Fig. 4

Fig. 6
MOVING WEIGHT STABILIZERS FOR FLOATING BODIES

Philip Henry Tanner and Terence Reginald Forbes Nonweiler, Glasgow, Scotland, assignors to Vosper Limited, Paulsgrove, Portsmouth, Hampshire, England, a British company

Filed Jan. 8, 1968, Ser. No. 696,294
Claims priority, application Great Britain, Jan. 13, 1967, 1,944/67
9 Claims. (Cl. 114—124)

ABSTRACT OF THE DISCLOSURE

A moving weight stabilizer for a floating body comprises generally horizontally disposed tubular means extending across the floating body and weight means mounted for reciprocation through the tubular means. The tubular means is filled with the liquid medium in which the body is to float and which is alternately drawn in and forced out at the two ends respectively as the weight means is reciprocated. A valve means dissipates the energy of the weight which is transferred to the liquid medium in the form of a pressure increase the liquid medium being forced out from the ends of the tubular means. A discharge means is provided to the floating medium for the thus heated liquid and replenishing means for supplying fresh liquid from the floating medium to replace the expelled liquid.

This invention relates to weight stabilizers for floating bodies.

The invention consists in a moving weight stabilizer for a floating body comprising generally horizontally disposed tubular means extending across the floating body and weight means mounted for reciprocation through the tubular means, the tubular means being filled with the liquid medium in which the body is to float and which is alternately drawn in and forced out at the two ends respectively as the weight means is reciprocated, valve means for dissipating the energy of the weight which is transferred to the liquid medium in the form of a pressure increase the liquid medium being forced out from the ends of the tubular means, discharge means to the floating medium for the thus heated liquid and replenishing means for supplying fresh liquid from the floating medium to replace the expelled liquid.

Preferably a roll or pitch sensing device is provided for the floating body and means operated from the roll or pitch sensing device for braking the movement of the weight means. In this way both the amplitude of oscillation and the period of oscillation of the weight means can be controlled.

The tubular means may be connected to the floating medium at each end. Alternatively the two ends of the tubular means may be joined by further tubular means filled with the liquid medium.

Conveniently the braking is effected by controlling the fluid flow.

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

FIGURE 1 is a cross-section of a ship in which the stabilizer according to the invention is installed.

FIGURE 2 is an enlarged and more detailed view of one end of the weight means shown in FIGURE 1.

FIGURE 3 is an end view of the part shown in FIGURE 2.

FIGURE 4 is a diagrammatic showing of the control system.

FIGURE 5 is a cross-section of a ship in which a modified form of the stabilizer according to the invention is installed.

FIGURE 6 is a diagrammatic showing of the control system for the FIGURE 5 embodiment.

In the drawings, across the hull of the vessel 1 extends a glass fibre reinforced plastic tube 2 of any convenient cross-section such as circular or square and lined with an epoxy composition so as to provide a good clearance for a weight 3 which may be of lead filling a steel casing.

The weight 3 runs in the tube by way of reinforced phenolic wheels 4 suitably mounted at each end.

Centrally of each end of the weight is a steel tube 5 in the form of a mandrel screwed into the end for a purpose to be described.

The respective ends of the tube 2 are closed by end plates 6 from the centre of the inner side of which projects a mandrel 7 into which the tube 5 is a tight fit.

From adjacent the ends of tube 2 there are pipes 8 which extend down the side of the hull 1 through a one-way valve 9 to a shut-down valve 10, normally open but which may be sealed adjacent the keel 11 of the ship or elsewhere.

A short distance inboard of the junction of pipes 8 and tube 2 there are further pipes 12, one on each side, extending vertically downward from tube 2 through a control valve 13 adapted to be controlled in a manner to be described to join with pipe 8 below the one-way valve 9.

There is also a short pipe on each side connecting the pipes 8 and 12 through a relief valve 14.

FIGURE 4 shows the arrangement for controlling the valve 13. Thus there is shown a stabilizer control 15 which can be of the well known usual type and which operates to control the diaphragm 13a of valve 13.

The actual operation of the valve 13 is effected by air pressure which is arranged to control the pipe fluid pressure in advance of the weight to be 20 lb./sq. in. (or any other convenient pressure) and which is supplied by means of a pressure control arrangement of suitable electronic circuitry operated from the line pressure under the influence of both of the stabilizer control 15 and the pipe pressure.

The stabilizer control 15 is controlled from the roll of the vessel, or a suitable combination of its derivatives. It may also be controlled from the position of the weight e and the velocity of the weight e means for determining these have not been shown but could be easily designed.

In operation the weight 3 reciprocates in tube 2 in response to the ship's roll. Water is drawn in behind the weight through valves 10 and 9; ahead of the weight pressure will build up and the water will be ejected through valve 13 which will thereby brake the movement, the pressure rising to, say, a constant 20 p.s.i.

When the forward end of the weight 3 passes the top of pipe 12 the water in front of the weight can then only escape through relief valve 14 which blows at a pressure of say 60 p.s.i., giving a deceleration of say, 3 g, so that the weight is rapidly brought to a stop.

If the weight nevertheless overshoots, then it will drive mandrel 5 into tube 7 and will thereby be stopped and secured.

The tube 2 and pipes are sized to give a desired degree of damping and the space between the weight 3 and wall of tube 2 will preferably be such that the leakage past the weight is small compared with the flow through the pipes and no seals are required.

The air operated valve 13 is normally closed, so that in the event of a failure in the air supply the stabilizer
is shut down, and the weight cannot move. When the air supply is in operation, a proportional controller (an off-the-shelf device) maintains the pressure in the tube ahead of the weight at a value which in a particular example gives a deceleration of 1 g in excess of that produced by the damping; in effect, this also means that the weight will not move, unless the ship heels 90°, or unless the stabilizer control operates to release the weight. The stabilizer control selects brake off by shorting out the proportional control and applying pressure direct to the valve, opening it fully. Thus, in the event of the control failing, the weight is brought to rest straight away.

There is no heat transfer problem since the system is being continually recharged with fresh sea water.

In the modification shown in FIGURE 5, the two pipes are joined in the middle forming one continuous closed pipe loop and eliminating the holes in the hull side. The two inboard branch pipes from the main tube can also be eliminated. The control gear is thus reduced to one control valve which is placed in the connecting pipe. This valve can be a butterfly valve which is actuated by a hydraulic cylinder. The hydraulic circuit can be controlled by the electronic control or electric means as in FIGURE 6.

The stabilizer control is controlled from the roll of the vessel, or a suitable combination of its derivatives. It can also be controlled from the position of the weight and the velocity of the weight. A signal is given to the hydraulic control which may be a solenoid valve, and this transmits a hydraulic pressure to the actuator of control valve.

Now, during operation, the energy dissipated in decelerating the weight would cause the water to heat up to an excessive level and so, to reject this heat, water is transferred from the sea by means of a small water pump and ejected through a restrictor or non-return valve. The system can also be pressurised somewhat with this pump, and this will alleviate any cavitation which might occur at the control valve. Alternatively, this water transfer can be achieved without the water pump by placing an inward flowing non-return valve at 18 and an outward flowing non-return valve at 19. Thus, during the stabilizing cycle, as the weight is travelling towards 19, the water pressure in the pipework will be high at 19 and low at 18. Therefore the two non-return valves will open and water will be transferred. The non-return valves can be doubled up for operation in the opposite sense, or a restricted pipe and a shut-off cock can be substituted for each.

By having the pipework placed in a vertical plane around the periphery of the hull, an extra stabilizing effect is produced by the inertia of the water moving around the pipe work. However, if it is more convenient, the pipe loop may be placed horizontally, i.e. side by side with the main reinforced plastic pipe.

The position of the weight is recorded outside the tube by means of the band secured at one end to weight and at the other end wound round a spring-loaded pulley movement of the shaft of which is used to give the location of the weight and if necessary its velocity of movement.

The weight is spring-loaded in its central position by means of a plurality of spring strips in tension connected from the two sides of the weight to the respective opposite ends of the tube. These spring strips may conveniently be of bungee rubber.

Various modifications may be made within the scope of the invention. Thus other forms of tube may be used than the one described and made from other materials and means may be provided to control the periodicity of the movement of the weight.

We claim:

1. A moving weight stabilizer for a floating body comprising generally disposed tubular means extending across the floating body and weight means mounted for reciprocation through the tubular means, the tubular means being filled with the liquid medium in which the body is to float and which is alternately drawn in and forced out at the two ends respectively as the weight means is reciprocated, valve means for dissipating the energy of the weight which is transferred to the liquid medium in the form of a pressure increase the liquid medium being forced out from the ends of the tubular means, discharge means to the floating medium for the thus heated liquid and replenishing means for supplying fresh liquid from the floating medium to replace the expelled liquid.

2. A moving weight stabilizer as claimed in claim 1 in which a roll or pitch sensing device is provided for the floating body and means operated from the roll or pitch sensing device for braking the movement of the weight.

3. A moving weight stabilizer as claimed in claim 1 in which each end of the tubular means communicates independently with the floating medium for discharge and replenishment.

4. A moving weight stabilizer as claimed in claim 1 in which the ends of the tubular means are joined by further tubular means filled with the liquid medium.

5. A moving weight stabilizer as claimed in claim 1 in which the liquid from the tubular means is circulated in a vertical plane around the periphery of the hull.

6. A moving weight stabilizer as claimed in claim 1 comprising relief valve means for stopping the weight means at the ends of its travel.

7. A moving weight stabilizer as claimed in claim 1 in which replenishing liquid is supplied by means of a pump.

8. A moving weight stabilizer as claimed in claim 1 in which at least one spring strip under tension joins the weight to each end of the tubular means.

9. A moving weight stabilizer as claimed in claim 8 in which the spring strip is of bungee rubber.

References Cited

UNITED STATES PATENTS

3,083,671 4/1963 Ripley ------------ 114—124
FERGUS S. MIDDLETON, Primary Examiner.
T. M. BLIX, Assistant Examiner.