July 6, 1965 S. B. FIELD 3,192,888

COMBINATION STABILIZATION AND HEELING SYSTEM FOR ICE BREAKERS

Filed Sept. 19, 1963 2 Sheets-Sheet 1

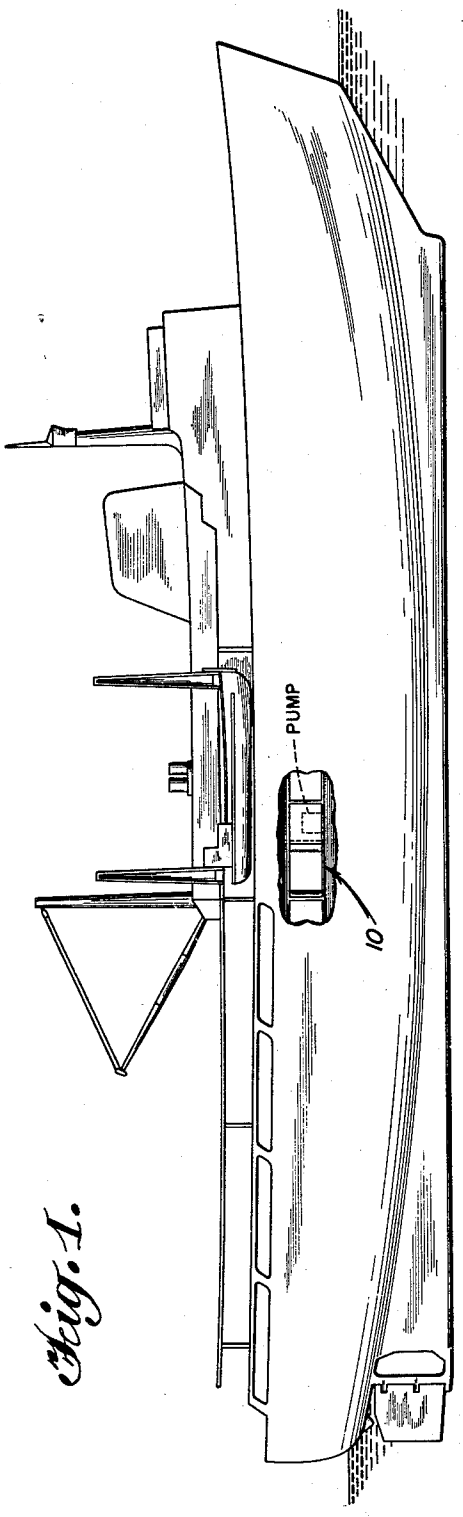


Fig. 1.

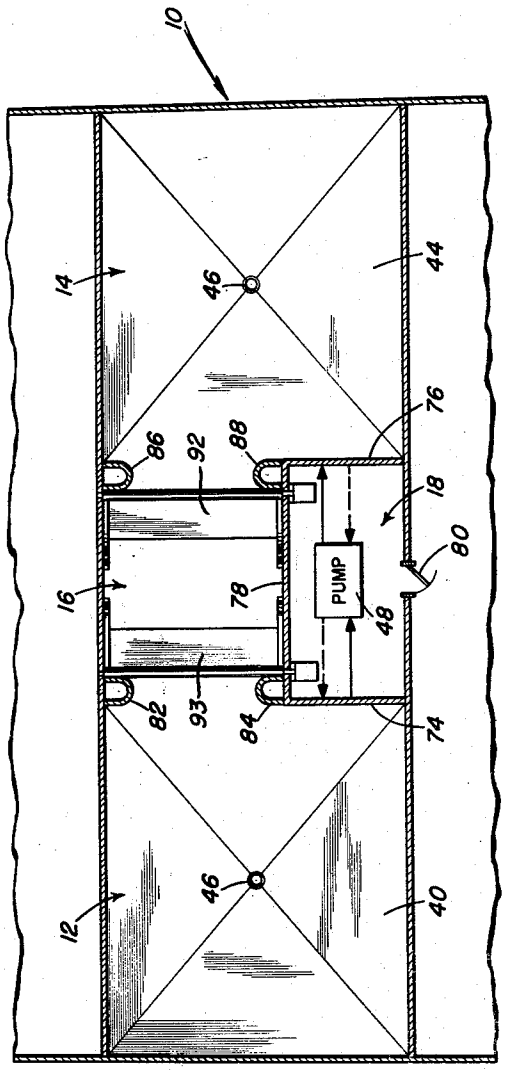


Fig. 2.

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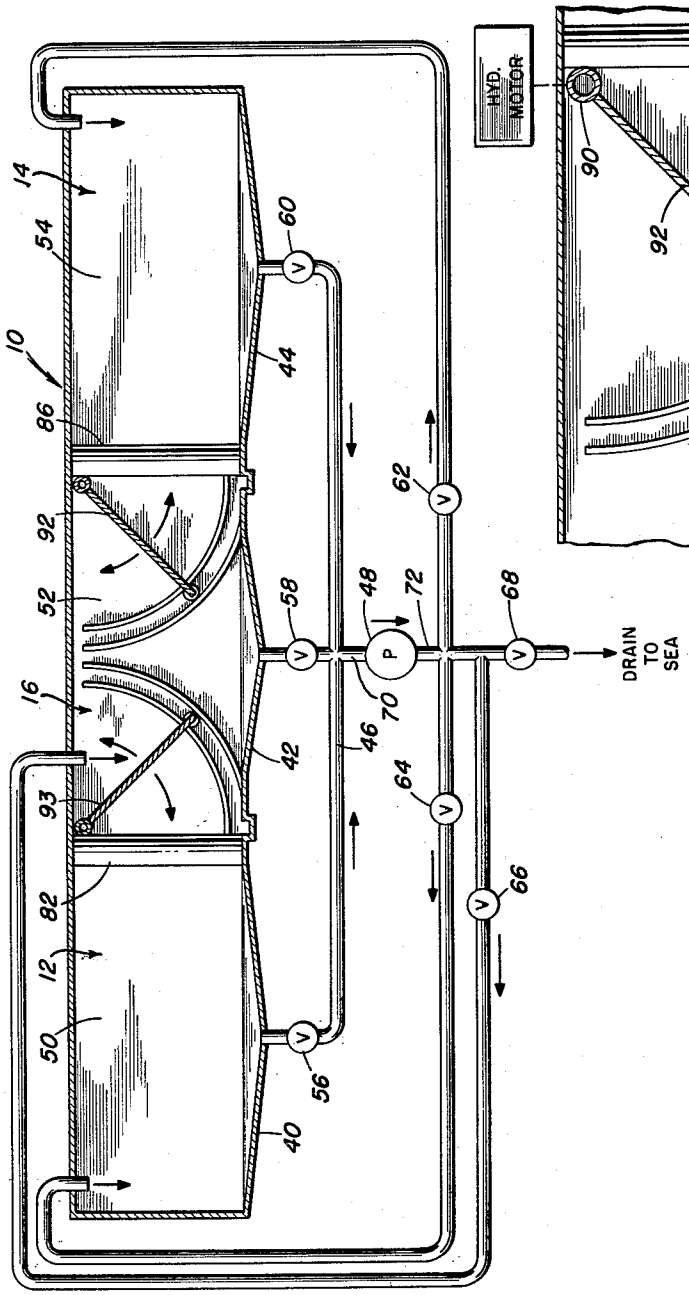


Fig. 3.

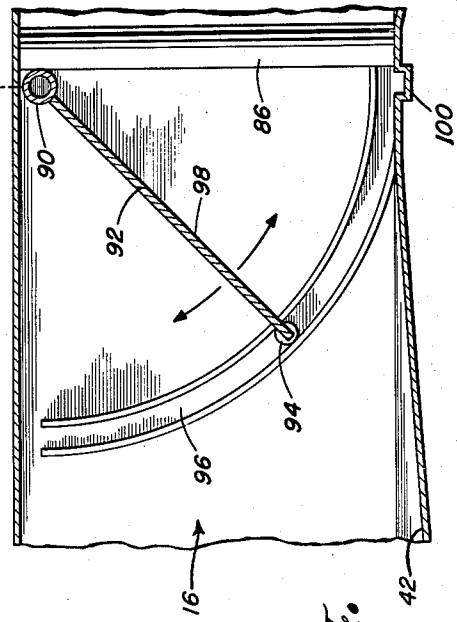


Fig. 4.

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United States Patent Office 3,192,888 Patented July 6, 1965

3,192,888

COMBINATION STABILIZATION AND HEELING SYSTEM FOR ICE BREAKERS

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Filed Sept. 19, 1963, Ser. No. 310,111
7 Claims. (Cl. 114—125)

The present invention relates to a combination ship stabilization and heeling system, and more particularly, to a system wherein transversely spaced tanks are utilized in cooperation with shutters or gates and pump means whereby the system can be adapted for operation as a passive stabilizer, active stabilizer or heeling tanks.

It is already known that vessel stabilization against rolling can be achieved through the use of passive stabilization systems incorporating various energy dissipation means inside the tanks. This is basically achieved in one form by establishing spaced liquid storage points athwart ship and interconnecting these points by use of crossover ducts in which energy dissipation means, such as nozzles are located. In ships designed for ice breaking duty, a very severe rolling action is often encountered in heavy seas due to the inherent design of the ship. At the same time, an ice breaking ship must be capable of heeling, that is, rolling or tilting deliberately to one side, to break itself free from ice. This is accomplished by designing the ship with a great metacentric height and a round bottom to facilitate heel by use of heeling tanks. These qualities, however, make the ship very unsteady in heavy seas, making it desirable to use a passive stabilization tank system such as that described in U.S. Patent No. 3,054,373. The invention of that patent dealt only with a passive tank stabilization system for an ice breaker; separate heeling tanks still had to be used. This produced an inherent loss of usable space, because two separate sets of tanks, that is, one for heeling purposes and one for stabilzation purposes, had to be installed in the ship.

In some instances it has been found desirable to implement the action of the stabilzation system by forcing the liquid to transfer between the tanks as a means to compensate for variations in the effectiveness of the system when operated simply in a passive condition. Such an adjustment can be accomplished by use of pump means to transfer the liquid from one tank to the other at a rate greater than that which would occur if only the force of gravity were relied upon. The same pump means, which is used for transferring liquid during a period when an active stabilization system is required, can also be used to transfer liquids from one wing tank to the other when the tank is being used as a heeling tank. Thus, the pump means serves a dual purpose, for both heeling tank operation and for active stabilization operation.

The single tank system of this invention may be used for three different purposes—a conventional passive stabilization system, a heeling tank system by closing shutters or valves between the various segments of the tanks and pumping water between the tanks to cause deliberate heeling, and an active stabilization system to transfer liquid back and forth between the stabilization tanks in aid or in lieu of natural gravity gravity flow.

It is therefore, an object of this invention to provide a multipurpose, novel stabilization system for ships as defined in the preceding paragraph.

It is a further object of the present invention to provide a ship stabilization system which utilizes a single set of tanks which can be adapted to function as integral parts of a passive stabilizer, a heeling tank system, and an active, stabilizer.

Other objects and advantages of the present invention

will become readily apparent from the following detailed description of a specific embodiment of the present invention when taken in conjunction with the appended drawings in which:

FIG. 1 is a side view of a ship partially broken away showing the present invention installed therein;

FIG. 2 is a top view in section of the present invention;

FIG. 3 is a side view partially in section showing schematic diagram of the piping of the present invention;

FIG. 4 is a sectional side view of the gate of the present invention.

Referring now to the drawings in greater detail, FIG. 1 shows one possible location of the present invention, generally indicated as **10**, mounted between two decks of a ship and FIG. 2 shows a top view of the tank system of this invention which has been placed transversely across the ship, preferably at a point near its center and includes a pair of wing tanks **12** and **14** disposed at opposite sides of the ship. A crossover duct **16**, narrower than either of the two wing tanks, is interposed between the wing tanks and interconnects them. Alongside this crossover duct, also interposed between the wing tanks is a pump compartment **18** containing pump **48**, valves **56** thru **68** and conduits **70** and **72**. This compartment is completely water-tight and separated from wing tanks and crossover duct by appropriate bulkheads **74**, **76** and **78** and is accessible from the outside through panel **80** for servicing of the machinery contained therein.

Along the vertical edges of the opening between each wing tank and the crossover duct are tubular half-round projections **82** thru **88** which serve as energy dissipation means with respect to water passing therebetween. Thus, when the ship rolls to the port side, wing tank **12** will be lowered and tend to fill with water being transferred by gravity from wing tank **14** through crossover duct **16**, as the tank system functions as a passive stabilizer.

Referring now to FIG. 4 which shows the details of drop-leaf gate **92**. It can be seen that this gate is opened and closed by means of a power operated hinge **90** with which a screw jack coacts to obtain a positive lock. This hinge is available as a standard piece of marine hardware manufactured in the United States under license from the Gotaverken Engineering Co. of Sweden and sold under the tradename Hydratorque Hinge. The hinge comprises a small hydraulic torque motor coupled to actuate one part of a hinge mechanism. The outer end of the gate **92** is equipped with a roller guide **94** which rides on track **96** to insure correct alignment while being rotated. In its extreme upward position the drop-leaf gate **92** lies in a horizontal plane directly above crossover duct **16** and is held in this horizontal position by a latch means. When the Hydratorque Hinge is operated, the gate rotates to its closed position, the inner face **98** of the gate being brought in contact with the outside edges of the tubular projections **86** and the roller guide **94** comes to rest in slot or recess **100** to secure the gate in place. A gasket of rubber or like material may be interposed between the face of the gate and the edge of the nozzle to form a more water-tight seal. Although the operation of only one of these gates has been explained in detail, it is to be understood that the other gate **93** is of the same construction and operates in like fashion. Although, in this particular illustration, the use of two gates has been shown to divide the tank into three separate compartments, a single gate can be used placed at or near the center of the crossover duct in order to divide the tank into two compartments.

The operation of the pump and valve system can best be understood through reference to FIG. 3 which shows the tank system partially in section. It will be noted that the bottom walls **40**, **42** and **44** of each section of the tank are slightly inclined towards the outlet of drain pipe **46**, which connects to pump **48**, in order to insure that

each section of the tank may be completely drained when the proper valve is opened. If it were desired to operate the tank system of this invention as a heeling type system, gates **92** and **93** would first be closed as previously described. If it is then desired to cause the vessel to heel to starboard, valves **56** and **58** would first be opened and valve **60** would be closed so that pump **48**, when operated, would cause tanks **50** and **52** to drain. Valve **62** would then be opened while the remaining valves on the pump discharge line **72**, namely, valves **64**, **66** and **68**, would remain closed, thus, as the pump was operated, tanks **50** and **52** would be empty and tank **54** would be filled causing the port side of the ship to lighten and the starboard side of the ship to become heavier, thus, resulting in the ship heeling to the starboard. By reversing the above operation, it would be possible to empty tank **54** and fill tank **50** causing the vessel to heel to port.

If it is desired to operate the tank of this invention as an active stabilization system, gates **93** and **94** could be open and held open by their respective latch mechanism as previously described or could be closed and the valve **58** would normally be left closed. Valves on the opposite side of the ship with corresponding functions would normally be operated at the same time but in a reverse direction. That is, in one condition when drain valve **56** were opened then drain valve **60** would be closed, while at the same time the supply valve **62** would be opened and supply valve **64** would be closed and water would be pumped into tank **54**. In the other condition, the position of these valves would be reversed with drain valve **60** being opened and drain valve **56** being closed at the same time that the supply valve **66** were opened and supply valve **62** were closed and water would be pumped into tank **50**. Thus, it would be possible through the manipulation of these four valves to control the flow of water from one wing tank to the other, effecting a corresponding stabilizing effect over the rolling motion of the ship. Drain valve **68** is connected on a line which discharges directly into the open sea and is opened only in case of emergency, such as when the ship is damaged. It is to be understood that each of these valves would be of a type that could be readily operated from a central remote control station, such as the engineer's control board or the bridge of the ship. Such valves could be electrically, pneumatically or hydraulically operated, and it is contemplated that they could be connected to a central automatic control system that is responsive to the movements of the ship so that the valves could be automatically opened and closed under ordinary running conditions without manual supervision.

Although the invention has been shown and described in terms of specific preferred embodiments, it will be appreciated that various changes and modifications will occur to those skilled in the art from a knowledge of the teachings of the present invention. Such changes as are obvious are deemed to come within the purview of the invention.

What is claimed is:

1. The combination of a vessel and a tank system therefor comprising an elongated enclosure transversely positioned in the vessel, wall means compartmenting said enclosure to define a wing tank on each end of said enclosure and an interconnecting central compartment, means within said tank means to dissipate energy from liquid moving longitudinally in said tank means, a pair of gate means mounted for movement between a first position in which the gate means divides the interior of said tank means into three compartments and a second position in which the gate means leaves the interior substantially unobstructed, and means to actuate said gate means and move same between said first position and said second position, pump means, first valve means connected to said pump means for enabling said pump means to draw liquid from one or any combination of each said wing tank and said central compartment, and second valve means connected to said pump means for enabling said pump means to deliver liquid to one or any combination of each said wing tank and said central compartment.

2. The device of claim **1** wherein said means within said tank means to dissipate energy comprises restricted vertically elongated openings communicating said wing tanks and said central compartment with the openings being shaped to cause substantial jet loss of head from liquid passing therethrough.

3. The combination of claim **2** wherein the edges of said vertically elongated openings are rounded.

4. The combination of a vessel and a tank system therefor comprising an elongated enclosure transversely positioned in the vessel, wall means compartmenting said enclosure to define a wing tank on each end of said enclosure and an interconnecting central compartment, means within said tank means to dissipate energy from liquid moving longitudinally in said tank means, a pair of gates pivotally mounted and extending across said enclosure to divide said enclosure into three compartments and means to actuate said gates, pump means, first valve means connected to said pump means for enabling said pump means to draw liquid from one or any combination of each said wing tank and said central compartment, and second valve means connected to said pump means for enabling said pump means to deliver liquid to one or any combination of each said wing tank and said central compartment.

5. The device of claim **4** wherein said pump means is mounted between said wing tanks adjacent said central compartment.

6. The device of claim **5** wherein said means within said tank means to dissipate energy comprises restricted vertically elongated openings communicating said wing tanks and said central compartment with the openings being shaped to cause substantial jet loss of head from liquid passing therethrough.

7. The combination of claim **6** wherein the edges of said vertically elongated openings are rounded.

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