May 13, 1952 W. R. LAURENSON 2,596,417

FLOODING CONTROL FOR SHIPS

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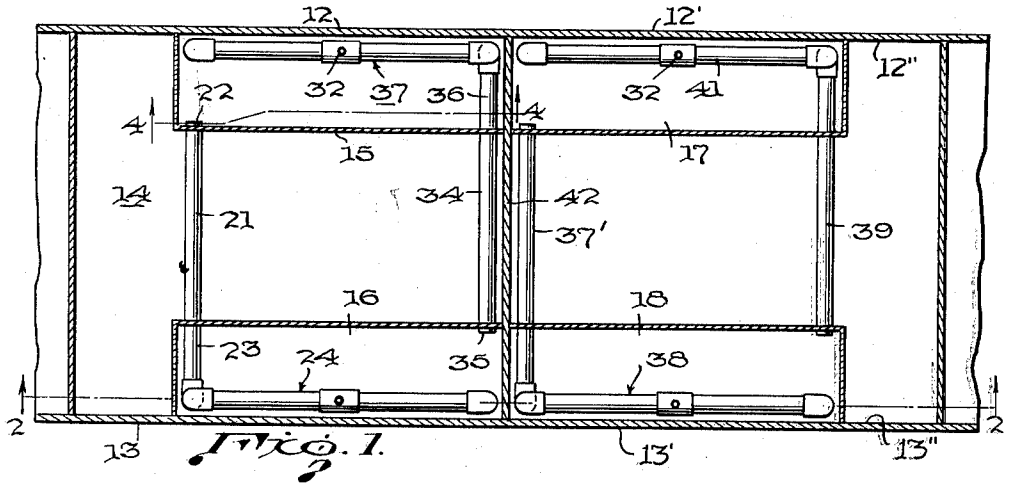


Fig. 1.

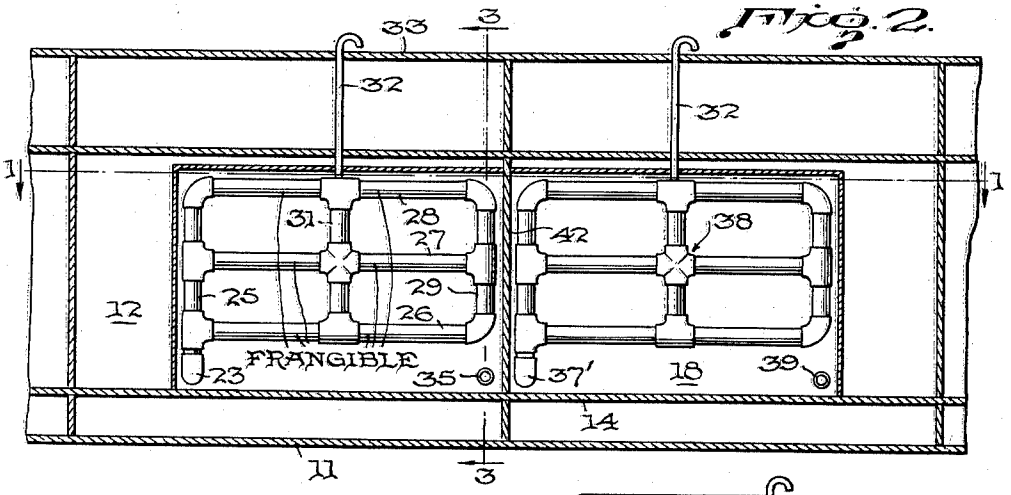


Fig. 2.

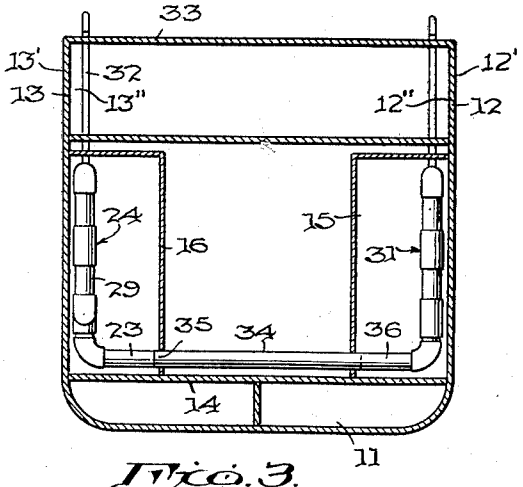


Fig. 3.

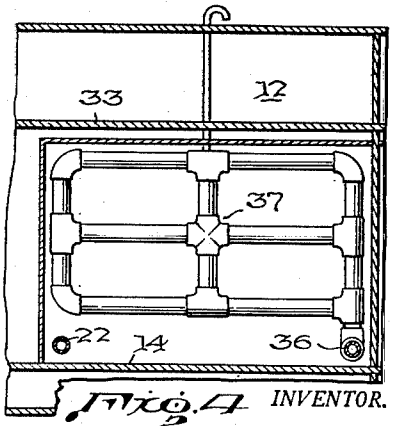


Fig. 4.

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FLOODING CONTROL FOR SHIPS

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9 Claims. (Cl. 114—125)

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This invention relates to flooding control apparatus for ships and particularly concerns damage activated apparatus for interconnecting the side tanks on opposite sides of a ship upon damage to a tank on either side.

Fuel oil, liquid cargo, sea water ballast, or fresh water are often carried in side or wing tanks along each side of the ship's hull. As is well known, the metacentric height of a ship suffers a "free surface loss" when liquid is free to move in a tank. When the tank is unconnected to any outside source so the liquid is confined to the tank, the "free surface loss" is a linear function of the moment of inertia of the area of the liquid surface about an axis through its own center of area.

Should two or more tanks be interconnected, the "free surface loss" becomes a linear function of the moment of inertia of the aggregate area of the liquid surface in the interconnected tanks about an axis through the center of all surfaces combined and considered as a single area, though in their respective positions. To minimize the "free surface loss" to the metacentric height, it is desirable to isolate each tank and prevent entrance or egress of liquid in the individual tanks.

In case a vessel suffers collision, torpedo, or other damage to one or more of its side tanks, the flooding of sea water into the tank or the loss of liquid from the tank will cause the vessel to assume an angle of heel which is dependent upon the stability of the vessel involved. For purposes of stability, the side tanks are customarily cross-connected in pairs arranged symmetrically or nearly symmetrically on opposite sides of the ship. Under normal conditions, valves in the cross-connections are closed to isolate each tank. Should a tank be damaged, the valve may be opened to interconnect the damaged tank with its counterpart on the opposite side of the ship, so excessive heel of the ship is prevented.

Provided the damaged tank can be identified and the proper valve quickly opened, the present system is satisfactory. However, delay in ascertaining the location of the damaged tank and in opening the valve endangers the ship. Should the wrong valve be opened, so an undamaged pair of tanks are interconnected, the increase in the "free surface loss" to the metacentric height aggravates the unstable condition caused by the damage. Then, the vessel will heel at a greater angle rather than right itself.

It is a major object of this invention to minimize the heeling of the ship as a result of damage

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to a side tank by automatically connecting the damaged tank to the other side tank of a symmetrical pair. More particularly, an object of this invention is to provide a system activated by the damaging force to interconnect the pair of tanks when one of the pair is damaged.

In accordance with these objects, one important feature of the invention resides in the arrangement of damage activatable means in a side tank adjacent the outer wall thereof to open the normally closed cross-connection between the tanks of a pair. Another feature resides in the arrangement in each tank of means to open the normally closed cross connection in response to a force rupturing either tank of a pair.

Other objects and advantages will become apparent from the following specification taken in connection with the accompanying drawings, wherein

Figure 1 is a horizontal sectional view through a portion of the hull of a ship in which a preferred form of the invention is installed, which section is taken below the main deck as indicated by the line 1—1 in Fig. 2;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken on the line 3—3 of Fig. 2; and

Fig. 4 is a partial vertical sectional view taken on the line 4—4 of Fig. 1.

In the drawings, the hull of the ship is illustrated as having a bottom 11, and side walls 12 and 13 running longitudinally of the hull. Outer surfaces 12' and 13' of side walls 12 and 13, respectively, form the exposed outer shell of the ship. On floor 14 of the hold there are supported a plurality of side or wing tanks such as the tanks 15, 16, 17 and 18. These side tanks have their outer walls adjacent the exposed outer shell of the ship. As illustrated, the outer walls of the tanks 15 and 17 are formed by inner surface 12'' of the side 12 whereas the outer walls of the tanks 16 and 18 are formed by inner surface 13'' of the side 13.

As previously explained, liquid fuel, cargo or ballast is usually carried in these side tanks and the tanks are usually cross-connected in pairs, with one tank of each pair on either side of the ship. While the tanks of a pair are usually diametrically opposite each other, this arrangement is not essential.

In the preferred form of my invention, as illustrated in the drawings, a first steel pipe 21 has one end 22 opening into the tank 15. The other

end 23 of the pipe 21 extends into the tank 16 and is closed by a closed network 24 of frangible pipes within the tank 16 and adjacent the outer wall of the tank 16. The steel interconnecting pipe 21 is positioned as near to the bottom of the tanks as possible. The network or grid 24 is preferably composed of cast iron pipes, although pipes of other frangible material may be used.

This network 24 of frangible pipes may include a riser 25 connected to the end 23 of the steel pipe 21 and extending upwardly adjacent the outer wall of tank 16. Connected to the riser 25 and extending horizontally therefrom are a number of horizontal pipes extending along the outer wall of the tank 16. As illustrated, these horizontal pipes 26, 27 and 28 each have one end connected to riser 25 and their other end closed by a vertical pipe 29. If desired, the central portions of the three horizontal pipes may be interconnected by a vertical pipe 31. In order that liquid in the closed network 24 will assume the same level as liquid in the tank 15, a vent 32 is connected to the upper horizontal pipe 28 and extends upwardly above deck 33.

With this arrangement, a force rupturing the outer wall of tank 16 will also break one or more of the frangible pipes in the closed network 24. Immediately, the tanks 15 and 16 will be interconnected so the liquid in tank 15 will assume the same level as the liquid in the damaged tank 16.

Similarly, a steel interconnecting pipe 34 has one end 35 opening into tank 16 and its other end 36 extending into tank 15. End 36 is closed by a closed network 37 of frangible pipes arranged adjacent the outer wall of tank 15 in the same way that the pipes of network 24 are arranged in tank 16. It will be noted that the networks 24 and 37 extend almost the entire length of their respective tanks so damage at any point will rupture some part of the network. Also, the horizontal pipes are spaced vertically over the area of likely damage. The vertical pipes are spaced horizontally so they would be broken should the damaging force strike between two horizontal pipes. Of course, the number of horizontal and vertical pipes may be changed according to the dimensions of the outer walls of the tank in which they are located.

Each pair of tanks is connected in similar fashion. For example, steel interconnecting pipe 37' has one end opening into tank 17 and its other end extending into tank 18 where it is closed by a closed network 38 of frangible pipes arranged adjacent the outer wall of the tank 18. Steel interconnecting pipe 39 has one end opening into tank 18 and its other end closed by network 41 of frangible pipes adjacent the outer wall of the tank 17.

Wherever the ship may be damaged, the damaging force itself activates interconnecting means so all damaged tanks are connected to the other tanks of their respective pairs. For example, should a damaging force strike exposed surface 12' of wall 12 in the area of bulkhead 42 and damage both tanks 15 and 17, at least one of the frangible pipes in each of the networks 37 and 41 would be broken by the damaging force. As a result tanks 15 and 16 would be interconnected through pipe 34 and tanks 17 and 18 would be connected through pipe 39. A substantially constant liquid level is thus maintained in the tanks of each pair, so there is very little, if any, tendency of the ship to heel.

From the foregoing description it will be apparent that a normally closed interconnecting pipe extends between the tanks of a pair and that damage activated means adjacent the outer wall of the tank is responsive to the damaging force to immediately open the interconnecting pipe for the damaged tank without opening the interconnecting pipe of any other pair.

What is claimed is:

1. In a ship, a damage-activated flooding control system comprising a pair of side tanks, one on either side of the ship, a pipe interconnecting said tanks, and means normally closing said pipe including an element adjacent the outer wall of one of said tanks responsive to a force rupturing said outer wall for opening said pipe.

2. In a ship, a damage-activated flooding control system comprising a pair of side tanks, one on either side of the ship, pipe means interconnecting said tanks, and means normally closing said pipe means including elements adjacent the outer walls of both tanks responsive to a force rupturing the outer walls of the respective tanks for opening said pipe means.

3. In a ship having a pair of side tanks, one on either side of the ship, damage-activated flooding control apparatus comprising pipe means interconnecting said tanks, and frangible means adjacent the outer wall of one of said tanks normally closing said pipe means and responsive to a force rupturing said outer wall to open said pipe means.

4. In a ship having a pair of side tanks, one on either side of the ship, damage-activated flooding control apparatus comprising a pipe interconnecting said tanks, and a frangible device adjacent the outer wall of one of said tanks closing said pipe from said one tank.

5. In a ship, damage-activated flooding control apparatus comprising a pair of side tanks, one on either side of the ship, and a pipe extending between said tanks, one end of said pipe opening into one of said tanks, the other end of said pipe being closed from the other tank by a frangible device in said other tank positioned adjacent the outer wall thereof.

6. In a ship having a pair of side tanks, one on either side of the ship, damage-activated flooding control apparatus comprising a closed network of frangible pipe sections in one of said tanks adjacent the outer wall thereof, and a pipe extending between said tanks, one end of said pipe being connected to said network and the other end thereof opening into the other of said tanks.

7. In a ship having a pair of side tanks, one on either side of the ship, damage-activated flooding control apparatus comprising a pair of pipes interconnecting said tanks, and a frangible device in each tank adjacent the outer wall thereof, the frangible device in one tank closing one end of one pipe from said one tank, and the frangible device in the other tank closing one end of the other pipe from said other tank.

8. In a ship having a pair of side tanks, one on either side of the ship, damage-activated flooding control apparatus comprising a first pipe extending between said tanks, one end of said first pipe opening into one of said tanks, a frangible device in the other tank adjacent the outer wall thereof closing the other end of said first pipe, a second pipe extending between said tanks, one end of said second pipe opening into said other tank, and a frangible device in said one tank adjacent the outer wall thereof closing the other end of said second pipe.

9. In a ship having a pair of side tanks, one

on either side of the ship, damage-activated flooding control apparatus comprising a first pipe extending between said tanks, one end of said first pipe opening into one of said tanks, a closed network of frangible pipes in the other of said tanks adjacent the outer wall thereof connected to the other end of said first pipe, a second pipe extending between said tanks, one end of said second pipe opening into the other of said tanks, and a closed network of frangible pipes in said one tank adjacent the outer wall thereof connected to the other end of said second pipe.

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