

Nov. 27, 1923

H. H. THOMPSON ET AL

1,475,460

STABILIZED SHIP

Filed April 14, 1919

2 Sheets-Sheet 1

Fig. 1.

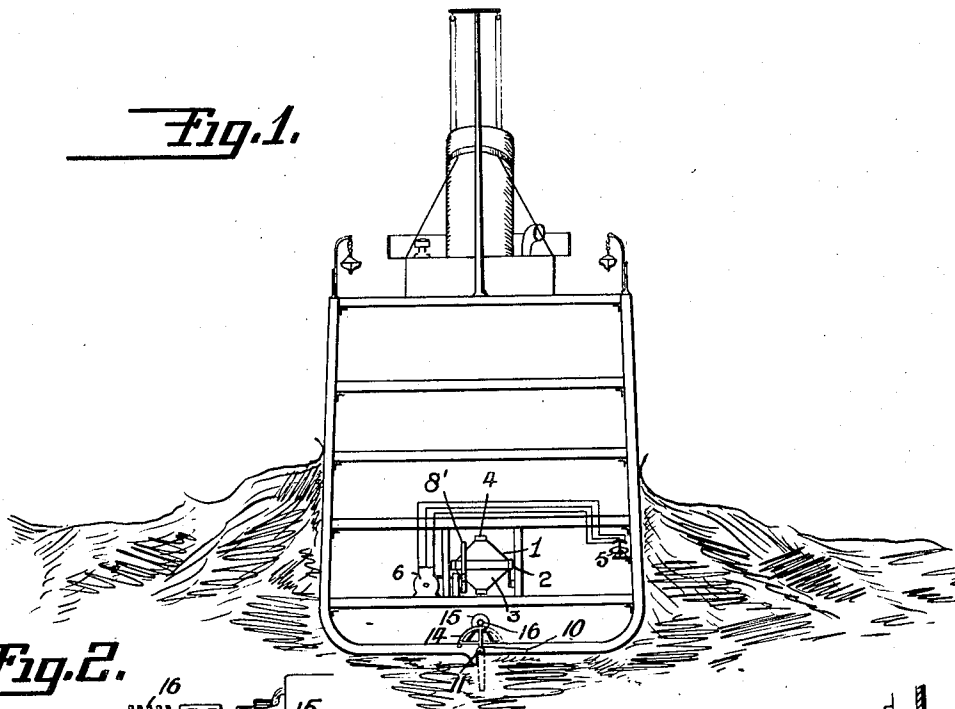


Fig. 2.

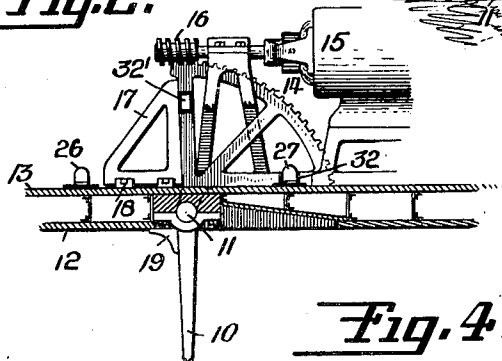


Fig. 3.

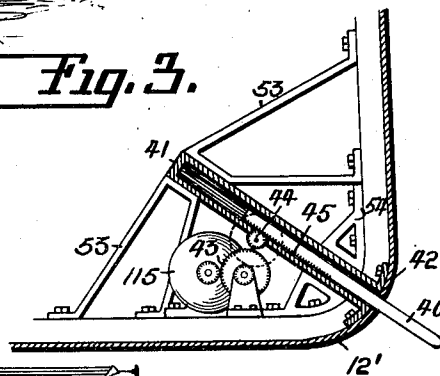
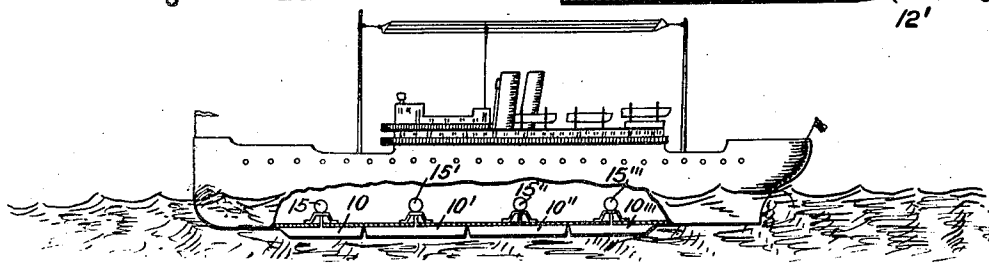


Fig. 4.



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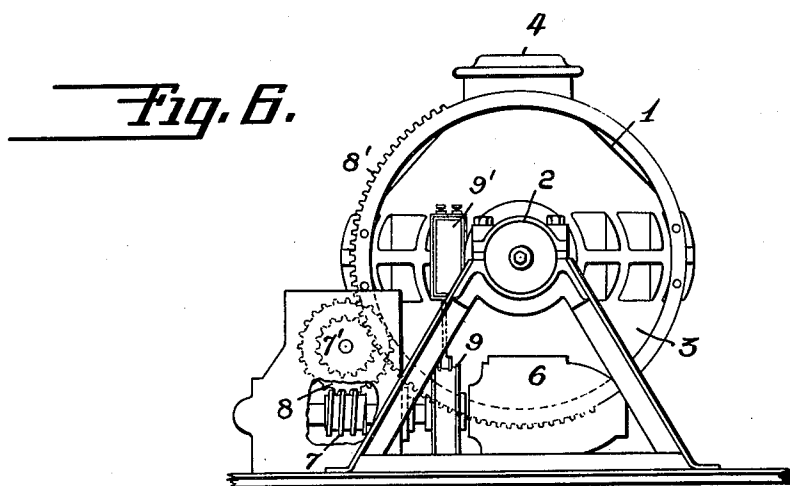
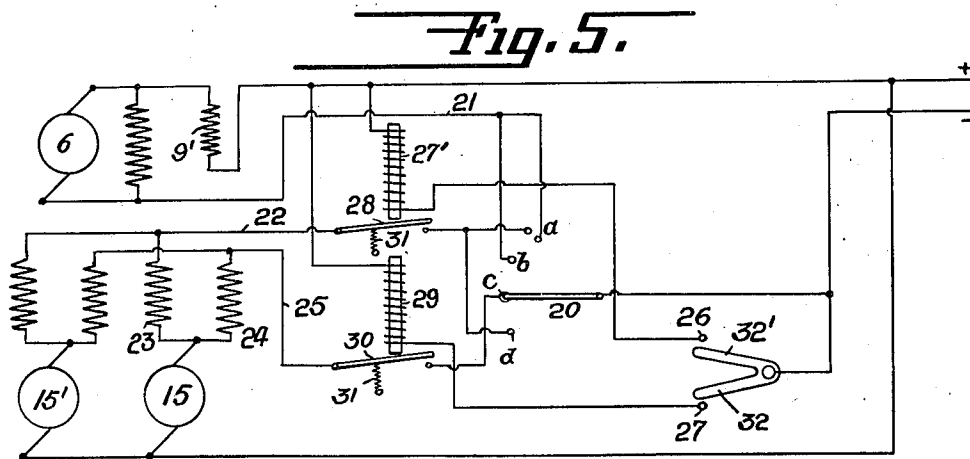
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

HERBERT H. THOMPSON AND ALEXANDER E. SCHEIN, OF BROOKLYN, NEW YORK, ASSIGNORS TO THE SPERRY GYROSCOPE COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK.

STABILIZED SHIP.

Application filed April 14, 1919. Serial No. 289,991.

To all whom it may concern:

Be it known that we, HERBERT H. THOMPSON and ALEXANDER E. SCHEIN, citizens of the United States of America, residing at 1487 E. 18th St. and 476 Clinton Ave., Brooklyn, respectively, in the county of Kings and State of New York, have invented certain new and useful Improvements in Stabilized Ships, of which the following is a specification.

This invention relates to means for reducing the rolling or pitching of ships without increasing their resistance to motion through the water. It is now well recognized by naval architects that a ship which is rolling or pitching consumes a great deal more energy when traveling at a definite speed than a ship in calm water. This is due in large part to the increased wetted surface of the ship when rolling or pitching and also to the displacement of water first to one side of the vessel and then to the other as the ship rolls. To reduce the rolling it has become the practice on large ships and war vessels to employ bilge keels extending along the bottom or sides of the vessel, such bilge keels acting as a brake to quickly damp out oscillations imparted by the waves. Such keels, of course, do not prevent rolling but simply serve to reduce the amplitude. Such keels, however, possess the disadvantage that they increase materially the wetted surface of the ship and, therefore, increase its resistance. In fact large bilge keels such as employed on fast passenger and navel vessels consume from five to ten per cent of the power of the vessel in still water and when the ship is pitching the power consumption is greatly increased since the bilge keel tends to drive the bow of the vessel under the water when plunging thereby dissipating power uselessly. As when pitching a considerable thrust is caused by the projected area or planing effect of the bilge keels varying from zero to a maximum as the vessel pitches, the average resistance due to this item alone being over 15% of the total head resistance.

It is the object of this invention to reduce or entirely eliminate the aforementioned losses. To accomplish the foregoing purpose we propose to provide the ship with a gyroscopic stabilizer and to eliminate the employment of bilge keels except possibly in the

case of break down or shut down of the gyroscope or in case exceptionally heavy weather is encountered when both the gyroscope and bilge keels may be employed.

Referring to the drawings in which what we now consider the preferred form of the invention is shown:

Fig. 1 is a diagrammatic transverse section of a ship showing our alternative means for reducing the rolling of the ship.

Fig. 2 is an enlarged detail view of one form of movable bilge keel and operating motor therefor.

Fig. 3 is a similar view of a modified form of bilge keel which extends outwardly from the turn in the bilge, preferably from the middle thereof as shown in Figs. 1 and 2.

Fig. 4 is a side view of a vessel showing the proposed method of operating a long bilge keel.

Fig. 5 is a wiring diagram showing the preferred methods of controlling the gyroscope and movable bilge keel.

Fig. 6 is a side elevation of the stabilizing gyroscope.

For stabilizing the ship during normal operation thereof we prefer to employ a gyroscopic stabilizer of the Sperry type such as disclosed in U. S. patent to Elmer A. Sperry 1,232,619, "Ships' stabilizing and rolling apparatus", dated July 10, 1917, or in the pending application of Elmer A. Sperry 74,075, filed January 25, 1916. According to this method one or more main or stabilizing gyroscopes 1 are employed which is mounted for precession on the ship about an axis 2 which is at an angle to the longitudinal axis of the ship and in this instance is shown as transverse. The rotor of the gyroscope is enclosed within a casing 3 and rotates about a normally vertical spinning axis 4. The gyroscope is controlled from a much smaller control gyroscope 5 so that its action is properly timed with the roll of the ship. The control gyroscope governs a motor 6 geared to the main gyroscope through worm 7, worm wheel 8, pinion 7', and large gear sector 8' on the casing 3 so as to accelerate or retard the precession thereof. A brake 9 controlled by a solenoid 9' is preferably employed in connection with the motor to assist in bringing the gyroscope to rest, such brake being normally applied, and disengages only on excitation of the motor 6. It will, therefore,

be seen that the gyroscope is normally locked about its precessional axis by the brake and the locking effect of the worm gears, and, therefore, inoperative to stabilizing the ship when the motor 6 is inoperative.

The vessel is also shown as equipped with a movable bilge keel 10 which in this instance is shown as pivoted at 11 between the outer bottom or bilge 12 of the ship and the false bottom 13. The bilge keel 10 has secured thereto a worm gear sector 14 or other operating member by means of which the keel may be rotated out of the stream line of the vessel and hence the resistance due thereto eliminated. An actuating motor 15 is shown as provided with a worm 16 meshing with said gear 14 to rotate the said gear sector. If desired an angle member 17 hinged to the floor 18 may be provided to lock the gear in the position shown and hence to assist in holding the bilge keel in the operative position in heavy weather. In this position the keel may rest against outer reinforcing blocks or longitudinally extending members 19. Even without such locking means, however, the bilge keel will be held firmly in place by means of the worm and worm wheel connection between the gear sector and motor.

Preferably we control the motor 15 automatically from the gyroscope so that when the gyroscope is started up, or at least when rendered operative, the bilge keel is moved to an inoperative position without the stream line of the vessel and when the gyroscope is shut down or rendered inoperative the bilge keel is returned to its operative position. For this purpose we have shown in the circuit of the motor 6 (Fig. 5) which controls the gyroscope 3 a means for actuating the motor 15 in one or the other direction depending upon the condition of the stabilizing gyroscope. For this purpose we have shown a switch 20, which when on point *a*, as shown in Fig. 5, excites motor 6 through wire 21 and also the motor 15 through wire 22. Motor 15 may be provided with two oppositely wound field coils 23 and 24, the former only being excited when switch 20 is on point *a*. When the switch 20 is moved downwardly to point *c* the circuit through motor 6 is broken and a circuit is completed through the motor 15 through wire 25 and the oppositely wound field coil 24 thereby operating the motor in the reverse direction. Limit switches 26 and 27 are provided to shut off the motor when the keel has been moved to either limiting position. A contact 32' in circuit with one branch of the main supply engages contact 26 to energize electro-magnet 27' in the position shown in Fig. 2 which, when excited, opens a switch 28 in circuit with wire 22. A similar contact 32 engages in the other position switch 27 in circuit with a

similar electro-magnet 29 adapted to open a switch 30 in circuit wire 25. Switches 28 and 30 are held normally closed by means of springs 31. In case it is desired to employ both the gyroscope and the bilge keel at the same time, such as in extremely heavy weather, we may provide a point *c* on switch 20 so that the bilge keel may be projected and the switch arm then moved to point *b* to supply current to the gyroscope. To further effect such purpose an additional point *d* may be provided for switch 20 to place field 23 and motor 15 in said circuit so that the bilge keel may be moved to any desired position irrespective of the gyroscope. The keel being out by closing of contact *c*, contact *d* may be closed to draw the keel inwardly and opened when the keel reaches the desired position.

As shown in Fig. 4 we find desirable on account of the length of bilge keels employed on large vessels to make the same in a plurality of separate sections 10', 10'', and 10''' and to control each section by a separate motor 15', etc., all the motors, however, preferably being in the same circuit (see diagram, Fig. 5).

A modified form of bilge keel is shown in Fig. 3. This form illustrates the usual form employed on battleships and other vessels having a large beam. According to this form of the invention the bilge keel 40 is slidably mounted in a water-tight compartment 41 located adjacent the upward turn 42 of the bilge 12' of the vessel. The walls of the compartment are well braced as by means of brackets 53 and 54 extending to the sides of the bilge of the vessel so that the strains exerted on the bilge keel when extended may be properly absorbed. The bilge keel may be projected into or withdrawn from the water by means of a motor 115 which may be similar in all respects to motor 15 and which is shown as connected to the bilge keel by means of reduction gears 43 and pinion 44. Said pinion 44 meshes with rack teeth 45 preferably cut in the face of the heavy plate 40 forming the bilge keel. It will be understood that in this form of the invention also, a plurality of sections may be employed for the keel which are preferably simultaneously operated.

The operation of our invention is as follows: In a moderate sea, in other words during normal conditions, the gyroscope alone is operated, the bilge keel then being automatically and normally withdrawn beyond the stream line of the vessel by means of the governing action of the switch 20 on the motor 15 when on point *a*. In a very calm sea, both the gyroscope and bilge keel may be inoperative by moving switch 20 to point *d*. This will withdraw the keel and the gyro will be connected. On the other

hand, in a severe storm, both may be rendered operative by moving switch 20 from the first point to point *c* until the keel is in the desired position and then to point *b*.

5 In accordance with the provisions of the patent statutes, we have herein described the principle of operation of our invention, together with the apparatus which we now consider to represent the best embodiment
10 thereof, but we desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and
15 others omitted without interfering with the more general results outlined, and the invention extends to such use.

20 Having described our invention, what we claim and desire to secure by Letters Patent is:

1. The combination with a ship, of a stabilizing gyroscope thereon, a precession
25 engine connected to said gyroscope for governing the precession of the gyroscope, a movable bilge keel and means responsive to the stopping of said engine for projecting said keel into the operative position.

30 2. The combination with a ship, of a stabilizing gyroscope thereon, a lock for preventing precession of said gyroscope, a keel for said ship adjustable to operative or inoperative positions, and means brought into
35 action on the release of said lock for moving said keel to the inoperative position.

3. In combination, a ship, a gyroscopic stabilizer therefor, a keel for said ship, said keel being adjustable to operative and inoperative positions, and common controlling
40 means for controlling the position of said keel and for rendering said stabilizer operative, said means being adapted to render said

stabilizer and keel operative separately or in combination.

4. In combination, a ship, an internal
45 stabilizing element and an external stabilizing element on said ship, and a common controlling means whereby either of said stabilizing elements is automatically rendered in-
50 effective when the other of said elements is rendered effective.

5. In combination, a ship, a plurality of stabilizing elements on said ship, and a
55 common controlling means whereby any of said elements is automatically rendered ineffective when the other of said elements is rendered effective.

6. In combination, a ship, a gyroscopic
60 stabilizer on said ship, said ship having a keel movable to effective and ineffective positions, and a common controlling means whereby either said stabilizer or said keel may be automatically rendered ineffective
65 when the other is rendered effective.

7. In combination, a ship, an internal stabilizing element and an external stabilizing
70 element on said ship, and a common controlling means whereby either of said stabilizing elements is automatically rendered ineffective when the other of said elements is rendered effective and whereby both of said
75 elements may be rendered effective or ineffective.

8. In combination, a ship, a plurality
80 of stabilizing elements on said ship, and a common controlling means whereby any of said elements is automatically rendered ineffective when the other of said elements is rendered effective and whereby all of said
85 elements may be rendered effective or ineffective.

In testimony whereof we have affixed our signatures.

HERBERT H. THOMPSON.
ALEXANDER E. SCHEIN.