April 12, 1955 M. M. KÉFÉLI 2,705,934

STABILIZING DEVICE FOR SHIPS

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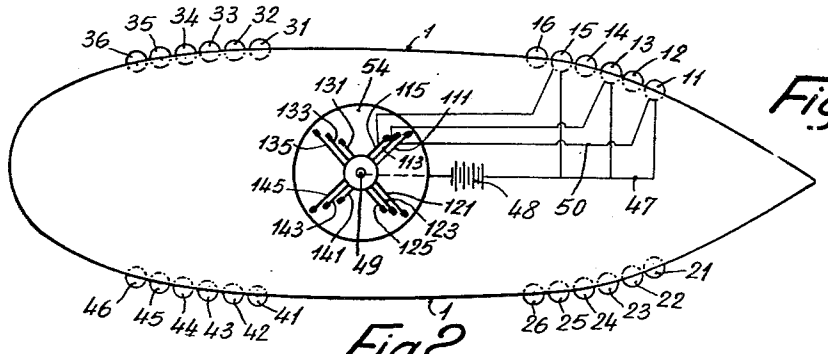


Fig.1

Fig.2

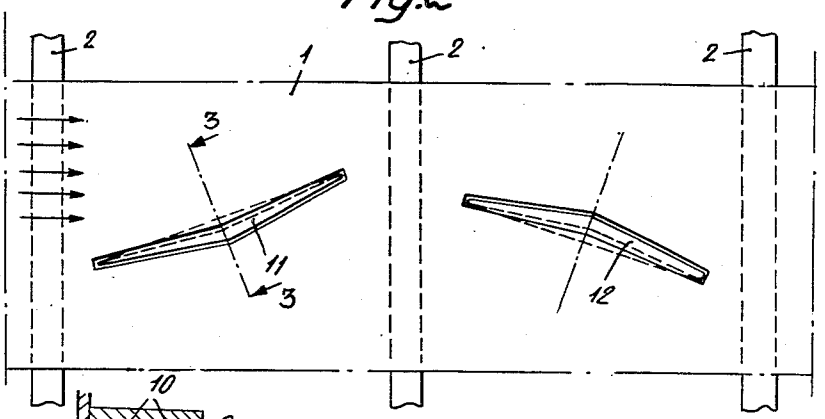


Fig.3

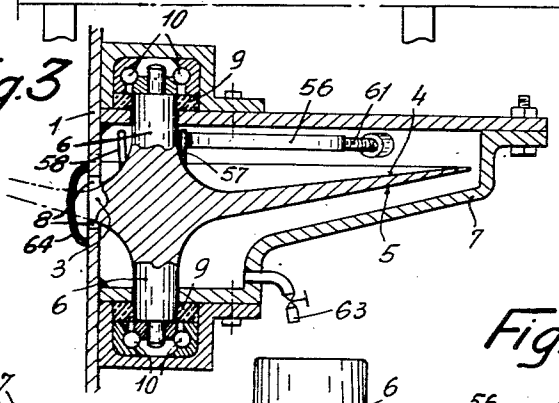
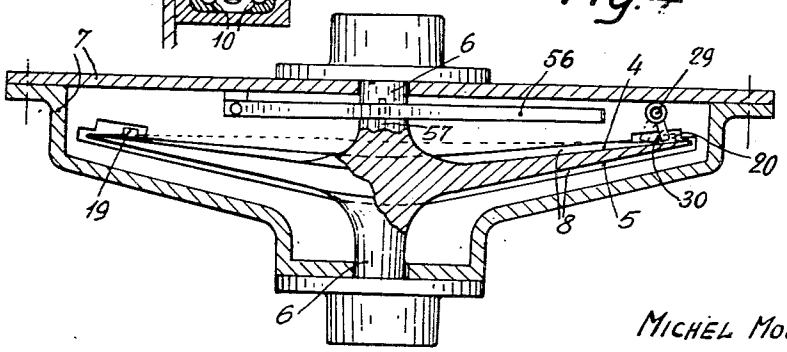


Fig.4



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STABILIZING DEVICE FOR SHIPS

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Fig. 5

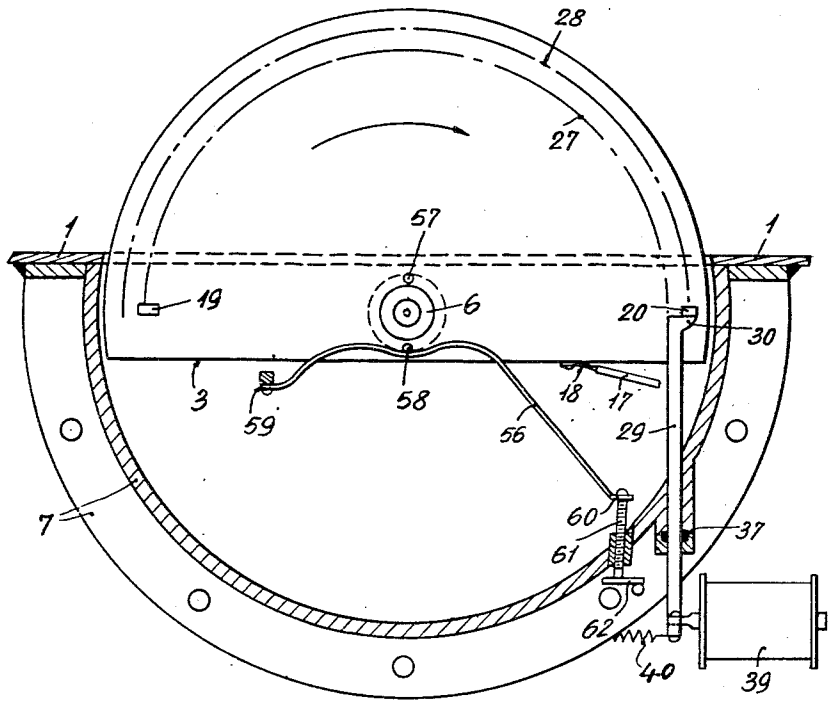


Fig. 8

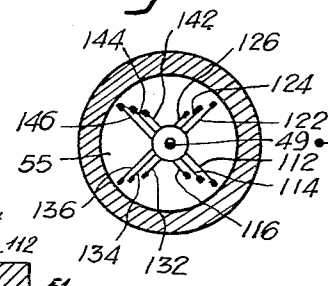


Fig. 6

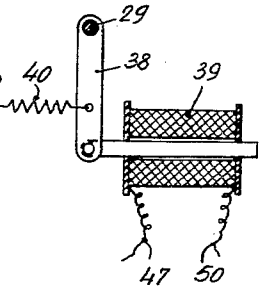
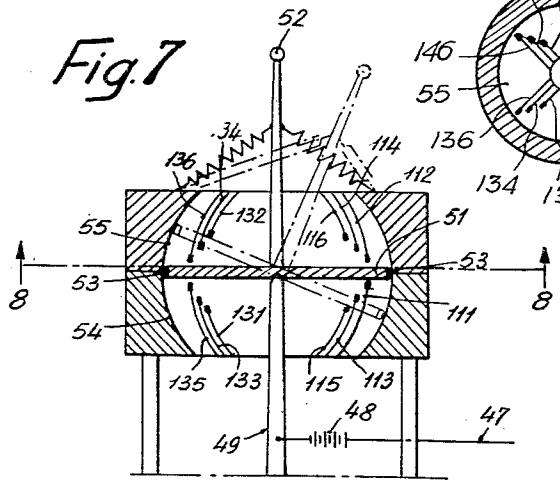


Fig. 7



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United States Patent Office

2,705,934

Patented Apr. 12, 1955

2,705,934

STABILIZING DEVICE FOR SHIPS

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Application May 7, 1952, Serial No. 286,519

Claims priority, application France May 22, 1951

11 Claims. (Cl. 114—126)

This invention relates in general to means for stabilizing ships against rolling and pitching and more particularly to a novel device adapted to counteract oscillations of this kind developed on ships by sea conditions.

It has already been proposed to counteract roll and pitch movements produced by the swell of sea on a ship by disposing along the ship's sides below the waterline collapsible surfaces similar to inclined planes so that when the ship is travelling forces are developed in directions adapted to counteract or oppose the undesired roll and pitch motion.

The fitting and control of pitch and roll control devices as hitherto known, require complicated, costly and cumbersome installations and equipment which can not be installed on existing ships and are at best adapted to be fitted on ships under construction. In addition to these drawbacks resulting from the complicated installations required, the results obtained were definitely insufficient. Notably, one familiar trend in the field was to endeavor to obtain automatic stabilization by resorting to controls actuated by apparatus responsive to the movements to be suppressed, such as gyroscopic apparatus; however, to render operative the apparatus against these movements, it was necessary to allow such movements to take place to a certain extent so that any corrective or compensating actions brought about at this time were too belated to be efficient.

Now this invention is based on a new principle consisting in utilizing as stabilizing surfaces, along the ship's sides, a plurality of movable blades disposed below the waterline and having in general the shape of circular segments retractable in slots provided in these sides and rotatable about axes inclined at an angle close to the perpendicular, these blades being only responsive to the hydrodynamic action produced by the water streamlines impinging thereagainst, the rotation of these blades being controlled at will for stoppage either in the outer or stabilizing position or in the retracted or inoperative position through locking means actuated from a central pilot room.

Since no other source of power than that developed by the slip stream resulting from the movement of a ship under way is required for moving the blades, it is obvious that the device can be constructed in a relatively simple and therefore economical manner while the space occupied thereby is reduced to a minimum. Besides, since the central control amounts to the operation of locking means and involves but a trivial power consumption, it can be constructed in the form of simple electrical or hydraulic circuits with a suitable relay means at each locking means. Thus, existing ships can be equipped with the novel stabilizer even if no provision has been made therefor when the ships were planned and constructed.

Of course, the central control could be of the automatic type but in order to avoid the time lag inherent to all automatic devices for the above-disclosed reasons a manual control will be preferred and an experienced pilot will thus be able to operate the device with reflex actions according to the angular motion he will foresee for the ship under his control. It is known in fact that oscillations either of a rolling or pitching character do not occur in an ill-regulated manner but have a certain recurrency called rolling or pitching period, according as the phenomenon affects the ship's angle of heel or her trim, respectively; thus, with a little experience the pilot will be able to foresee the nature of the oncoming oscillations and

therefore to handle his ship so as to counteract these oscillations.

Preferably, the control member will consist of a lever of the so-called "control-stick" type as used in aviation, which is movable in all directions from the vertical about a center of rotation and this control will be so disposed that any reactions exerted on the ship by one control movement will tend to oscillate the ship in the same sense as this lever. Thus, when the normally vertical control lever is moved to the left the device will tend to lower the left side of the ship while lifting the right side, this movement being produced for avoiding the consequences of a rolling surge likely to lift the left-hand side while lowering the right-hand side; similarly, when the control lever is pushed forward the ship's bow will dip to palliate a pitching surge likely to lift the bow; finally, a combination of both effects will be obtained by moving the control lever obliquely in relation to the ship's axis.

According to another characteristic feature of the invention the adjustment of the compensating forces brought into play for counteracting roll and pitch oscillations is effectuated neither by varying the angular position of the stabilizing surfaces nor by causing these surfaces to project more or less from the sides of the ship, but by varying the number of surfaces kept in operative position; this feature will make it possible to utilize surfaces having smaller dimensions, which are more easily and readily constructed, fitted and handled, while the framing or housing therefor can also be kept within reasonable size limits.

According to a specific embodiment of the invention, blades inclined in opposite directions are utilized so that certain blades will receive an upward thrust from the water while other blades will receive a downward thrust. The blades may be arranged by groups along-side the ship, fore and aft thereof, and each group may comprise blades having the aforesaid opposite directions of inclination, means being provided for causing the blades of same inclination in a same group to be actuated in a progressive manner or stepwise, according to the strength of the stabilizing forces required.

For a more complete understanding of the invention, reference may now be had to the following description taken in connection with the accompanying drawings showing diagrammatically by way of example how the invention can be carried out practically. In the drawings:

Figure 1 is a simplified plan view showing a ship provided with the stabilizer according to the invention;

Figure 2 is a fragmentary elevational view of one of the ship's sides, showing a pair of oppositely-inclined blades pertaining to the same group of blades;

Figure 3 is an axial section of a blade device, taken on lines 3—3 of Figure 2 at right angles to the ship's side;

Figure 4 is an axial section of a blade device, taken in a plane parallel to the ship's side;

Figure 5 is another sectional view of a blade housing taken at right angles to the axis thereof;

Figure 6 shows the operation of a blade locking device;

Figure 7 is a longitudinal vertical section of the central switch and lever arrangement for controlling the stabilizer;

Figure 8 is a diagrammatic plan view from beneath showing the upper half of the switch of Figure 7 and taken on line 8—8 of this figure, this view completing the lower half of the switch shown in Figure 1.

The diagram of Figure 1 shows in plan view a ship **1** provided with the stabilizing device according to the invention which comprises four groups of stabilizing blades disposed along the fore half of the port side, the fore half of the starboard side, the aft half of the port side and the aft half of the starboard side, respectively. Each group consists of a plurality of blades, the embodiment shown comprising six blades per group designated at **11** to **16** for the first group on the fore of port side, **21** to **26** for the second group on the fore of starboard side, **31** to **36** for the third group on the aft of port side and **41** to **46** for the fourth group on the aft of starboard side, respectively. In each group of six blades three blades are so oriented as to be responsive to a downward thrust from the water when the ship progresses normally ahead, while the other three blades are subjected to an upward thrust. The

downward-thrusted blades, that is the blades having their upper faces stricken by the water stream, are designated with odd numbers (**11**, **13**, **15**, **21**, etc. . . .) while the upward-thrusted blades, that is the blades having their lower faces stricken by the water stream, are referenced with even numbers.

The control system is so arranged that when the control lever is moved away from its normal inoperative central position in which all the blades are retracted inside their housings, certain blades will be moved from their inoperative or retracted positions to their operative or protruding positions and that in a given group one, two or three blades of the same inclination will be brought into their operative positions while the other blades of the same groups but of opposite inclination will remain inoperative or retracted; thus, it will be possible to proportion the number of similar blades brought into play in one group by modifying the amplitude of the angular movement produced with the control lever, with a minimum of one and a maximum of six blades per group in the example illustrated.

The blades may be positioned in the intervals between consecutive transverse elements **2** of the ship's frame structure supporting the side wall **1** of the ship. Figure 2 shows diagrammatically in elevation a pair of adjacent blades **11**, **12** of opposite inclinations, the arrows indicating the direction or movement of the water in relation to the ship's side. Each blade consists of a disk having the shape of a circular segment extending over more than 180° about its center and bound by a rectilinear or substantially a rectilinear chord **3** (Figure 5). In order to increase their strength these blades, instead of having a uniform thickness, consist of a volume formed between two coaxial cones **4**, **5** having very wide and slightly different angles so that the blade thickness will be greater at the center than at the periphery of each blade; the wider-angle cone **4** forms a concave face against which the water is caused to impinge and the other cone **5** forms the opposite convex face of the blade. Each blade has a central integral shaft **6** and the assembly is rotatably mounted in a housing **7** having an aperture **8** the contour and direction of which correspond to the profile and setting of the blade. Of course, the housing **7** is in water-tight relationship with the inner face of the ship's wall so as to prevent the ingress of water through this housing into the ship. When the blade is in its inoperative or retracted position its chord edge **3** is flush with the aperture or slot **8** and when the blade is in its operative or outer position, that is after having been rotated through 180°, the blade emerges from the ship's side and the projecting portion thereof forms a circular segment extending over a little less than 180°. The upper and lower ends or journals of shaft **6** pass through mechanical seals or packings **9** and are rotatably mounted in bearings **10** to which access may be had from inside the ship for inspection and maintenance; in the embodiment shown ball bearings are fitted but any other suitable bearing arrangement may be resorted to for the shafts **6**.

Along its chord edge **3** each blade may be provided with a small deflector plate **17** fixed to the blade through a flexible or resilient strip member **18**, the arrangement being such that when the blade is in its retracted position the water impinging on this deflector plate **18** will tend to start the angular movement of the blade to its operative or outer position; the provision of a flexible or resilient strip **18** will avoid any risk of breaking the deflector plate, for instance in case the latter were hit by an obstacle. When the blade is partly or fully extracted from its housing the action exerted by the water on the plate will still tend to rotate the blade in the direction corresponding to the direction of travel of the ship.

The angular displacement of the blade is limited by the provision of a pair of stops on the blade itself, these stops cooperating with the bolt of a two-position locking means whereby in one position of this locking means the blade is held in either of its two operative or inoperative positions whereas in the other position of the locking means the blade will be urged by the water pressure to its other position.

In the embodiment shown diagrammatically in Figures 4 and 5 one face of the blade carries a pair of stop members **19**, **20** positioned at slightly different radiuses as shown so that when the blade is rotated these stop

members will describe different concentrical paths **27**, **28** respectively; the movable locking means consists of a rocking shaft **29** carrying or formed with a bolt portion **30** movable across either of the aforesaid paths **27**, **28** by rocking shaft **29** accordingly. The shaft **29** passes through the wall of the housing and a watertight seal **37** and is formed inside the ship with an arm **38** adapted to be actuated by an electromagnet **39** against the resilient action of a return spring **40**. One terminal of the electromagnet is connected through a wire **47** to one terminal of a suitable source of current **48** the other terminal of which is connected to the central contact **49** of a multi-contact switch responsive to the control lever of the stabilizer. The other terminal of the electromagnet is connected through a wire **50** to a peripheral contact of the switch which corresponds to the blade in question. In order to facilitate the understanding of these connections the twenty-four peripheral contacts of the switch are each designated with the same reference numbers as the corresponding blade plus 100.

The switch has a movable portion rigid with the control lever and a fixed portion. The movable portion has the shape of a circular disk **51** pivotally mounted by its center on the aforesaid central contact stud **49** and carrying at right angles to its plane a control lever **52** normally resiliently held by spring or other suitable means in a vertical position when the stabilizer is not used. On its peripheral edge the disk **51** carries a conductive ring **53** electrically connected with the central contact stud **49**.

The fixed portion of the switch consists of two superposed sections of hollow hemispheres **54**, **55** having substantially the same center and radius as the disk **51** and extending between their joining diametrical plane and parallel planes at each end.

If we compare the horizontal plane separating these hemispheres to the plane of the equator, the contacts **111** to **116**, **121** to **126**, **131** to **136** and **141** to **146** are arranged along meridian lines on the inner face of these hemispheres so as to contact the conductive ring **53** when the lever **52** is moved through a sufficient angular distances from its normally vertical neutral position. All the odd-numbered contacts are carried by the lower hemisphere **54** and all the even-numbered contacts by the upper hemisphere **55**. The contacts corresponding to a same group of blades will be positioned on adjacent meridian lines forming with the vertical plane parallel with the longitudinal axis of the ship (see section of Figure 7) an angle of approximately 45°. From the foregoing, it is obvious that the contacts are spaced about the vertical axis of the switch according to substantially the same arrangement as that of the corresponding blades round the ship.

The engagement of one contact by the conductive ring **53** will energise the electromagnet of the locking means of the corresponding blade, thereby bringing the bolt **30** across the path **28** and maintaining the blade in its outward position (Figure 5); when this engagement ceases the energising circuit for the electromagnet is open and the spring **40** will return the bolt **30** in its other position across the other path **27**, thereby allowing the blade to resume its inoperative or retracted position. The switching of the bolt member **30** from one position to another is almost instantaneous and as soon as one stop **19** or **20** of the blade is released this blade will rotate through another half-revolution and be stopped in this new position; as a result, with this arrangement the blades are very quickly responsive to any handling of the control lever **52**.

When any one of the peripheral contacts closed its circuit the diametrically opposite contact will also close its circuit so that the action produced for example by a downward thrusted blade will be complemented by the action produced by an opposite upward-thrusted blade; in other words, two opposite blades (the reference numbers of which total **57** in each case for facilitating the understanding of the arrangement; for instance blades **36** and **21** are simultaneously moved, blades **35** and **22**, **11** and **46** etc.) are always actuated simultaneously, one blade (designated by an odd reference number) exerting a downward action on one side and at one end of the ship while the other blade (designated by an even reference number) exerts an upward action on the opposite side and at the opposite end of the ship.

The three contacts of each hemisphere which corre-

spond to the three blades of same inclination in any group of six blades extend from tiered levels towards the pole so as to become operative and close their respective circuits at progressively inclined positions of the control lever; thus, contact **11** will be closer to the equator than contact **113**, and contact **115** will be positioned at a still greater distance from the equator. As a result, when the control lever is inclined progressively in order to close the circuits of contacts **111**, **113** and **115** (at the same time as the opposite contacts **146**, **144** and **142**) it will first actuate the blade **11** (together with blade **46**), then the action produced by this blade will be supplemented by that of blade **13** (with blade **44**) and finally by that of blade **15** (with blade **42**).

The operation of the stabilizer appears clearly from the foregoing.

If, for example, the pilot wants to counteract the ship's tendency to lift her bow, he will push the control lever forward, thereby releasing the blades **11**, **21**, **46** and **36**; then, according to the amplitude of the angular movement impressed to this lever, the blades **13**, **23**, **44** and **34** finally the blades **15**, **25**, **42** and **32** will be brought into play. While the operation of blades **11**, **21**, **13**, **23**, **15** and **25** will tend to lower the ship's bow, owing to the downward pressure exerted by the water on these blades, the operation of blades **46**, **36**, **44**, **34**, **42** and **32** will tend to lift the ship's stern so that the combined actions of both series of blades will supplement each other. If the control lever is moved to the rear the twelve other blades will be operated with the opposite result. If it is desired to avoid the ship's tendency to lift her port side, the pilot will move his control lever to the left in order to release firstly the blades **11**, **35**, **46** and **22**, then the blades **13**, **33**, **44** and **24** and finally the blades **15**, **31**, **42** and **26**, thereby developing upward thrusts on the port side and simultaneously downward thrusts on the starboard side. The opposite result is obtained by moving the control lever to the right.

In order to prevent the blade from striking the cooperating stop member with excessive force at the end of an angular movement between its operative and inoperative positions, a shock damping means associated with the stop members or a braking means adapted to slow down the velocity of rotation of the blade to and from either positions may be provided. A braking device of this kind is illustrated diagrammatically by way of example in the accompanying drawings; it consists of a suitably shaped leaf spring **56** acting upon a cam or a pair of pins **57**, **58** carried by the blade or its shaft and adapted to deflect the leaf spring **56** at the end of a rotational movement of the blade. One end **59** of the leaf spring **56** may be anchored to the blade housing **7** and the other end **60** may be fixed to an adjustment device consisting in the example shown of a screw-threaded rod **61** passing through the housing for actuation from inside the ship by means of a conveniently shaped end **62**. The pin **57** may be so positioned that the leaf spring **56** will start the blade rotating as soon as the latter is released by the locking means **29**, **30**, that is, when these means have been rotated so as to clear the path **27** for the stop member **19**; in this case the device **17**, **18** can be dispensed with. For this purpose, pin **57** is placed in a position slightly in front of the axis of rotation of the blade when the same is retracted, the pressure of spring **56** tending to push externally said pin on the front of the axis of rotation and thus to rotate the blade.

Each blade housing **7** may be provided with a pipe **63** having fitted thereacross a suitable valve whereby convenient chemicals can be introduced into the housing for clearing same from any deposits likely to be formed therein. By closing the aperture **8** from the outside by means of a watertight cover **64** or plaster of any suitable character the pipe **63** may be used for draining any water contained in the housing and it will be possible even to dismantle this housing for major repairs, for example the replacement of the blade itself.

It will be understood that the invention is not intented to be limited to the specific disclosure hereabove and to the embodiments shown in the attached drawings, since many structural details may be varied without departing from the spirit and scope of the invention.

What I claim is:

1. A stabilizing device for a ship under way comprising in combination, a plurality of blades distributed on both sides of the ship, the sides of the ship having a corresponding plurality of slots below the water line, mounting means for mounting said blades, one within each of one of said slots, rotatable about an axis forming a small acute angle with a perpendicular axis, each of said blades having a generally semi-circular configuration and being mounted relative to the respective slot so as substantially fully to protrude from the respective side of the ship in one rotational position and to be substantially fully retracted in the ship in another rotational position about 180° opposite to the first position, and said first position being the operative position of the blades and said second position the inactive position, at least one blade on each side having a configuration and being positioned so as to exert an upward thrust upon the ship and at least one blade on each side of the ship having a configuration and being positioned so as to exert a downward thrust upon the ship in response to the hydrodynamic action of the flow of water along the blades when the ship is under way, the said flow of water also tending to impart a unidirectional rotation to the blades, a plurality of releasable locking means, each coacting with the respective one of said blades, for selectively and individually locking each of said blades either in its operative position or in its inactive position, and common electric remote control means controlling said locking means for actuating the latter for the purpose aforesaid.

2. A stabilizing device according to claim 1, wherein the said control means are operatively connected with said locking means so as simultaneously to control the positions of a selected number of said plurality of blades.

3. A stabilizing device according to claim 2, wherein the said blades are arranged in groups, each group including at least one blade producing an upward thrust and at least one blade producing a downward thrust when the ship is under way.

4. A stabilizing device according to claim 3, wherein each blade for producing a thrust in one direction is correlated with a blade for producing a thrust in opposite direction and disposed in a diametrically opposite location in relation to the spatial location of the first mentioned blade on the ship, and where the said remote control means are arranged simultaneously to control the positions of correlated pairs of blades.

5. A stabilizing device according to claim 1, wherein braking and damping means are provided for each blade for braking and damping the rotation of the blades from one of the blade positions into the other.

6. A stabilizing device according to claim 1, wherein each of the said blades is provided with an auxiliary blade protruding from the respective side of the ship when the blade is in its inactive position, the said auxiliary blades being positioned at an angle to the flow of water along the sides of the ship thereby producing a force tending to rotate the respective blade into its operative position.

7. A stabilizing device according to claim 1, wherein casings on the inside of the sides of the ship limit the ingress of water into the ship through said blade slots to the space sealed off by said casings.

8. A stabilizing device according to claim 1, wherein a cover is provided attachable to the outsides of the ship over each slot for preventing the ingress of water through a slot thus covered.

9. A stabilizing device according to claim 1, wherein the locking means for each blade comprise two stop members at diametrically and radially spaced points of the surface of one of the sides of each blade, a locking member selectively movable into engagement with either of said stop members, engagement of the locking member with one of said stop members locking the respective blade in its operative position and engagement of the locking member with the other stop member locking the respective blade in its inactive position, and electromagnetic means coacting with said locking member for controlling the position thereof by the energization of the electromagnetic means.

10. A stabilizing device according to claim 1, wherein the locking means for each blade comprise electromagnetic actuating means, and wherein the said remote control means comprise stationary contact means including a plurality of contact elements, each connected in circuit with one terminal of said electromagnetic means, and movable contact means including a contact conrol member connected in circuit with the other terminal of all

said electromagnetic means, the said control member being movable into engagement with selected ones of said contact elements thereby completing energizing circuits for the respective electromagnetic means for causing a corresponding positioning of the respective blades.

11. A stabilizing device according to claim 10, wherein the said contact control member comprises a joystick freely pivotal about a perpendicular axis and a contact ring secured to said joystick for movement in unison therewith in a palne perpendicular to the axis of the joystick, the contact elements of said stationary contact means being disposed for engagement by said contact ring, and wherein the said blades are arranged in groups symmetrically distributed along the sides of the ship, the contact elements associated with blades in the same group being arranged in a spacial relationship such as to cause engagement between said contact ring and the contact elements associated with blades occupying the same position in symmetrically arranged groups, the number of engaged contact elements being controllable by the angular position of said joystick relative to a perpendicular axis, the perpendicular position of the joystick being the neutral position of the control member in which no contact elements are in engagement with the contact ring.

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