

April 30, 1968

S. B. FIELD
SHIP STABILIZER

3,380,423

Filed March 31, 1966

2 Sheets-Sheet 1

Fig. 1

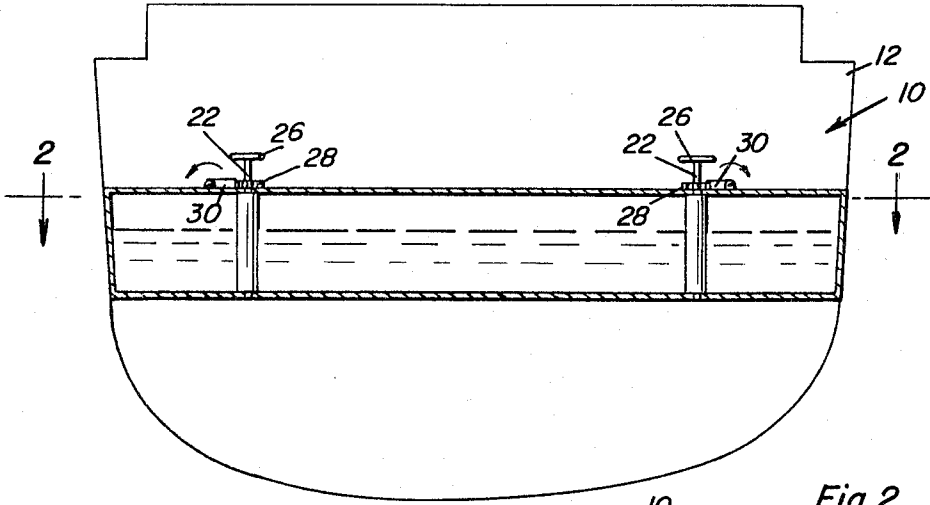


Fig. 2

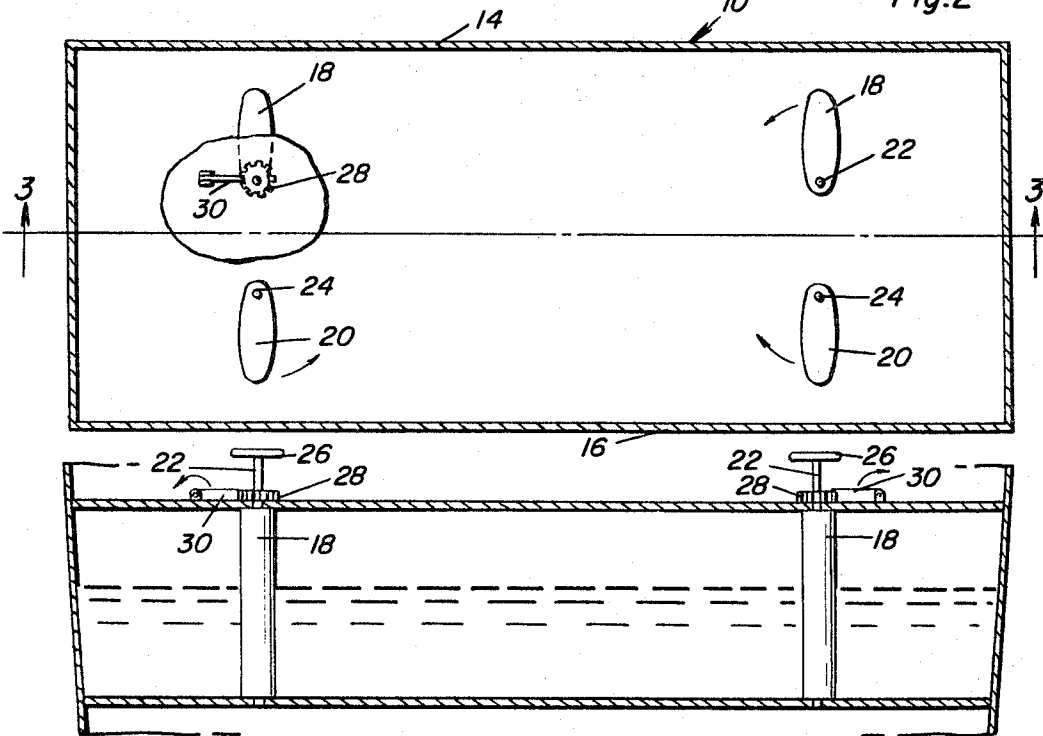


Fig. 3

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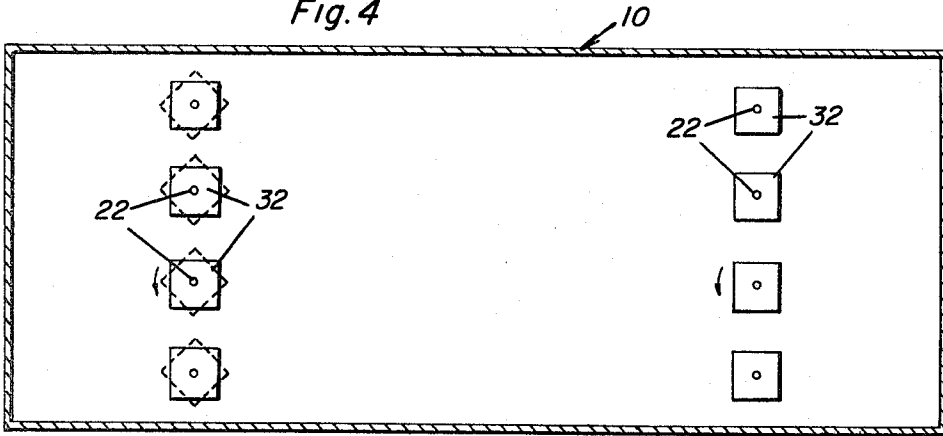
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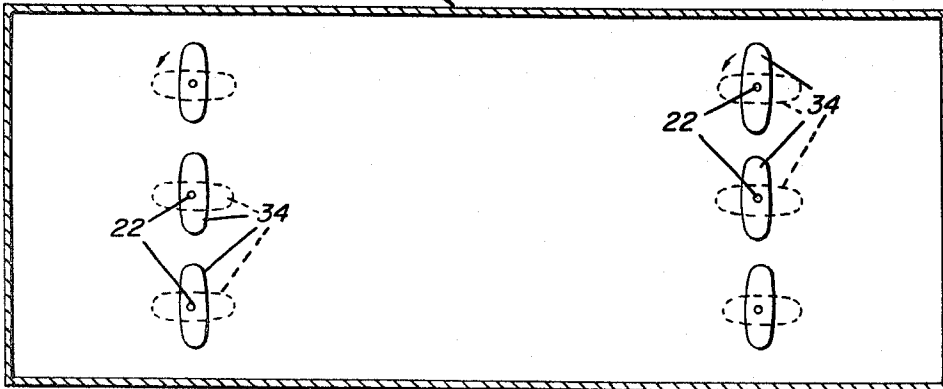
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Fig. 4



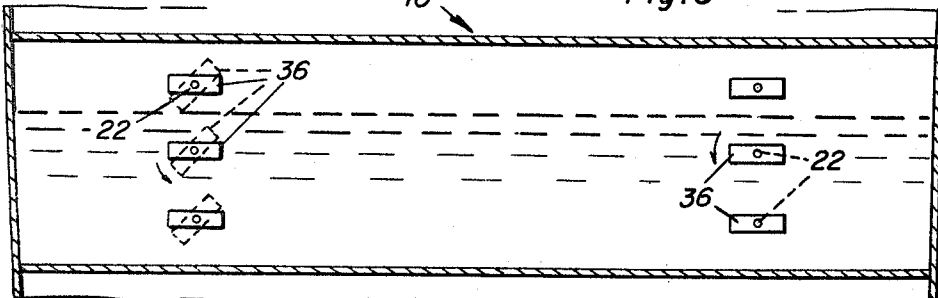
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Fig. 5



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Fig. 6



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SHIP STABILIZER

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10 Claims. (Cl. 114—125)

ABSTRACT OF THE DISCLOSURE

A passive tank stabilizer housing a liquid body in a free surface condition at all times and having a geometry so as to impart substantially no internal damping to liquid passage. The tank damping coefficient is variable by means of adjustable damping members arranged to define two wing tanks and an interconnecting channel within the tank. The damping members can be rotated and locked in different angular positions to vary the cross section available for liquid passage so as to adjust the tank damping coefficient to an optimum value according to the conditions of the tank and the ship at sea.

The present invention relates to a passive ship stabilizer and more particularly to an improved stabilizer of the open channel type having selectively movable members or gates the angular positions of which control the amount of damping imparted to the transferring liquid within the tank.

It is an object of the present invention to provide an elongated tank mounted across the hull of a ship with one or more elongated members rotatably mounted near opposite ends of the tank and means for rotating said one or more members thereby changing the effective cross-sectional area of the tank in the region of said members.

One embodiment of the present invention comprises a pair of gates extending vertically and eccentrically mounted on rotating axes. The gates are aligned across the tank and are mutually movable between a first position in which they are aligned in the fore and aft direction and a second position in which they extend parallel to the longitudinal axis of the tank. Mechanical means are provided to rotate the gates and lock the same in any angular position between said first and second positions.

Another embodiment of the present invention comprises a plurality of elongated bars having rectangular or square cross sections and each mounted vertically on a rotating axis. Each of two sets of these bars are aligned across the tank near an end thereof, and are spaced from each other to define a plurality of passageways therebetween. The cross-sectional area of each passageway is selectively varied by changing the angular position of the bars. An alternate arrangement comprises the use of elongated plates having rounded edges in lieu of the bars with rectangular profiles.

Still another embodiment of the present invention comprises two sets of elongated members spaced from opposite ends of the tank, each member being mounted on a rotating axis. In this embodiment, the members are spaced vertically from each other with the axes of rotation being horizontally arranged in the fore and aft direction.

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 diagrammatic illustration of a ver-

tical transverse section of a ship with the stabilizer according to the present invention mounted therein.

FIGURE 2 is a horizontal section of the tank taken along line 2—2 of FIGURE 1 and showing one embodiment of the invention.

FIGURE 3 is a vertical longitudinal section of the tank taken along line 3—3 of FIGURE 2.

FIGURE 4 is a horizontal section illustrating another embodiment of the present invention.

FIGURE 5 is a horizontal section of yet another embodiment of the present invention.

FIGURE 6 is a vertical longitudinal section of the tank of still another embodiment of the present invention.

With reference to the drawings in detail, stabilizer 10, according to the present invention, is mounted across the hull 12 of a ship. The longitudinal axis of tank 10 is mounted in a plane perpendicular to the roll axis of the ship. In a preferred embodiment, the top and bottom of tank 10 comprises two spaced existing decks of the ship and the ends of tank 12 comprise the sides of hull 12. A pair of transverse bulkheads 14 and 16 are mounted between the decks and extend from one side of the hull to the other to form the enclosed tank. All seams are welded so as to present a watertight enclosure.

With reference to FIGURES 2 and 3, a pair of elongated gates 18 and 20 are provided in tank 10 at locations spaced from each end of tank 10. Each gate has an elliptical or oval cross section and extends vertically from the top to the bottom of tank 10 and is eccentrically mounted to a vertical shaft 22 and 24 which is journaled or otherwise retained in the top and bottom of the tank. Shafts 22 and 24 are spaced near and equal distance from the longitudinal center axis of tank 10 and are aligned in the fore and aft direction. Gates 18 and 20 have their inner edges connected to shafts 22 and 24 so that the free edges of the gates extend away from the center axis of the tank. If desired, each pair of shafts or all shafts can be mechanically ganged so that the gates move together and assume equal relative positions.

As better seen in FIGURE 3, shafts 22 and 24 extend above the top of tank 10. A manual or mechanically operated member such as hand wheel 26 or the like is connected to shaft 22. Any suitable locking means is provided to retain shaft 22 in any desired angular position, relative to tank 10. For example, gear 28 is fitted to shaft 22 and finger 30 is rotatably mounted on the top of tank 10. Finger 30 locks shaft 22 when it engages the teeth of gear 28. However, when the shaft 22 is to be turned, finger 30 is rotated up and out of engagement with gear 28 so that the new angular setting of shaft 22 can be made.

Gates 18 and 20 are rotatable between a first position in which they are aligned fore and aft and a second position in which they are parallel to the longitudinal axis of tank 10. In the first position, gates 18 and 20 cooperate with the walls of tank 10 and with each other to form restricted passageways in the tank. With gates 18 and 20 in this position, a relatively high damping coefficient exists within tank 10, whereas, when gates 18 and 20 are in the second position a relatively low damping coefficient is provided. Advantageously, the damping coefficient can be suitably changed by rotating gates 18 and 20 to any angular position between said first and second positions.

In operation, tank 10 is partially filled with a body of liquid so that an air space exists above the liquid throughout the length of the tank. The height of the liquid, and therefore, the mass is selected so that the natural frequen-

cy of liquid oscillation is equal to the natural roll frequency of the ship. If the conditions of the ship change, such as having its freight unloaded, the liquid level in tank 10 can be changed so that the roll frequency and the liquid oscillation frequency remain the same. Any suitable liquid such as sea water, bunker oil, fuel, fresh water, or the like, can be used as the stabilizing medium. If desired, heavy density liquid and liquid-solid suspensions can be used as the stabilizing medium.

The amplitude of liquid oscillation and consequently the magnitude and phase of the stabilizing movement imparted to the ship is related to the coefficient of damping within tank 10. This coefficient is adjusted by setting gates 18 and 20 at predetermined angular positions relative to tank 10. For example, if a high coefficient of damping is desired, gates 18 and 20 are set and locked in the aligned fore and aft position so as to present the smallest effective passageway between the end portion and the center portion of the tank. If a lower coefficient of damping is required so that less damping takes place during one cycle of roll, gates 18 and 20 are rotated either clockwise or counterclockwise toward a position in which they are parallel to the longitudinal axis of the ship.

Once the setting has been made to gates 18 and 20 they are locked in position by rotation of fingers 30 into engagement with gears 28 on shafts 22. As the forces of the sea cause the ship to roll the liquid body in tank 10 transfers from one end thereof toward the other so as to part a stabilizing moment to the ship in opposition to the roll thereof. For optimum results a 90° phase lag should be maintained between the liquid body oscillation and the roll of the ship.

Referring to FIGURE 4 where like characters refer to like structures, an alternate arrangement is illustrated in lieu of gates 18 and 20. Specifically, elongated members 32 extend from the bottom to the top of tank 10 and each are mounted to a rotating shaft 22. Each member 32 has a square cross section. Members 32 are aligned in the fore and aft direction and are spaced from the walls of tank 10 to form a plurality of passageways therebetween. Each member is rotatable on its axis 22 so that the effective cross-sectional area of the passageways therebetween can be selectively changed in the manner described above. It can be seen that when the sides of members 32 are perpendicularly arranged with the walls of tank 10, the passageways have a maximum cross-sectional area. However, when members 32 are rotated 45° and locked as described above, the effective cross-sectional area of each passageway is decreased. Again, members 32 can be rotated and locked at any angular position between the first and second positions.

FIGURE 5 illustrates another embodiment of the present invention, wherein elongated upstanding plates 34 are secured to vertical rotating shafts 22 as described above. Plates 34 are spaced from each other in the walls of tank 10, and are aligned in the fore and aft direction. Each plate 32 has a cross section with its width greater than its thickness. Preferably, the edges of plates 34 are rounded, but can be squared off if desired. In one example, each plate 34 is symmetrically mounted on its shaft 22. When the width of each plate 34 is directed in the fore and aft direction, the effective cross-sectional area therebetween is at a minimum, and when the width of each plate 34 extends in the longitudinal direction of tank 10, the passageways have a maximum cross-sectional area. As in the above embodiments, plates 34 can be secured at any angular position between the two above-mentioned positions.

Yet another arrangement of the present invention is illustrated in FIGURE 6 wherein elongated members 36 are each mounted to a rotatable shaft 22, and wherein members 36 and shafts 22 extend horizontally in the fore and aft direction. Each member 36 is spaced from the other members and from the top and bottom of tank 10 and are aligned in the vertical direction. Thus, members

36 form with tank 10 a plurality of horizontally extending passageways through which the liquid body transfers. Preferably, some of the members 36 are located above the static liquid level and some of the members 36 are located below the static liquid level.

Each member 36 has a rectangular cross section so that the cross-sectional areas of the passageways is selectively changed when members 36 are rotated and locked in various angular positions relative to tank 10. The operation of the stabilizer shown in FIGURE 6 is the same as mentioned above, however, liquid transfer takes place through submerged and partially submerged horizontal openings near the ends of tank 10.

It should be understood that various modifications can be made to the herein disclosed present invention without departing from the spirit and scope thereof.

What is claimed is:

1. A passive stabilizer for a vessel comprising an elongated tank having its longitudinal axis positioned across the vessel and having a top, a bottom, two side walls and two ends, said tank having a generally rectangular cross section so as to impart insignificant damping to the tank liquid, a pair of elongated members each spaced from an opposite end of said tank and being spaced from each other so that said tank is divided into two end portions and an interconnecting portion, and means for rotatably mounting each said member to said tank and for locking during steady state operation each member in a selected one of a plurality of angular positions relative to said tank so as to adjust the damping imparted to the tank liquid during steady state operation, a body of liquid partially filling said tank such that an air space is defined throughout between the top surface of said liquid and the top of said tank, said tank liquid filled to a level such that the tank liquid oscillation is generally tuned to the ship's roll, and said liquid transferring from one end of said tank toward the other in response to the roll of said ship, each said member defining with said tank at least two passageways through which said liquid transfers, and each member having a cross-sectional profile such that the effective cross-sectional areas of said passageways are changed by changing the angular position of said member.

2. The stabilizer as set forth in claim 1, wherein said member extends upwardly and said means comprise an upward extending shaft mounted to each member to rotate the same in an arc about said shaft.

3. The stabilizer as set forth in claim 2, wherein said members comprise gates, each gate having a profile which is generally elliptical and each gate being eccentrically mounted to said shaft, each gate being movable between a position in which the long dimension of its profile is perpendicular to the longitudinal axis of said tank and a position in which the long dimension of its profile is parallel to the longitudinal axis of the tank.

4. The stabilizer as set forth in claim 3, wherein a pair of such plates and shafts are provided spaced from each end of said tank, said plates being aligned in the fore and aft direction and being spaced from each other and the side walls of said tank to define the passageways therebetween.

5. The stabilizer as set forth in claim 1, wherein a plurality of such members is provided, spaced from each end of said tank, said members being aligned in one of the fore and aft and upward directions and extending in the other of said directions, said members being spaced from each other to define a plurality of liquid passageways communicating with the adjacent end portion and interconnecting portion of the tank.

6. A stabilizer as set forth in claim 5, wherein said members have a rectangular cross-sectional profile.

7. The stabilizer as set forth in claim 6, wherein each said member has a square cross-sectional profile.

8. The stabilizer as set forth in claim 6, wherein each

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said member has a profile which is generally rectangular with rounded edges.

9. The stabilizer as set forth in claim 1, wherein a plurality of such members is provided spaced from each end of said tank and being spaced from each other and the top and bottom of said tank, and being upwardly aligned within the tank, each said member extending generally horizontally in the fore and aft direction, said members defining a plurality of passageways communicating with the adjacent outer and interconnecting portions of the tank, at least one of said members being arranged below the static liquid level so as to define at least one submerged horizontal passageway.

10. The stabilizer as set forth in claim 9, wherein at

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least one of said members is located above the static liquid level.

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