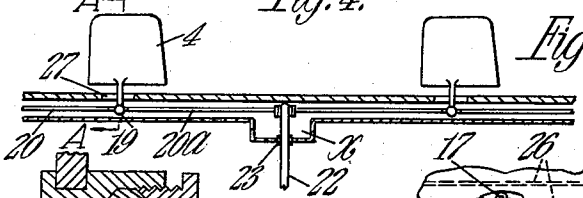


Fig. 5.

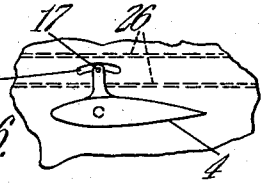


Fig. 6.

Fig. 10.

Fig. 2.

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SHIP STABILIZERS

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Claims priority, application Great Britain May 20, 1959

3 Claims. (Cl. 114—126)

This invention relates to devices for stabilizing or damping the rolling motion of ships and in particular to small ships and yachts by means of fins projecting laterally, from each side of the ship below the water line. Such fins are normally of hydrofoil section and their planes are parallel to the flow of water past the ship when in forward motion so that they do not react with the water, that is to say, they present zero angle of incidence to the water flow. However, in order that the fins may act to stabilize the ship the angle of incidence of the fins may be adjusted positively and negatively, i.e. they may be tilted in such a manner that the ensuing force due to the reaction between the fin and the water continuously opposes the sea forces causing the ship to roll. In this way the rolling motion is limited to a very small degree.

A power means to actuate the fins is provided which may be hydraulic, electric or steam operated or combinations of the same. A well known system uses hydraulic rams supplied by a variable delivery pump. The power means and hence the fin angle is controlled by a sensing means which measures one or more of the functions of the roll, e.g. displacement, velocity or acceleration and provide a control signal proportional to a single function or a combination of said functions.

Such power means and sensing means are well known and do not form a part of the present invention.

The invention relates to an arrangement in which a plurality of fins are provided on each side of the ship, suitably placed and of such dimensions that they do not materially interfere with normal operation and manoeuvring. Thus, they are placed at the curved section between the vertical sides and sensibly horizontal bottom, and do not extend beyond the projection of these surfaces.

In other such arrangements such fins are erected on and held to the side of the ship by longitudinal members and A-brackets or similar stiffening arrangements to withstand the forces generated by the fins due to their passage through the water.

The invention relates to a particular fin construction one object of which is the avoidance of hydrodynamic inefficiency due to the use of extraneous supports. The omission of said extraneous supports also avoids a serious inefficiency in respect of the "lift" of the fins which would occur due to the upwardly and downwardly moving water (after deflexion by the fins) striking such supports and causing an opposing lift which would subtract from the total lift available from the whole fin assembly.

The invention consists of a ship stabilizer fin arrangement comprising a plurality of fins provided along the side of the ship each fin being supported for rotation about a stub-axle the fins having cranks secured thereto, in which the cranks are linked by a connecting rod for simultaneous operation.

Each fin is supported on the equivalent of a stub axle or pintle providing either a single long bearing or two bearings co-operating with bearing surfaces internal to the fin, such bearing surfaces being made from a suitable

grade of hard rubber, resin impregnated fabric or other substance which provides a suitable bearing surface with water acting as the lubricant, allowances being made in the fitting of the bearings for swelling which may take place under conditions of continuous immersion in water. A suitable resin impregnated fabric is available, under the trade name "Tufnol."

In the construction the pintle and fin are both in the form of castings and the pintle is provided with a groove or flange which engages with a split ring of "Tufnol," for example, for the purpose of retaining the fin or the pintle. Access to the bolts for securing the split ring may be obtained through holes suitably placed in the base of the pintle. The section through the fin may vary from the inner to the outer portions, the inner portion being the deeper section in order to accommodate a larger bearing where the bending moment of the pintle is greater and hence, a larger diameter of pintle is required.

Since the connecting rods must operate alternately under compression and tension, they are preferably made of large diameter. The rods are preferably formed of sections and ends of adjacent rod sections may be connected by a flexible joint in the form of a split moulding of tough rubber, the moulding engaging with the spherical end of a crank pin attached to the extremity of the fin crank. The flexibility of this joint enables the system of connecting rods to respond to flexures in the ship structure and further, to operate a system of fins mounted on a curved surface of the ship, each connecting rod being straight in itself.

The fins are preferably spaced sufficiently far apart from each other so that interference of one fin on a succeeding fin or fins is reduced. Still further to diminish this effect the fins subsequent to the first may be deflected through a larger angle. By way of example, the second, third and fourth fins might operate through angles progressively greater than the first, with subsequent fins all operating at the same angle.

The movement of the fins is controlled by a controlling means and a power means as hereinbefore referred to, the mechanical motion from the power means being passed via a shaft through the hull to a crank on one of the connecting rods disposed among the group of fins. On larger ships there may be two or more controls per side but on small ships one control unit could operate all the required fins.

The fins may be subject to damage from floating objects, or in the case of stranding, the ship may heel over and rest on the fins. To avoid structural damage to the ship it is a feature of the invention to make the pintle definitely weaker than its attachment to the side of the ship so that in the event of overstraining, the fins will break off before damage is caused to the hull. As an example, where the normal maximum stress on the pintle is 2 tons per in.^{2}, the breaking stress may be made 15 tons per in.^{2}.

It is desirable that the fins and all operating parts which are exposed to the water are made of non-corrosive material such as Monel metal although stainless steel may alternatively be used for all or some portions, for example, the connecting rods and pintles. Alternatively, a fabricated construction by welding may be used instead of castings. The surfaces which are not operating or bearing surfaces may alternatively be of other materials covered with a protective coating such as rubber or plastic having both protective and anti-fouling properties.

The invention will now be further described with reference to the drawings in which:

Figure 1 is a part section through a fin,

Figure 2 is a plan of a fin,

Figure 3 is an elevation of a fin,

Figure 4 shows a group of fins attached to a ship's side,

Figure 5 is an alternative arrangement of fins,

Figure 6 is an elevation of a fin in accordance with the arrangement of Figure 5,

Figure 7 is a section of part of a ship's hull showing a fin assembly in accordance with the arrangement of Figure 5,

Figure 8 is a flexible coupling,

Figure 9 is an alternative flexible coupling,

Figure 10 is a detail of a crank.

Figure 1 shows pintle mounting plate 1 bolted to ship's side 2 and supporting pintle 3 disposed within fin 4. Pintle 3 is tapered and provided with a bearing surface 5 at its extremity and a further bearing surface 6 of larger diameter at the inboard end. Fin 4 is rotatively supported on pintle 3 by bearings 7 and 8 engaging with bearing surfaces 5 and 6 respectively.

Shoulder 9 adjacent large bearing surface 6 together with the reduced diameter 10 of pintle form a groove or slot containing split ring 11 which is further enclosed by an annular recess 12 in the inboard end of fin. Bolts 13 suitably disposed round the outer edge of split ring 11 secure the latter to fin. Thus, the fin is secured to the pintle by the split ring but is free to rotate about said pintle on bearings 7 and 8. Fin 4 and pintle 3 may be of cast construction in a non-corrosive material such as Monel metal or stainless steel. Bearings 7 and 8 and split ring 11 are of hard rubber or resin impregnated fabric, and bearing clearances *a*, *b*, *c* or *d* are water lubricated and adjusted to allow for swelling of the bearing material due to water immersion. Hole 14 drilled concentrically in the inboard end of pintle 3 is provided to reduce the strength of said pintle to a degree that will allow the pintle and fin to break off in an emergency without damage to the ship structure. Holes 15 drilled through the pintle mounting plate 1 give access to bolts 13 when securing the fin to its pintle. Angular motion is imparted to the fin over crank 16 terminating in crank pin 17. The crank may be formed integrally with the fin or welded or otherwise attached thereto. The end of crank pin is in the form of a sphere or knuckle 18 which engages with spherically formed flexible joint 19 in the assembly of connecting rods and indicated in the figure by the broken line surrounding the knuckle.

Figure 2 is a plan and Figure 3 is an elevation of the fin assembly wherein like reference characters refer to like parts in Figure 1.

Figure 4 shows an assembly of fins 4 arranged along the curvature of a ship's side 2 and actuated by connecting rods 20. Flexible joints or couplings 19 linking adjacent connecting rods enable said connecting rods to take up positions tangentially to the curvature of the hull without imparting undue strain. Longitudinal motion for actuating the fins is imparted to said connecting rods by shaft 22 passing through watertight gland 23 to the outside of the ship and terminating in a crank. This structure is shown in greater detail in Figure 10 in which shaft 22, operated at its inner end by the power means (not shown) passes to the outside of the ship through watertight gland 23. The outer end of shaft 22 terminates in crank 24 having a forked end. This forked end engages two abutments 25 on connecting rod 20 whereby rotary or oscillatory motion of the crank is translated into linear motion of the connecting rod.

The assembly of connecting rods around the side of the ship will cause a degree of turbulence and drag in their passage through the water tending to slow up the ship and to obviate this undesirable tendency the connecting rods may be contained in a channel within the ship. The crank pins of the various fins associated with the assembly pass through curved slots in the ship's side where they connect with their respective flexible joints in the system of connecting rods in a similar manner to the construction of Figure 4. An advantage of this construction is that the channel containing the connecting rod assembly is in effect an additional bilge stringer of a form contributing greatly to the strengthening of the ship. Details of the construction are shown in Figures 5, 6 and 7, in which like reference characters refer to like parts throughout the several views. Referring firstly to Figure 7 which is a traverse section of a part of the hull (on line A—A, Figure 5) in the region of the bilge, fin 4 is attached to the hull as shown and is so proportioned that its extremity does not protrude beyond the projections of the ship's side and bottom as indicated by the broken lines. Crank pin 17 of fin 4 protrudes into the channel 26 within the hull through curved slot 27 where it connects with flexible coupling 19 uniting connecting rods 20 and 20*a* (Figure 5). Channel 26 may be of welded construction in steel and welded to the sides of the ship for watertightness and strength. The channel is widened at a suitable point X (Figure 5) to accommodate the watertight gland of Figure 10 associated with the fin actuating shaft 22.

Figure 6 shows a part elevation of the ship's hull in the region of fin 4. In the figure, the broken lines represent the channel within the hull. Slot 27 cut in the ship's side enables crank pin 17 to pass into channel 26 and connect with a flexible coupling (not shown) in the system of connecting rods located longitudinally within said channel.

Figure 8 shows a method of uniting two connecting rods by means of a flexible coupling to impart a degree of resilience between the rods so connected. The flexible coupling 19 consisting of two halves *e* and *f* is moulded in a suitable grade of hard rubber. The centre portion is preferably in the form of a hollow sphere, the internal diameter (indicated by the broken line) being a working fit with respect to the spherical end or knuckle 18 of crank pin 17 (Figure 1). The spherical part is provided with two oppositely facing cylindrical extensions or stubs 28 which are a squeeze fit in the ends of the tubular connecting rods 20 and 20*a*. In assembly, the two halves of the flexible coupling are placed so that the central portion encloses the aforementioned knuckle on the crank pin. The cylindrical extensions are then forced into the ends of the connecting rods and secured by through bolts 29. In Figure 9 an alternative construction is shown in which slots 29 are moulded in the cylindrical extensions 28 and the ends of the hollow connecting rods 20 and 20*a* are turned inwardly to engage said slots as shown in the figure. The ends of the connecting rods are further provided with a number of longitudinal slots or saw-cuts (not shown) to enable the ends to be opened up or increased in diameter. To assemble the flexible coupling in this construction the ends of the connecting rods are opened out by forcing in a conical tool for example. This will allow the cylindrical extensions of the flexible coupling to pass easily into the ends of the connecting rods and for the inwardly turned ends of same to register with slots. Clamping rings 30 are then placed round the ends of the connecting rods and tightened by means of screws 31 until the inwardly projecting ends of the rods are seated in slots 29.

I claim:

1. A ship stabilizer comprising a ship's hull, a plurality of stub axles mounted outside the hull, spaced water-lubricated bearings mounted on the stub axles, fins mounted on the bearings for rotation about the stub axles, cranks secured to the fins, a connecting rod secured to the cranks for simultaneous operation of the fins and formed of sections connected by moulded flexible joints which also engage the ends of the cranks, a watertight gland in the hull and operating means for the connecting rod extending through the gland.

2. A ship stabilizer as claimed in claim 1, in which the stub axles are made only of such a strength that they will break off in the event of over-straining before damage is caused to the hull.

3. A ship stabilizer comprising a ship's hull, a plurality of stub axles mounted outside the hull, the stub axles being made only of such strength that they will break off in the event of over-straining before damage is caused to the hull, spaced water-lubricated bearings mounted on the stub axles, fins mounted on the bearings for rotation about the stub axles, actuating means mounted to form part of each fin and means extending through the hull to operate the actuating means.

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