April 25, 1939. C. VON DEN STEINEN 2,155,892

STABILIZING DEVICE

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Fig. 1

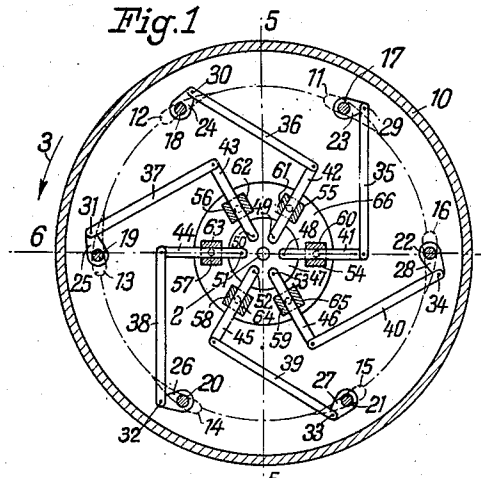
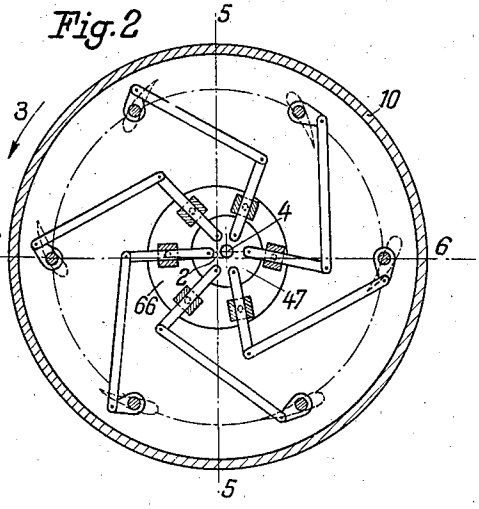


Fig. 2



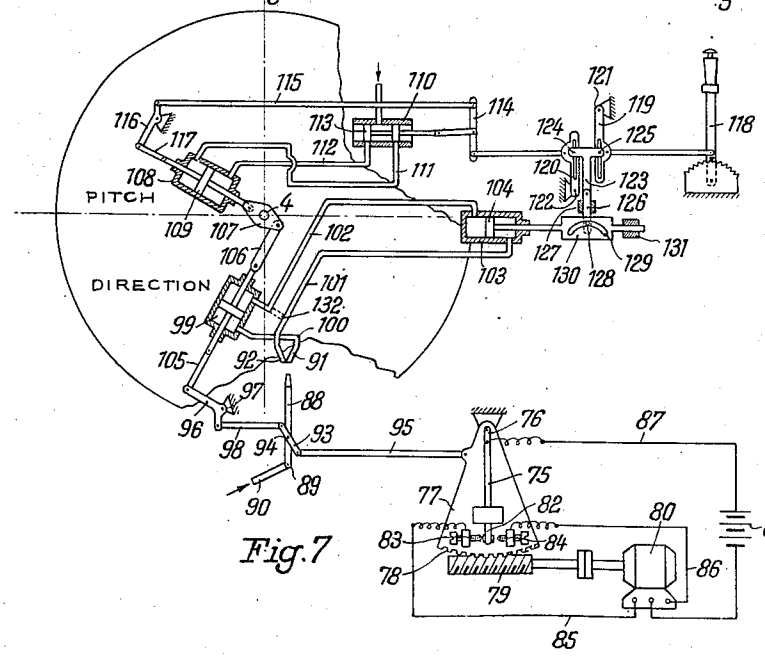


Fig. 7

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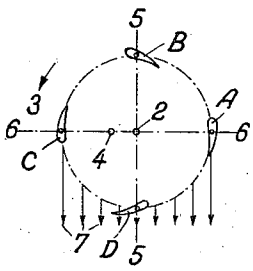


Fig.4

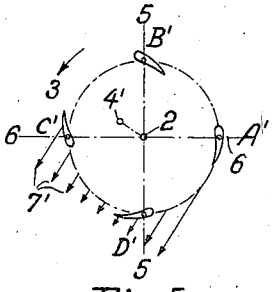


Fig.5

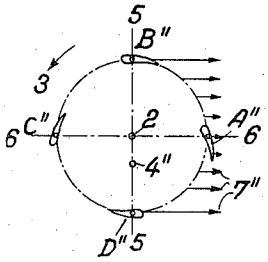


Fig.6

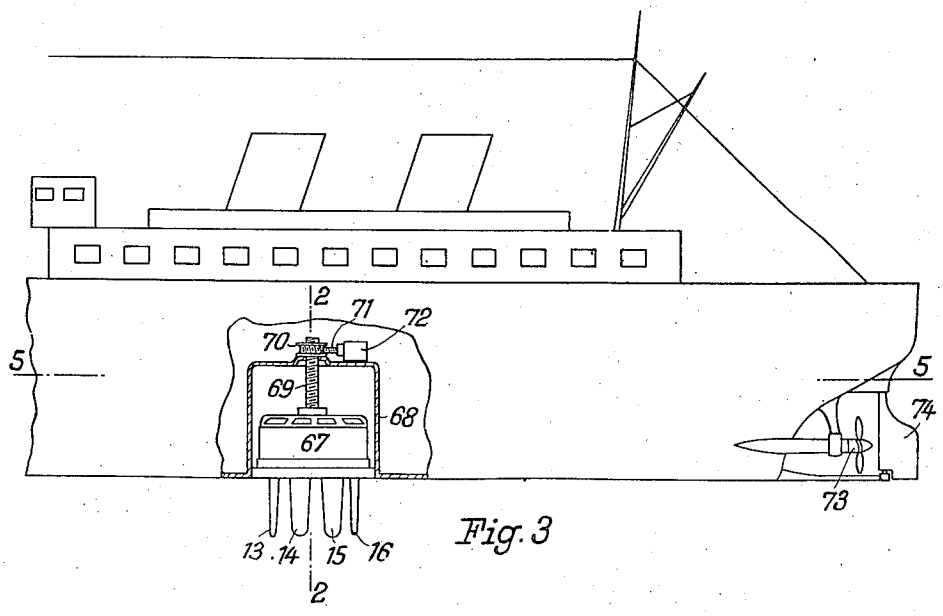


Fig.3

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Patented Apr. 25, 1939

2,155,892

UNITED STATES PATENT OFFICE

2,155,892

STABILIZING DEVICE

Carl von den Steinen, Hamburg-Bergedorf, Germany, assignor to Askania-Werke A. G., a corporation of Germany

Application January 11, 1938, Serial No. 184,492
In Germany January 8, 1937

5 Claims. (Cl. 114—122)

This invention relates to stabilizing devices for ships.

It is an object of this invention to provide a device for exerting stabilizing moments on a ship about its longitudinal axis for the purpose of effecting an anti-rolling stabilization of the ship.

It is a further object to provide a device capable of simultaneously propelling and stabilizing a ship.

According to this invention I provide in a ship, as hereinafter set forth in detail, a Schneider propeller adjustable in response to lateral inclinations and capable of exerting moments about the longitudinal axis of the ship. The Schneider propeller as an element is well-known in the art and comprises a rotatable support from which a plurality of blades project parallel to the axis of rotation of the support, the blades being adjustable relatively thereto. Depending upon the adjustment of the blades relatively to the support the blades exert a propelling force in any desired direction normal to the axis of rotation. According to this invention a Schneider propeller is employed normally to propel the ship and to exert stabilizing moments on the same upon deviations of the ship from its normal position.

Further aims, objects, and advantages of this invention will appear from a consideration of the description which follows with the accompanying drawings showing for purely illustrative purposes an embodiment of this invention. It is to be understood, however, that the description is not to be taken in a limiting sense, the scope of this invention being defined in the appended claims.

Referring to the drawings:

Fig. 1 is a plan view, partly in section, of a Schneider propeller, the propeller blades being shown in a neutral inactive position.

Fig. 2 shows the propeller of Fig. 1 adjusted for propelling action.

Fig. 3 is a diagrammatic illustration of a ship equipped with a stabilizing Schneider propeller.

Figs. 4 to 6 are diagrams illustrating different adjustments of the propeller.

Fig. 7 is a diagram illustrating apparatus for adjusting the propeller blades.

The construction and operation of the Schneider propeller are well-known in the art and described for example in my copending application Ser. 184,492 filed January 11, 1938. It may therefore suffice to show and describe in connection with this invention only the most essential elements of the propeller.

In a support 10 rotatable about an axis 2 and driven by a suitable source (not shown) a plurality of propeller blades 11 to 16 are mounted with their shafts 17 to 22 extend parallel to the axis of rotation. The propeller blades are of a cross section similar to that of the wing of an air-plane to offer a minimum resistance to the water. To the shafts 17 to 22 webs 23 to 28 are secured having crank pins 29 to 34 to which connecting rods 35 to 40 are connected. The other ends of the connecting rods are pivotally linked to levers 41 to 46, the levers being pivotally connected to a disk 47 at 48 to 53, respectively. The levers 41 to 46 are guided in guiding blocks 54 to 59 pivotally connected at 60 to 65, respectively, to a disk 66 secured to or integral with the support 10.

Assuming that the disk 47 be adjusted to be concentric to the disk 66 and the support 10 it follows that the blades will upon rotation of the support 10 travel in a circle indicated in a dash-dot line without exerting on the water a force, other than the resistance offered to the curved front of the blades.

Turning now to Fig. 2, the disk 47 is shown in an excentric position relatively to the support 10 and the disk 66. Assuming now that the support 10 is rotated about the axis 2 in the direction of the arrow 3, while the center 4 of the disk 47 is maintained fixed, the propeller blades will perform an oscillating movement about their respective shafts and a further movement about the axis 2 with their surfaces inclined relatively to the direction of travel. Accordingly forces will be exerted on the water as will become still clearer from a consideration of the diagrammatic Figures 4 to 6.

In Figs. 4 to 6 the center of the support is indicated at 2, while the center of the disk 47 is indicated at 4. The direction of movement of the blades is again indicated by arrows 3. An axis 5—5 may be assumed to be parallel to the longitudinal axis of the ship, while an axis 6—6 is normal thereto.

A displacement of the center 4 in the direction of the axis 6—6 will result in a movement of the blades which is shown in Fig. 4.

Four different positions of the blades are indicated at A to D. The lever mechanism shown in Figs. 1 and 2 will cause an oscillating movement of the blades as follows: A blade which is aligned with the direction of travel at A will be oscillated in clockwise direction to become inclined as shown at B reacting on the water. Thereafter the levers impart a counter-clockwise oscillation to the blade. At C the blade is again

aligned with the direction of travel and at D inclined to react on the water.

The oscillating movement of the blades together with the rotary movement in the direction 3 results in a reaction of the blades on the surrounding water indicated by the arrows 7. The direction of the resultant force is approximately normal to a line connecting the centers 2 and 4.

A different adjustment of the blades is shown in Fig. 5 caused by a displacement of the center of the disk 46 into a position 4'. Four different positions of the blades are again indicated at A' to D'. It clearly appears from the position of the blades that a force will be exerted on the water in the direction of the arrows 7' inclined to the direction of the axis 6—6.

A still different adjustment of the Schneider propeller is shown in Fig. 6. In this example the center 4 is displaced in the direction of the axis 5—5 resulting in a movement of the blades which is again shown in four phases A'' to D''. The resultant force on the water is indicated by the arrows 7'' directed parallel with the axis 6—6 and normal to the longitudinal axis 5—5 of the ship.

For exerting stabilizing moments on a ship the Schneider propeller is mounted on the body of the ship in such manner that the propeller blades protrude from the ship's bottom.

In Fig. 3 a Schneider propeller having a casing 67 with an electric motor enclosed therein for driving the propeller is mounted without a water-tight compartment 68 of the ship. A spindle 69 and a nut 70 forming part of a worm gear 71 driven by a motor 72 permits the casing 67 to be lowered into the operative position shown in the drawings in which the propeller blades protrude below the bottom of the ship. In shallow water, where damage is likely to occur to the propeller blades, the casing 67 may be raised into the compartment, whereby the blades are protected.

Inasmuch as the blades are arranged below the center of gravity of the ship through which also the longitudinal axis 5—5 is assumed to pass it is easily understood that the propeller blades are capable of exerting a reacting moment on the ship about the axis 5—5, when adjusted in response to lateral inclinations of the ship.

Assuming, for example, that the blades be adjusted as shown in Fig. 6 in which the propeller acts on the water in the direction normal to the axis 5—5 it appears that a maximum moment will be exerted on the ship.

When, in turn, the propeller is so adjusted as to act parallel to the axis 5—5 it appears that it will assist in a propulsion of the ship. The propeller accordingly fulfills a double purpose, first the purpose of stabilizing the ship and second the purpose of propelling it. For propelling the ship the Schneider propeller may be assisted by the usual propeller indicated at 73 in Fig. 3, it being understood that the propeller 73 may also be dispensed with and the propulsion of the ship be effected exclusively by the Schneider propeller 67. The course of the ship is controlled by the usual rudder 74.

The most effective stabilizing action of the Schneider propeller is obtained when the propeller is positioned below the center of gravity of the ship, but vertically spaced relatively thereto. I have found by experiments that the stabilizing action is not essentially affected when the propeller is positioned spaced not more than one quarter of the ship's length from the center of gravity in a horizontal direction. When the horizontal distance of the propeller is greater than one quarter of the ship's length, the course of the ship will be affected by the propeller and the direction of the ship be changed rather than its stability.

A suitable form of apparatus for controlling and adjusting the Schneider propeller in response to lateral inclinations of the ship is shown in Fig. 7. A pendulum 75 is pivoted at 76 for oscillations transversely to the direction of travel of the ship. The pendulum may be of the short period type assuming the direction of the apparent vertical or of the long period type assuming the direction of the true vertical, depending upon whether it is desired to stabilize the ship with respect to the apparent or the true vertical.

The pendulum in the illustrated example is combined with a follow-up device including a sector shaped follower 77 provided with a toothed edge 78 meshing with a worm 79 rotatable by a reversible motor 80. The motor is supplied with current from a battery 81 and controlled by contacts 82 on the pendulum and 83, 84 carried by the follower. The contacts 83 and 84 are connected with the motor through leads 85 and 86, while a lead 87 connects the battery with the pendulum.

When the pendulum becomes displaced relatively to the follower, one of the pair of contacts 82, 83 or 82 84 will be closed causing the motor to turn the worm 79 in such direction that the follower 77 follows the movement of the pendulum. Thus the position of the follower becomes a measure of the lateral inclinations of the ship.

The movements of the follower are transmitted to actuate a relay, in the illustrated example shown as being an "Askania" jet-pipe relay including a jet-pipe 88 pivoted at 89 and supplied with pressure fluid through a conduit 90 which is issued from the jet-pipe into reception orifices 91 and 92 depending upon the relative position of the jet-pipe and the orifices. A double armed lever 93 is pivotally mounted on the jet-pipe at 94, one arm of the lever being connected with the follower 77 by means of a link 95, the other arm being connected to an angle lever 96 pivoted at 97 through a link 98. The angle lever 96 is moved in response to the movements of the piston of a servo-motor 98, the piston being connected with the angle lever through a link 105. The servo-motor is supplied with pressure fluid from the jet-pipe relay 88 through conduits 100, 101, and 102. A second repeater servo-motor having a cylinder 103 and a piston 104 movable therein may be provided between the conduits 101 and 102 for purposes later to be described.

The servo-motor 98, 99 is connected through a link 106 to actuate a movable lever 107 defining the position of the center 4 of the disk 47 (Figs. 1 and 2).

The operation of the device so far described is as follows:

When a lateral inclination of the ship occurs, the follower 77 of the pendulum device will displace the movable jet-pipe 88 relatively to the reception orifices. Pressure fluid entering the conduits leading to the servo-motor 99 will cause the piston of the servo-motor to travel in one direction or the other, until the relay is restored to its neutral position through the restoring connection 105, 96 98 acting on the other end of the differential lever 93. Accordingly the piston of the servo-motor 99 will at all times assume a

position which is a function of the lateral inclination of the ship.

In response to the movements of the servo-motor 99 the movable member 107 will cause an adjustment of the blades of the Schneider propeller by displacing the axis 4 relatively to the axis 2 as hereinbefore described. The result is a change in direction of the force exerted by the propeller on the water. The force exerted on the ship by the propeller in a direction different from the direction of the longitudinal axis 5—5 will thus produce a moment about the longitudinal axis to counter-act the inclination of the ship and to erect the same.

The device so far described will effectively stabilize a shipe against lateral inclinations.

Instead of solely changing the direction of the force of the Schneider propeller it may also be advantageous to vary the magnitude of the propeller force. This can be achieved in the following manner. A second servo-motor having a cylinder 108 and a piston 109 movable therein is connected to the movable member 107. The servo-motor 108, 109 is controlled by and supplied with pressure fluid from a control valve 110 connected to the servo-motor through conduits 111 and 112. The piston 113 of the control valve is moved from a differential lever 114 to which a restoring connection 115, 116, 117 is linked, the other arm of the differential lever being controlled by a handle 118. A variable transmission device is inserted between the handle 118 and the differential lever 114 including in the illustrated example slotted levers 119 and 120 pivoted at 121 and 122, respectively. A connecting member 123 engages with pins 124 and 125 the slots in the levers 119 and 120. The connecting member is pivotally connected to a rod 126 guided at 127 and provided with a pin 128 guided in a curved slot 129 of a cam member 130. The cam member is connected to be moved from the piston 104 and guided at 131.

The position of the servo-motor 108, 109 controlling the movable member 107 effects an adjustment of the pitch of the Schneider propeller.

It was explained in connection with Figs. 1 and 2 that in the position in which the axes 4 and 2 coincide, the pitch of the propeller blades is zero and the rotating blades will exert no force on the surrounding water. When the movable member 107 is displaced through the servo-motor 108, 109, the pitch of the propeller blades determining the magnitude of the propeller force is varied. The pitch of the propeller blades is normally set by adjusting the handle 118 operating the control valves 110 and 113. The predetermined pitch of the propeller set at the handle 118 is now increased to vary the reaction force of the propeller on the water for the purpose of erecting the ship as follows.

When the ship is in its normal upright position, the servo-motors 99 and 103 will be in their central position. In this instance the member 123 of the variable transmission device is in its uppermost position in which the ratio of transmission between the handle 118 and the differential lever 114 is one to one. When, however, the ship assumes an inclination and the pistons of the servo-motors 99 and 103 become displaced, the pin 128 will travel in the curved slot 129 of the cam member 130 in a downward direction, increasing the ratio of transmission between the control handle 118 and the pitch controlling valve 110. The pitch of the propeller blades and accordingly the force of the propeller is thus increased resulting in an increased erecting moment on the ship.

Obviously, the present invention is not restricted to the particular embodiment herein shown and described. Other forms of inclination responsive devices may be used and other forms of control devices for adjusting the blades of the Schneider propeller be employed. Moreover, it is not indispensable that all the features of this invention be used conjointly, since they may advantageously be employed in various combinations and subcombinations.

Thus, for example, the stabilizing device may be simplified by eliminating the elements of the device for changing the pitch of the propeller in response to inclinations of the ship. In this instance the repeater servo-motor 103, 104 may be omitted and the conduits 101, 102 be connected at 132. The pitch controlling handle 118 will now control directly the control valves 110 and 113, the variable transmission device being omitted.

What is claimed is:

1. The combination with a ship's body of a propeller having a plurality of blades and a rotatable support for said blades on which said blades are adjustably mounted parallel with the axis of rotation of said support, said propeller being mounted on said body substantially below the center of gravity of the ship; power means for driving said propeller; and means responsive to lateral inclinations of the ship and connected to adjust said blades, whereby upon a lateral inclination the direction of the propelling force exerted by the propeller is varied and an erecting torque is exerted on the ship.

2. The combination with a ship's body of a propeller having a plurality of blades and a rotatable support for said blades on which said blades are adjustably mounted parallel with the axis of rotation of said support, said propeller being mounted on said body to protrude from the bottom thereof and at a horizontal distance from the ship's center of gravity of less than one quarter of the ship's length; power means for driving said propeller; and means responsive to lateral inclinations of the ship and connected to adjust said blades, whereby upon a lateral inclination the direction of the propelling force exerted by the propeller is varied and an erecting torque is exerted on the ship.

3. The combination with a ship's body of a propeller having a plurality of blades; a rotatable support for said blades on which said blades are adjustably mounted parallel with the axis of rotation of said support; means for mounting said propeller on said body to be projectible and retractable relatively to the bottom thereof and at a horizontal distance from the ship's center of gravity of less than one quarter of the ship's length; power means for driving said propeller; and means responsive to lateral inclinations of the ship and connected to adjust said blades, whereby upon a lateral inclination the direction of the propelling force exerted by the propeller is varied and an erecting torque is exerted on the ship.

4. The combination with a ship's body of a propeller having a plurality of blades and a rotatable support for said blades on which said blades are adjustably mounted parallel with the axis of rotation of said support, said propeller including a servo-motor for adjusting said blades to vary the direction of their propelling action; means for mounting said propeller on said body

to protrude from the bottom thereof and at a horizontal distance from the ship's center of gravity of less than one quarter of the ship's length; power means for driving said propeller; and means responsive to lateral inclinations of the ship and connected to control said servo-motor, whereby upon a lateral inclination the direction of the propelling force exerted by the propeller is varied and an erecting torque is exerted on the ship.

5. The combination with a ship's body of a propeller having a plurality of blades and a rotatable support for said blades on which said blades are adjustably mounted parallel with the axis of rotation of said support, said propeller including a first servo-motor for adjusting said blades to vary the direction of their propelling action and a second servo-motor for adjusting the pitch of the blades; means for mounting said propeller on said body to protrude from the bottom thereof and at a horizontal distance from the ship's center of gravity of less than one quarter of the ship's length; power means for driving said propeller; and means responsive to lateral inclinations of the ship and connected jointly to control said first and second servo-motors, whereby upon a lateral inclination the direction of the propelling force exerted by the propeller is varied and an erecting torque is exerted on the ship.

CARL VON DEN STEINEN.