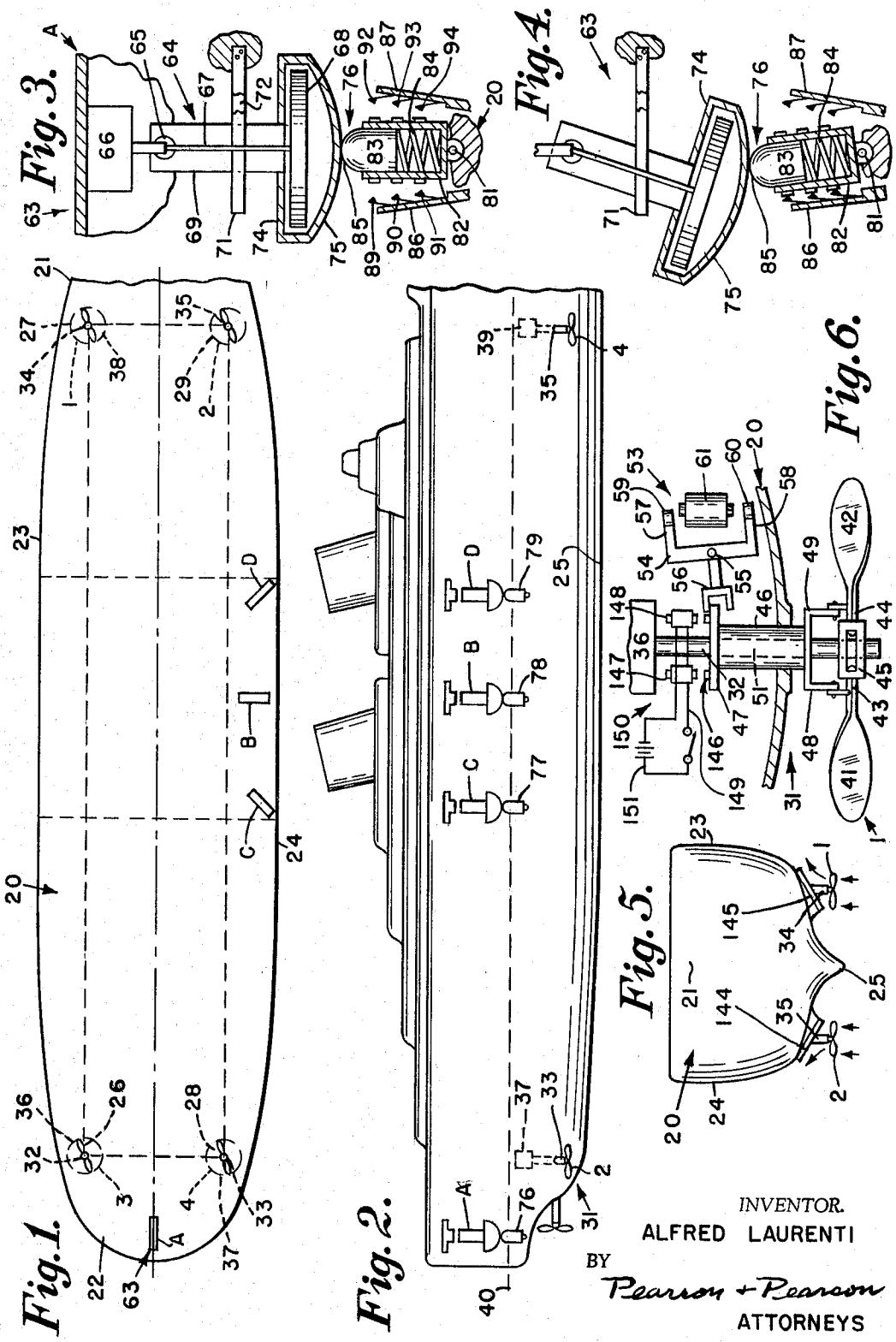
Aug. 9, 1966 A. LAURENTI 3,265,029

SHIP STABILIZER

Filed July 21, 1964 2 Sheets-Sheet 1



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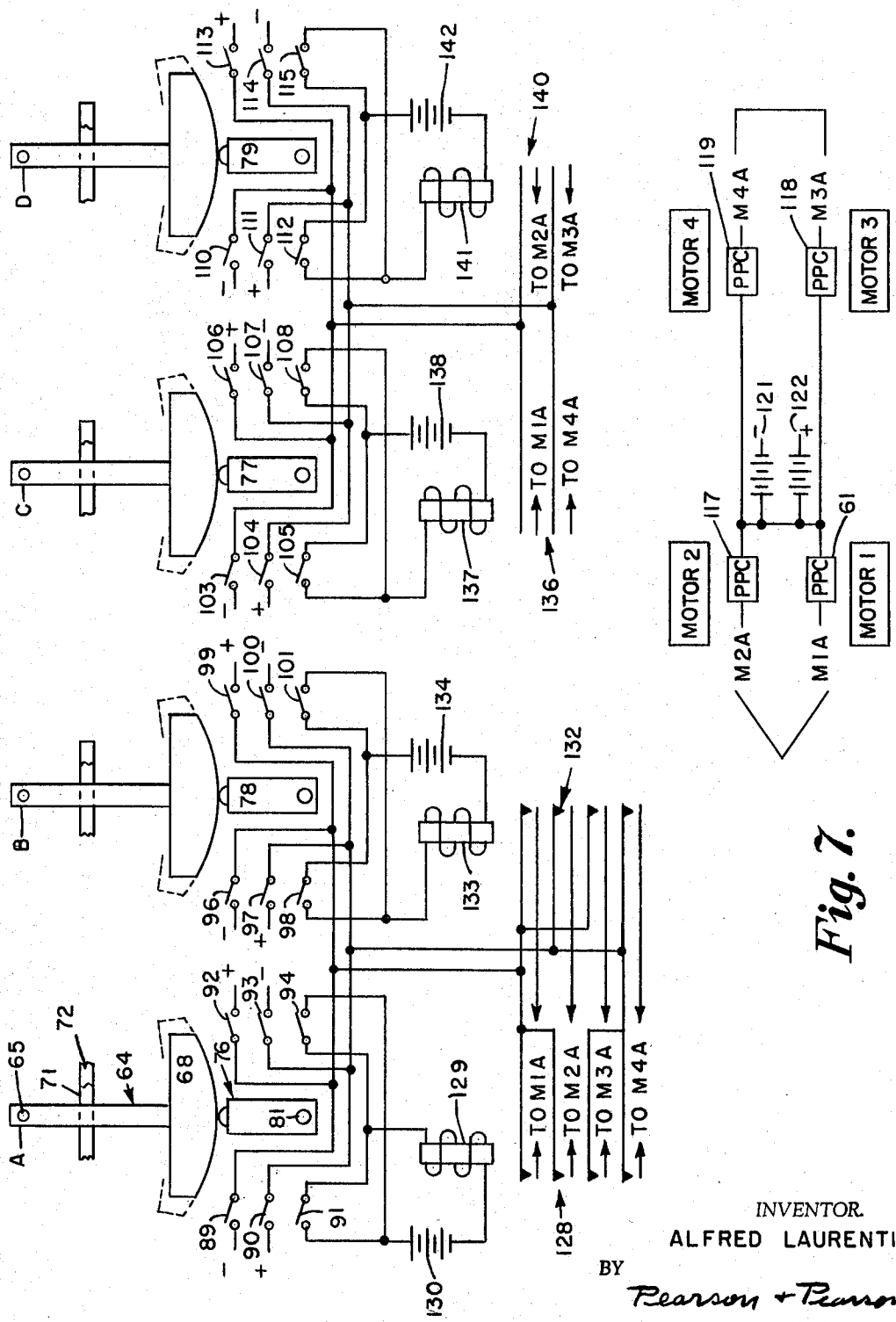


Fig. 7.

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SHIP STABILIZER

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This invention relates to apparatus for stabilizing ships.

I am aware that various types of gyroscopes or other level sensing devices and various types of propellers and fins have been used heretofore for the same purpose, but in general such devices have countered only roll, or other pitch, and have not been instantaneous in countering the motion of the ship.

It is an object of this invention to provide mechanism, below the water line, in each of the four corners of the rectangular outline of a ship capable of exerting either upward or downward thrust to instantaneously counter the upward or downward movement of that corner of the ship.

Another object of the invention is to provide level sensing means peripherally on the longitudinal center line, the lateral center line and on both diagonals of the rectangular outline of a ship in order that pitch, roll, and combined pitch and roll will be sensed and an appropriate thrust exerted at all four corners of the rectangular outline of the ship.

A further object of the invention is to provide a plurality of propellers, each individually unidirectionally rotating on a fixed vertical axis in a horizontal plane below the water line, preferably two on opposite sides of the bow and two on opposite sides of the stern, the pitch of the propellers being reversible to exert either upward or downward thrust as required to counter the motion of the ship. Thus if the bow is descending the bow propellers oppose the descent and the stern propellers oppose the ascent of the ship. Similarly, if the ship rolls to one side, the two propellers on that side impede the descent, while the two propellers on the other side impede the ascent of that side. If the ship rolls and pitches diagonally, one propeller at one end of the diagonal opposes the descent, while the propeller at the other end of the diagonal opposes the ascent.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawing, and from the drawing, in which

FIG. 1 is a diagrammatic plan view of a typical ship showing the preferred location of the propellers and level sensing mechanisms;

FIG. 2 is a diagrammatic side elevation of the ship shown in FIG. 1;

FIG. 3 is an enlarged, fragmentary side elevation of one of the level sensing mechanisms in vertical position;

FIG. 4 is a view similar to FIG. 3, showing the ship in tilted position and the mechanism signalling the propellers;

FIG. 5 is a diagrammatic end elevation showing the bow propellers and associated deflector plates;

FIG. 6 is an enlarged, fragmentary side view of a preferred thrust reversing mechanism, and

FIG. 7 is a diagram showing one form of control circuit.

As shown in FIGURES 1, 2 and 5, **20** is a typical ship, having a bow **21**, stern **22**, port side **23**, starboard side **24**, and keel line **25**. For convenience of description, the ship **20** is treated herein as forming an elongated rectangle, in plan, the rectangle being shown in dotted lines, and having the four corners **26**, **27**, **28** and **29**.

Propeller means

The propeller means **31** of the invention preferably comprises four reversible pitch propellers, **1**, **2**, **3** and **4**, each at one of the four corners, **26**, **27**, **28** and **29**, and each rotatable in a horizontal plane on a fixed vertical axis formed by the shafts **32**, **33**, **34** and **35**, of the individual drive motors, **36**, **37**, **38** and **39**. Each propeller is on the outside of the ship below the water line **40**, so that there is a vertical thrust mechanism on the port and starboard side of both the bow and the stern.

While it would be possible to have pairs of side by side, or coaxial, propellers each with an individual motor and each rotating in an opposite direction to provide either upward or downward thrust, I prefer to use a single motor, shaft and propeller rotating unidirectionally but to reverse the pitch of the blades for reversing the direction of thrust. Any suitable reversible pitch propeller mechanism could be used. However, as shown in FIGURE 6, each propeller such as **1**, **2**, **3** or **4** of this invention, is especially simple and unique in having opposite blades **41** and **42** with their bases **43** and **44**, journalled in a yoke **45** for rotation on their longitudinal axes. A sleeve **46**, having an integral disc **47**, is slidable axially on shaft **32**, the sleeve carrying a pair of opposite arms **48** and **49** connected to the blades **41** and **42**, so that axial movement of the disc **47** turns the blades from forward to reverse position during rotation. The sleeve **46** may be keyed at **51** to shaft **32**.

Thrust reversing means

The thrust reversing means **53** of the invention includes the blade reversing mechanism described above and a member **54**, pivoted at **55** and having a bifurcated element **56** embracing the disc **47**. Member **54** also includes a pair of arms **57** and **58**, each carrying a permanent magnet **59** and **60**, and each on an opposite side of an electro magnet **61**.

The members **54** of propellers **1** and **2** are attracted in one direction by the electro magnets such as **61** when the electro magnets receive the positive of the power source while the members **54** of propellers **3** and **4** are attracted in the opposite direction, because the polarity of the permanent magnets fixed on the arms of the **1** and **2** propeller members **54** is the opposite of the polarity of the permanent magnets fixed on the arms of the **3** and **4** propeller members **54**. The electro magnets **61** of the four propeller members **54**, when receiving the negative of the power source, invert the attraction, thereby inverting the thrust of the propellers.

Thus the reversal of the propeller blades depends on the positive or negative currents established in the control circuit by the level sensing mechanisms of the apparatus.

Level sensing mechanisms

The level sensing mechanisms **63**, as shown in FIGURES 1 and 2, are mounted peripherally of the ship with a mechanism A on the longitudinal center line, a mechanism B on the lateral center line, and mechanisms C and D each on one of the opposite diagonals passing through the center of the ship **20**. The mechanism A is especially sensitive to pitch, mechanism B is especially sensitive to roll, and mechanisms C and D are sensitive to combined pitch and roll.

Each level sensing mechanism such as A, comprises a plummet **64**, pivoted within the ship **20** as at **65** and preferably including a motor **66**, flexible shaft **67**, and weighted rotor **68**. The flexible plumb line strip **69** is oscillatable between a pair of parallel laterally extending guides **71** and **72**, each spaced on an opposite side with a predetermined clearance, so that the plummet **64** can swing only in one vertical plane, along its particular line, rather than swinging omni-directionally in the manner of a plumb bob. The rotation of rotor **68** by the motor **66** provides a gyroscopic, pendulum effect, and the level

sensing mechanisms A, B, C, and D, each tend to remain vertical during compound motions of the ship **20**, although frictional contact with the guides **71** and **72** dampens the oscillatory travel when the weighted rotors are subjected to omni-directional forces as in combined pitch and roll.

Each rotor, such as **68**, is contained in a housing **74**, having a convex lower face **75**.

Actuation means

Each level sensing mechanism includes an upstanding follower **76**, **77**, **78** or **79**, pivoted to the ship **20** as at **81**, and arranged to actuate the propeller control system in accordance with the direction in which it is tilted, or oscillated, by its level sensing mechanism, such as A. As shown in FIGURES 3 and 4, the upstanding follower **76** is normally vertical, and includes the cylindrical tube **82** having a head **83** spring loaded upwardly therein by the coil spring **84**. The upper face **85** of head **83** is convex and of friction material, for example cork, rubber, or the like, so that it engages the curved face **75** of the housing **74**, with considerable adhesion as motion of the ship causes relative motion there-between. The path of oscillation of each follower such as **76** is limited by the rigid unyieldable upstanding posts, **86** and **87** on each opposite side thereof.

Thus, when as shown in FIGURE 4, the pitch of the ship causes the bow to rise and the stern to fall, the friction of the face **85** on the plummet face **75** causes the follower to tilt in the direction shown, until it is stopped by the post **86**.

It remains in this tilted position as the stern continues to descend and as it follows the remaining contour of face **75**. However, as soon as the descent ceases and the portion of the ship to which the follower is pivoted commences to rise, the friction of the faces **85** and **75**, causes the follower to instantly tilt in the opposite direction until it is stopped by the posts **87**, even though the follower is still in engagement with the same side of the face **75** and has not yet reached the midpoint of face **75**.

While the followers could be arranged to actuate valves in an hydraulic or pneumatic control system, I prefer that the control be electrical. Each tube, such as **82**, thus is an oscillating switch arm, pivotally mounted to the ship at **81**, and having three normally open switches, **89**, **90** and **91**, on one side, and three normally open switches, **92**, **93** and **94**, on the other side. The corresponding switches on the followers, **78**, **77** and **79** are designated **96**, **97**, **98**, **99**, **100**, **101**, **103**, **104**, **105**, **106**, **107**, **108**, and **110**, **111**, **112**, **113**, **114** and **115** respectively.

Each post, such as **86** or **87**, carries three flexible strip switch contacts, which are engaged by their respective movable contacts on the follower to close the indicated circuit, a single numeral being used to designate both terminals of the switches to simplify the description.

Control means

As shown in FIGURE 7, the propeller pitch control of each propeller **1**, **2**, **3** and **4** is designated PPC, this symbol representing the electro magnet **61** in the case of propeller **1** and representing the corresponding electro magnets **117** of propeller **2**, **118** of propeller **3** and **119** of propeller **4**.

Each electro magnet **61**, **117**, **118** and **119** is shown as powered by a negative source **121** or a positive source **122**, depending on the closing of appropriate circuits designated M1A, M2A, M3A, and M4A. The actual wiring to accomplish the circuitry has been eliminated to avoid confusion in the diagram, and will be obvious to anyone skilled in the art.

A four section relay **128**, having four normally open contacts, each arranged to close a circuit to M1A, M2A, M3A, or M4A is actuated by a relay coil **129**, the coil **129** being energized by the closing of switch **91** or switch **94**, thereby completing a circuit including a power source **130**.

A four section relay **132**, having four normally open contacts, each also arranged to close a circuit to M1A, M2A, M3A or M4A is actuated by a relay coil **133**, the coil **133** being energized by the closing of switch **98** or switch **101** of follower **78**, thereby completing a circuit including a power source **134**.

A two section relay **136**, having two normally open contacts, each arranged to close a circuit to M1A or M4A is actuated by relay coil **137**, power source **138** and the closing of switches **105** or **108** of follower **77**.

A two section relay **140**, having two normally open contacts, each arranged to close a circuit to M2A or M3A is actuated by relay coil **141**, power source **142** and the closing of switches **112** or **115** of follower **79**.

The switches, **89**, **90**, **92**, **93**, **96**, **97**, **99**, **100**, **103**, **104**, **106**, **107**, **110**, **111**, **113** and **114**, each close a circuit to either the positive source **121** or the negative source **122**, as indicated.

In operation, if tube **82** of follower **76**, for example, tilts to the left, it closes switches **89**, **90** and **91**, switch **91** closing the relay **128**, switch **89** closing a negative circuit to the two forward propellers **1** and **2**, and switch **90** closing a positive circuit to the two aft propellers **3** and **4**. Thus upward pitch aft is countered by downward pull by the aft propellers, and downward pitch forward is countered by upward push of the forward propellers. A tilt of tube **82** in the opposite direction, immediately closes switches **92**, **93** and **94**, keeping relay **128** closed but connecting the electro magnets of the above mentioned pairs of propellers to opposite sources to reverse the pitch thereof, and again counter pitch in the opposite direction.

The same operation takes place with the tilting of follower **78** in closing relay **132** and thereby closing circuits to the port propellers **1** and **3** and closing opposite source circuits to the starboard propellers **2** and **4**.

Similarly a tilt of follower **77**, for example, to the left, causes switch **104** to close relay **136**, and causes diagonally opposite propellers **1** and **4** to be connected through switches **103** and **104** with a negative source in one case and a positive source in the other case. The operation of the follower **79** is similar to that of the follower **77** in actuating the electro magnets of the propeller pitch control of propellers **2** and **3** on the opposite diagonal.

As shown in FIGURE 5, since the propellers of the invention are outside the hull of the ship, and tend to discharge an upwardly directed stream when pulling downwardly, I prefer to provide a deflector plate, such as **144** or **145**, mounted on the ship in the path of the effluent from the bow propellers. The plates may be at about 45° in order to deflect away from the ship rather than countering their own thrust.

Also because the propellers project into the slip stream of the ship, I provide a magnetic brake means **150** for halting each propeller, when not in use, in a streamlined, fore and aft position parallel to the direction of advance of the ship. Magnetizable means **146** is mounted on each disc **47** and a plurality of electro magnets **147** and **148** are mounted in the ship, in parallelism with the longitudinal center line, the magnets being connected by conductors **149** to a suitable source **151**, so that energization of the magnets manually or automatically, will bring each propeller to rest in a streamlined position.

Direct current motors could probably be substituted for the reverse pitch propeller mechanism of the invention, with a consequent change of direction of the propeller shafts, but I prefer that the shafts rotate unidirectionally while the blade pitch is changed, thereby avoiding a total stop and reversal of the shaft with its consequent delay and impact.

I claim:

1. In combination with a ship

four reversible-pitch, bladed propellers, each rotatable on a fixed vertical axis relative to said ship, on a

horizontal plane outside said ship and below the water line, one on the starboard and one on the port side of both the stern and of the bow;

four level sensing mechanisms mounted peripherally on said ship, one on the longitudinal center line, one on the lateral center line, one on a diagonal center line forward of the ship and one on a diagonal center line sternward of the ship;

individual power drive means connected to each said propeller for rotating the same;

blade reversing means associated with each said propeller for reversing the pitch of the blades thereof to selectively exert upward or downward thrust in a vertical direction on said ship, and

electric control means, connecting each said level sensing means with each such blade reversing means for instantaneously countering pitch, roll and combined pitch and roll of said ship.

2. A combination as specified in claim **1**, wherein

each said sensing means is a plummet type gyroscope, having a depending rotor housing, with a convex lower face, oscillatable on an upper pivot;

said electric control means includes a tubular switch arm vertically mounted on said ship under said housing, with a vertically movable friction faced follower spring loaded upwardly therein into contact with said lower face, said arm being oscillatable on a bottom pivot;

and a plurality of switches, each on an opposite side of said arm, at a spaced distance therefrom, each adapted to close a circuit when said arm is tilted into contact therewith, and to open said circuit when said armature is tilted out of contact therewith.

3. A combination as specified in claim **1**, wherein

said blade actuation means comprises mechanical pitch reversing means, on the shaft of each said propeller, actuatable by a yoke and electro magnetic means mounted between the arms of said yoke for moving the same.

4. A combination as specified in claim **1**, plus

electro magnetic brake means mounted adjacent the path of rotation of each said propeller and aligned with the path of said ship;

magnetizable means on each said propeller within the flux of the adjacent electro magnetic means;

and means for energizing each said electro magnetic means for halting the rotation of each said propeller.

5. In combination with a ship

a plurality of reversible-pitch, bladed propellers, each rotatable in a horizontal plane on a fixed vertical axis under the water line of said ship, at least two

of said propellers being on opposite sides of the bow and at least two of said propellers being on opposite sides of the stern;

a plurality of level sensing mechanisms mounted peripherally within said ship for sensing pitch and roll, each said mechanism including an oscillatable plummet having a convex lower face;

a plurality of upstanding followers, each oscillatably mounted under one of said pendulums and each having a convex, friction-faced, upper portion slidably engaging the lower face of said pendulum;

normally open actuation means, each on an opposite side of the path of oscillation of each said follower, and adapted to be closed by the tilting of said follower in the direction thereof;

drive means for rotating said propellers;

blade reversing means operable connected to each said propeller; and

control means responsive to the said actuation means of each said follower to reverse the pitch of said propellers to counter pitch, roll, and combined pitch and roll of said ship.

6. A combination as specified in claim **5**, wherein the actuation means of each said follower is closely spaced therefrom, and includes an unyielding, rigid post, for limiting the angle of tilt of the follower to about two degrees

whereby the oscillation of said pendulum in one direction initially tilts said follower in that direction and closes the actuation means on that side, the pendulum then continuing in its path of oscillation to the end thereof, the reversing of the path of the pendulum instantly tilting the follower in the opposite direction to close the opposite actuation means by reason of the friction face and pivot mounting of the oscillatable follower.

References Cited by the Examiner

UNITED STATES PATENTS

1,637,133	7/1927	Tew	114—121 X
2,946,868	7/1960	Kowalyshyn	200—61.48
3,097,622	7/1963	Bell	114—125
3,185,122	5/1965	Pleuger	114—151

FOREIGN PATENTS

332,925	12/1935	Italy.
515,399	2/1938	Great Britain.
1,165,626	6/1958	France.

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