April 14, 1925. 1,533,328

S. MOTORA

STEADYING DEVICE OF THE ROLLING OF SHIPS

Filed April 19, 1922 2 Sheets-Sheet 1

Fig. 1

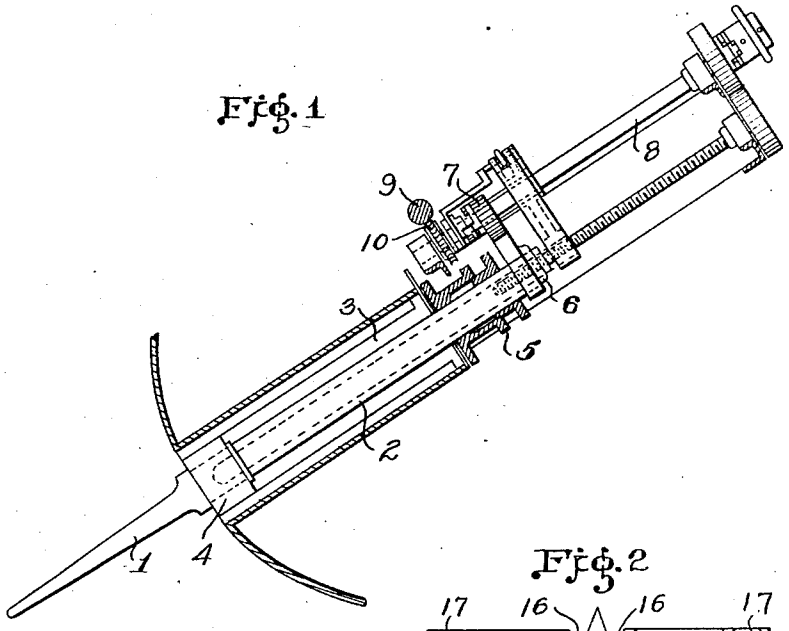


Fig. 2

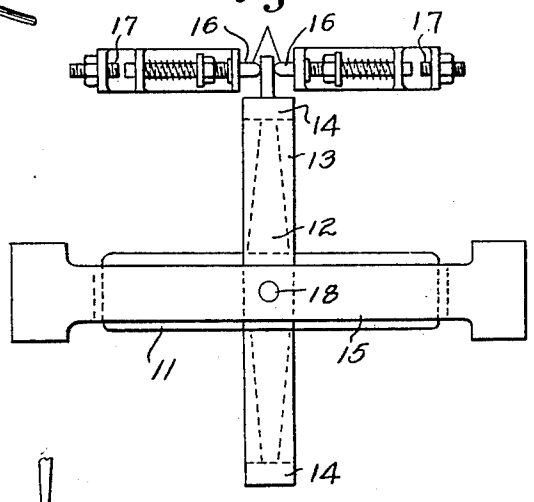
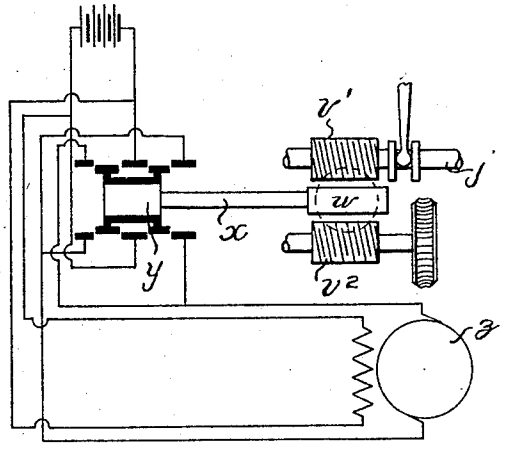


Fig. 5



Inventor.
S. Motora
By Marks & Clerk
Attys.

April 14, 1925. 1,533,328

S. MOTORA

STEADYING DEVICE OF THE ROLLING OF SHIPS

Filed April 19, 1922 2 Sheets-Sheet 2

Fig. 4

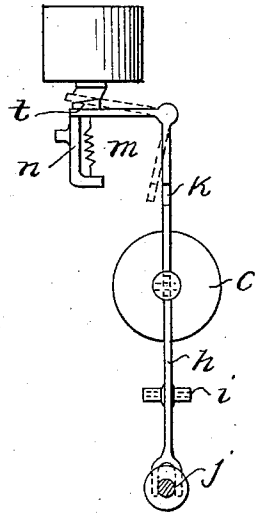


Fig. 3

Inventor.

S. Motora,

By Marks & Clerk

Attys.

Patented Apr. 14, 1925. 1,533,328

UNITED STATES PATENT OFFICE.

SHINTARO MOTORA, OF NAGASAKI, JAPAN, ASSIGNOR TO MITSU BISHI ZOSEN KABUSHIKI KAISHA, OF TOKYO, JAPAN.

STEADYING DEVICE OF THE ROLLING OF SHIPS.

Application filed April 19, 1922. Serial No. 555,641.

To all whom it may concern:

Be it known that, SHINTARO MOTORA, a subject of the Emperor of Japan, residing at city of Nagasaki, Nagasaki Prefecture, Japan, has invented certain new and useful Improvements in Steadying Device of the Rolling of Ships, of which the following is a specification.

This invention relates to devices for steadying the rolling of ships of the type comprising rotatable fins extending from the ship, which are set by means of engines regulated automatically by one or more gyrostats.

This application is a continuation in part of my application Serial No. 377,053, filed April 27, 1920.

The fins are normally set in a position parallel to the stream lines of the water around them due to the ahead or astern motion of the ship. If the ship commences to roll, the automatic regulator comes into action and the engine is caused to operate to set the fins in such position that the force on them due to the forward or backward movement of the ship tends to oppose the rolling motion of the ship.

The controlling engine is similar in its manner of operation to a steering engine; any well designed steering engine worked by steam, electricity, or hydraulic power, may be employed. For the automatic regulator, the properties of gyrostat may conveniently be utilized. The spinning axle of the gyrostat is placed in nearly horizontal plane and is allowed to rotate around a vertical axis within a small range of angle, but is kept in the central position which is nearly in athwartship direction by small springs. If the ship begins to roll, the gyrostat, by the well known properties of rotating bodies, will precess against the spring in a direction depending on the direction of the rotation of the gyro-rotor and the direction of the roll of the ship and will make one of the electric contacts which are arranged on each side of the gyrostat. The electric current thus started energizes solenoids which operate on the valves or the switches of the controlling engines. Two or more gyrostats are employed when a closer stabilization is required. In this case the first gyrostat is so adjusted that it makes the electric contact very sensitively responding with a small angular velocity of the rolling motion of the ship caused by small wave impulses. The second gyrostat is adjusted a little less sensitive than the first and it controls another circuit which allows the fins to rotate further than allowed by the first gyrostat. When wave impulses to roll the ship are great and the first gyrostat is unable to keep the amplitude of the roll of the ship within a small limit, the second gyrostat comes into action and produces additional stabilizing couple. A third, fourth and more gyrostats may be used if desired. This system is advantageous especially when a powerful stabilizer is employed. In such a case, if only one gyrostat is employed, the fins will be feathered to their maximum inclination whatever may be the magnitudes of the wave impulses. Thus if the wave impulse be very small, the stabilizing couple will be too great, resulting an irregular vibratory motion of the ship. This objection can be avoided by introducing two or more gyrostats arranged as mentioned in above. The saving of power of the controlling engines and the propelling machineries resulting from elimination of unnecessary feathering of the fins is another advantage of this system of regulation.

In the accompanying drawings, Fig. 1 is an example of the general arrangement of the fin at the bilge of the ship in which a recess is provided for housing the fin when not in use. Fig. 2 is the plan of the regulating gyrostat, and Fig. 3 is a diagrammatical sketch of the arrangement of two regulating gyrostats and electric system. Fig. 4 and Fig. 5 are detail views of a part of the mechanisms shown in Fig. 3.

Referring to Fig. 1, 1 is the fin, 2 its stock, 3 the recess into which the fin may be housed when not in use; 4 is the bearing which is allowed to slide along the guides fixed on the wall of the recess, 5 is the stuff-

ing box and serves also as a bearing of the stock of the fin. 6 is a toothed segment fixed on the top of the stock and engages to a pinion 7, mounted on a shaft 8. The shaft 8 is driven by the shaft 9 of the controlling engine or the motor through the worm and wormwheel 10. Other parts of the mechanism shown in the figure and designed to move the fins in and out the recess are not essential parts in this invention.

In the Fig. 2, 11 is the revolving rotor, 12 its shaft, 13 is a frame supporting the shaft 12 at two bearings 14, 14 and is mounted on a frame 15 fixed to the ship so as to be free to rotate about an axis through 18 which is nearly in vertical plane. 16 are buffers to keep the spinning axle 12 in athwart ship direction. 17, 17 are stoppers. These buffers and stoppers, in this special case, serve as electric contacts. Thus if the ship begins to roll the revolving wheel precesses pressing the spring and make the contact, closing a circuit which energizes the solenoids actuating the valves or the switches of the controlling machines.

In the Fig. 3, the arrangement of two gyrostats is shown, a and b are two gyrostats. The gyrostat a is so adjusted that it precesses very sensibly responding with small roll of the ship. c and d are two solenoids which are connected with the gyrostat a together with an electric source e by wire as shown in the figure. If the gyrostat a makes one of the contacts f, the corresponding one of the solenoids is energized and pulls in the plunger g. The plunger has a slit at the middle portion and has a pin g' across the slit which engages in a slit cut in a lever h. The lever is pivoted at i and has a fork shaped end engaging in an annular space between two collars fixed on the rod j which is connected to the valve or the switch of the controlling engine. The plunger g, the lever h and the rod j are kept in their normal positions by the centralizing springs u. k is a stopper revolvable around the axis 11 but kept in its normal position by means of the springs m and stopper n, the other end of the stopper forms an armature for the electro-magnet o. This electro-magnet, the gyrostat b, and the electric source p are connected by wires as shown in the Figure 3. If the roll of the ship is small, one of the circuits q only is closed by the gyrostat a, the gyrostat b, being less sensitive than the former, remains in its normal position. Therefore the rod j moves so far as the end r of the lever h strikes the stopper k and the valve or the switch is half open. But if the roll of the ship is great, the second gyrostat b also comes into action and an electric current through the circuit s energizes the electro-magnet o and it attracts the armature t or the top of the stopper k, so that the stopper k swings as shown by broken line in the Figure 4. The lever, now being free from the stopper k moves on as far as the plunger g reaches to the stopping end and the valve or the switch of a controlling engine is fully opened, resulting in maximum inclination of the fins.

In the later stage of the roll, the gyrostat b first opens the circuit s, demagnetizing the electro-magnet o, and the stopper k is allowed to swing back to its normal position. The gyrostat a then opens the circuit q and the plunger g together with the lever will travel back to their central position. But as the stopper k is now in its normal position, it will be necessary to make the end of the stopper in wedge shape as shown in k' in Fig. 3 to allow the lever end r to push aside the stopper and easily pass therethrough. As it will be convenient to use a weak current for gyrostat control and a stronger one for energizing solenoids and electro-magnet, a relay may be inserted in each of the circuits q and s.

The mechanism of controlling the valve or the switch by the rod j is the so called follow-up-gear and an example thereof is shown in Fig. 3 and Fig. 5. v_1 is a worm fixed on the rod j and engages in a wormwheel w which is mounted on the valve rod x or the sliding member of the switch y. v_2 is another worm engaging in the worm wheel w and the shaft of which is driven by the controlling engine or the motor z so that the valve or the switch returns to its central position after a certain number of revolutions of the engine or the motor. This number of revolutions must of course be predetermined corresponding to the valve opening or the amount of shifting of the switch caused by the motion of the rod j.

The arrangement described in above is merely an example to show the principle of the gyrostat regulator to be employed in my invention. Many equivalent arrangements may be devised based on the same principle.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed I declare that what I claim is:—

1. A steadying device for preventing or minimizing the rolling of ships, including a rotatable fin adapted to extend into the water from the hull of the ship, a controlling engine for turning said fin, controlling means for said controlling engine, a gyrostat operated means for effecting operation of the controlling means, stops for said controlling means, and means including a less sensitive gyrostat for moving said stops out of the position in which they engage said controlling means.

2. A device for steadying ships including a rotatable fin adapted to extend into the water from the hull of the ship, an engine

for actuating said fin, controlling means for effecting the intermittent operation of said engine, said controlling means including a lever, a rod connected to the lever, solenoids for moving said rod in opposite directions, a gyrostat for effecting the operation of said solenoids, stops for limiting the movement of said lever, and means including a less sensitive gyrostat for moving said stops out of the position in which they engage said lever.

In testimony whereof he affixes his signature.

SHINTARO MOTORA.