April 26, 1932. J. H. HAMMOND, JR 1,855,349

TORPEDO STABILIZATION

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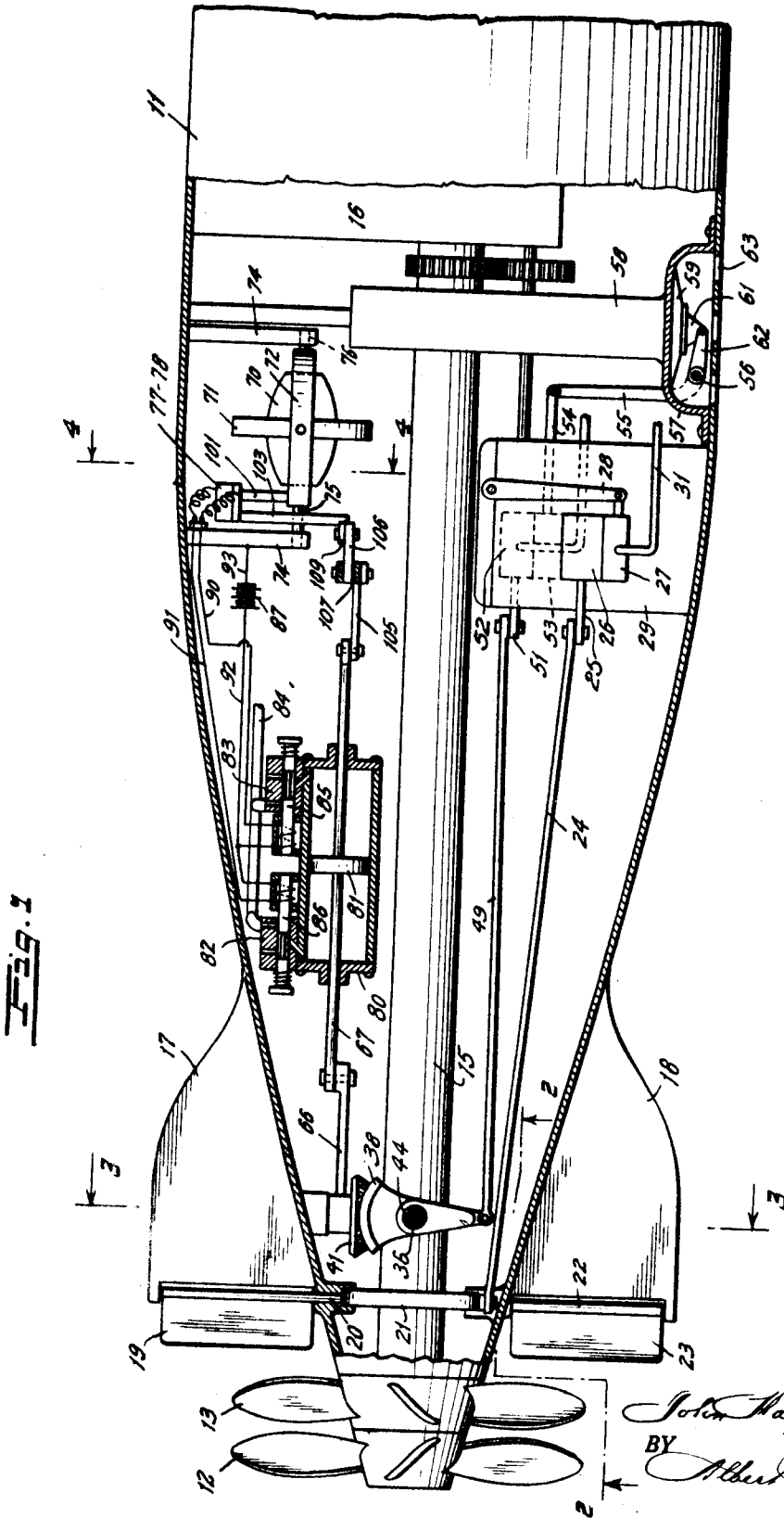


Fig. 1

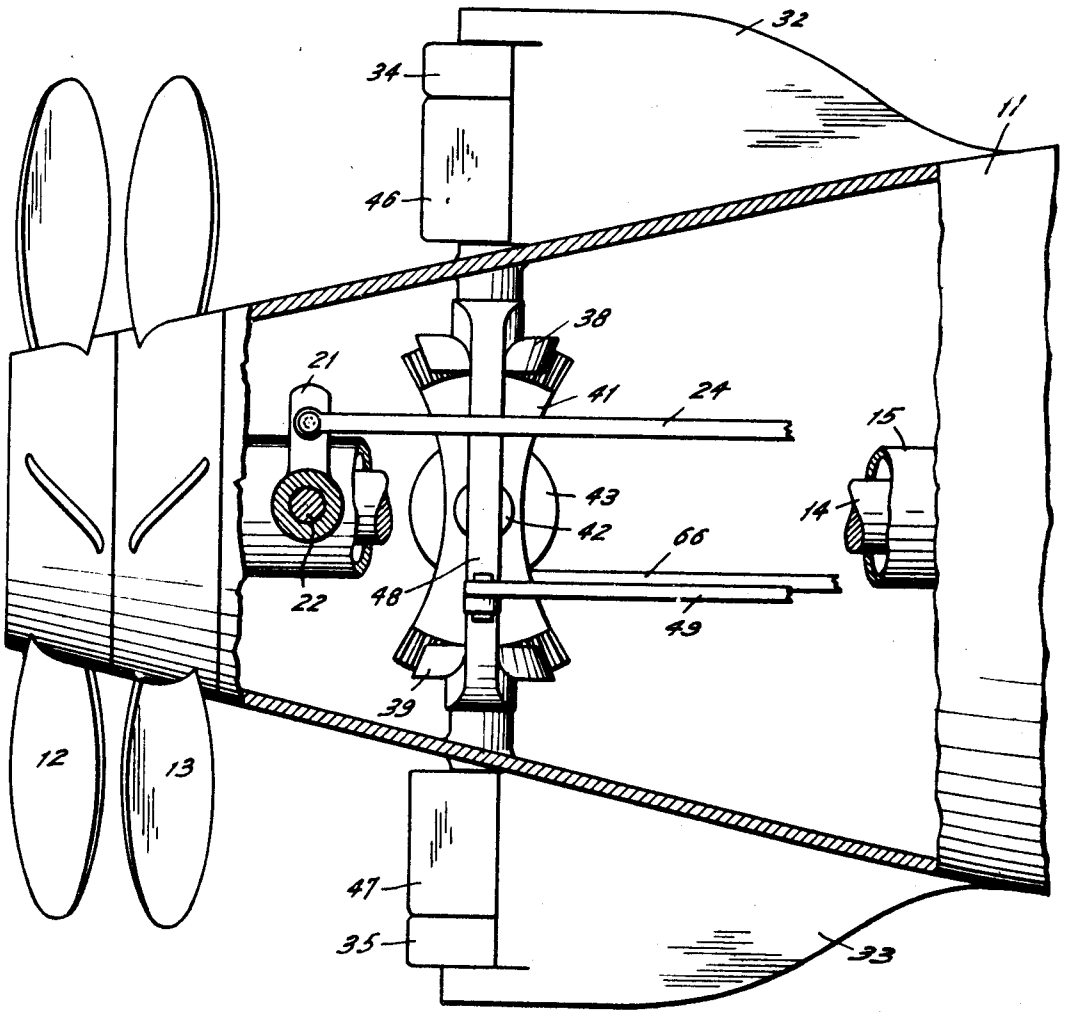
INVENTOR.
John Hays Hammond Jr
BY
Albert K. Austin
ATTORNEY.

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Fig. 2



INVENTOR.
John Hays Hammond Jr.

BY
Albert K. Austin
ATTORNEY.

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Fig. 3

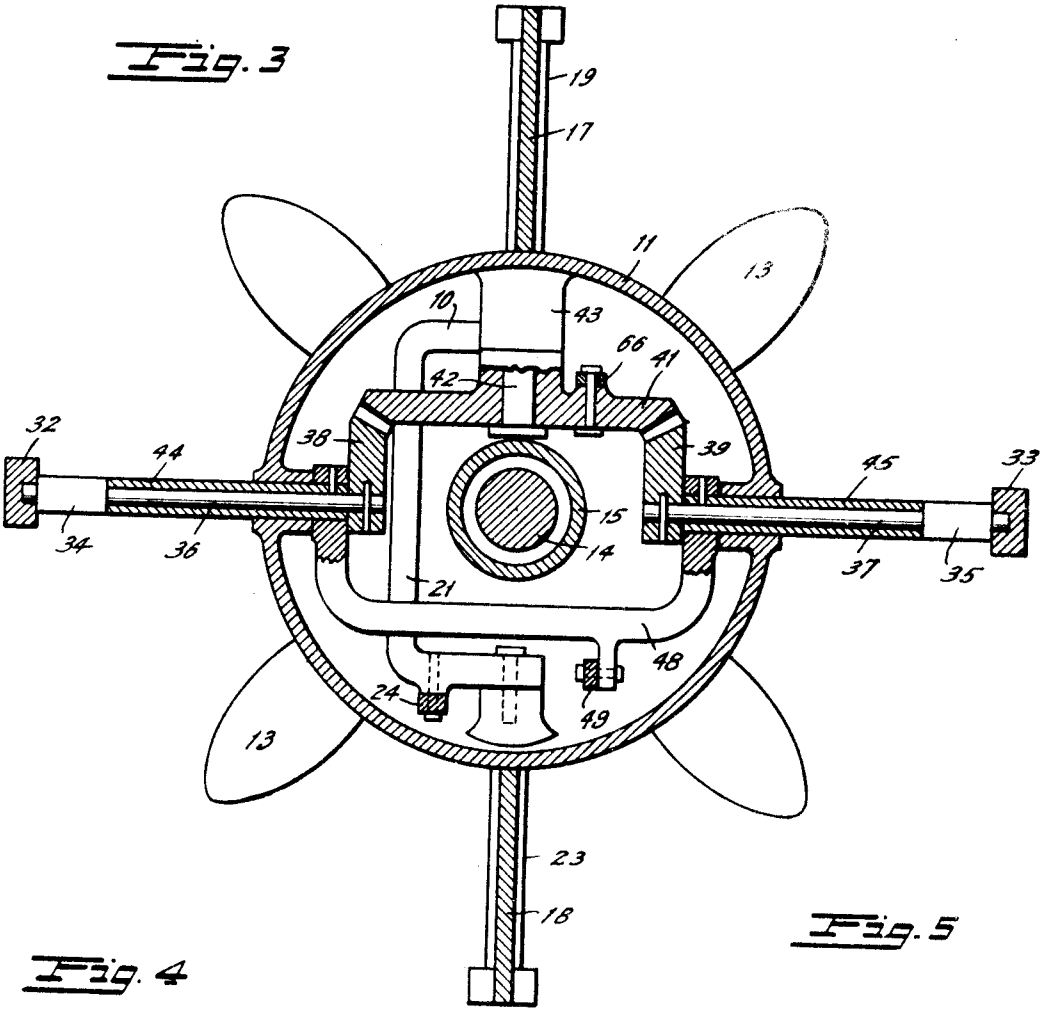


Fig. 4

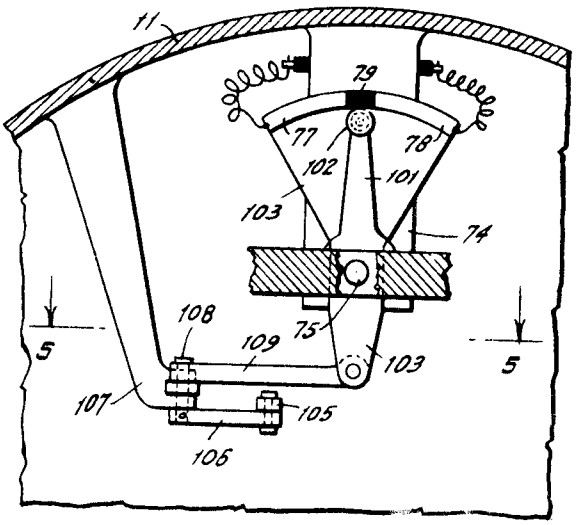
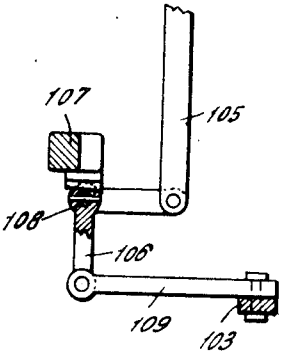


Fig. 5



INVENTOR.
Johns Hays Hammond Jr.
BY
Albert A. Austin
ATTORNEY.

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UNITED STATES PATENT OFFICE

JOHN HAYS HAMMOND, JR., OF GLOUCESTER, MASSACHUSETTS

TORPEDO STABILIZATION

Application filed October 29, 1929. Serial No. 403,208.

The invention relates to stabilizing devices and more particularly to a stabilizing device adapted to obviate the heeling of a moving body while making a turn.

The present invention is particularly adapted to a redirectable torpedo similar to that disclosed in application Serial No. 252,716, filed February 8, 1928, and entitled Paravane torpedo. In that case a torpedo was disclosed having a trailing paravane associated therewith which in response to the influence of the steel hull of an enemy ship initiated the operation of certain control devices in the interior of the torpedo so as to effect the redirection of the torpedo towards the missile which it had previously missed. During this redirecting operation the torpedo usually makes a sharp turn which, due to the difference in the location of the center of buoyancy of the torpedo and its center of gravity, causes the torpedo to heel over.

According to the present invention a torpedo is provided having oppositely positioned stabilizing rudders which are operated in opposite direction in response to the actuation of the stabilizing device. These stabilizing rudders may be disposed in substantial hinge alignment with either the steering rudders or the depth control rudders. In a concrete exemplification of the present invention a horizontal stabilizing rudder is provided which is positioned in substantial hinge alignment with the depth control rudders. The actuation of the stabilizing device is initiated in response to the relative displacement of the hull of the torpedo with a member associated with a gyroscope system and maintained in a fixed position thereby. The resultant operation of the stabilizing rudders impresses a turning moment on the torpedo opposite to that which effects the heeling thereby permitting the torpedo to make a sharp turn without listing.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is a longitudinal section of the after body of a torpedo in which the mechanism of this invention is diagrammatically indicated more or less;

Fig. 2 is a section taken on line 2—2 of Fig. 1;

Fig. 3 is a section taken on line 3—3 of Fig. 1;

Fig. 4 is a section taken on line 4—4 of Fig. 1; and

Fig. 5 is a section taken on line 5—5 of Fig. 4.

Referring to the accompanying drawings the torpedo comprises the usual shell 11 on one end of which are mounted two sets of propellers 12 and 13. These propellers are rotated in opposite directions and are driven by means of concentric shafts 14 and 15 actuated by a pair of driving turbines located in the casing 16. At the stern of the torpedo are located an upper fin 17 and a lower fin 18. In the upper fin 17 is rotatably mounted a vertical rudder 19, secured to a shaft 20, which has a bearing in the hull of the torpedo. To the lower end of this shaft there is pinned one arm 10 of the yoke 21, the other arm 9 being pinned to a shaft 22 which has a bearing in the hull of the torpedo. This shaft 22 is pivoted at the lower end in the fin 18 and has fixedly mounted thereon a vertical rudder 23.

To the yoke 21 there is pivotally connected one end of a rod 24, the other end of which is pivotally connected to the piston rod 25 of an air cylinder 26. This cylinder has a valve mechanism 27 controlled by a lever 28 which is operated by means of a gyroscopic mechanism indicated diagrammatically at 29. The valve mechanism 27 and cylinder 26 are supplied with air under pressure through a pipe 31. This assembly is adapted for steering the torpedo in azimuth and its construction forms no part of the present invention.

Mounted on the sides of the tail of the torpedo are two horizontal fins 32 and 33 in which are pivotally mounted two small horizontal stabilizing rudders 34 and 35. These rudders are secured to two shafts 36 and 37; to the ends of which are pinned two gear sectors 38 and 39. These sectors mesh with a double gear section 41 which is rotatably mounted on a stud 42. This stud is carried by the bracket 43 secured to the hull 11 of the torpedo. Surrounding the shafts 36 and 37 are two sleeves 44 and 45 which have bearings in the hull 11, and to which there are attached two horizontal rudders 46 and 47. Pinned to these two sleeves is a yoke 48 to which is pivotally connected a rod 49. The other end of this rod is pivotally connected to a piston rod 51 of an air cylinder 52 which is provided with a valve mechanism 53 controlled by a rod 54. One end of this rod 54 is pivotally connected to an arm 55 which is pinned to a rock shaft 56. This shaft is rotatably mounted in a casing 57 which forms part of the depth mechanism 58. This mechanism is provided with a diaphragm 59 having secured thereto a bracket 61. This bracket is pivotally connected to an arm 62 which is pinned to the rock shaft 56. The casing 57 is mounted on to the bottom of the hull 11 which is provided at this point with openings 63 so that the water may have free access to the diaphragm 59.

In order to automatically control the operation of the stabilizing rudders 34 and 35 a gyroscopic unit is provided within the torpedo body. This unit comprises a gyroscope 70 mounted in a gimbal ring 71 which is journalled on a gimbal ring 72. The ring 72 is supported in brackets 74 by pivots 75 and 76. Loosely mounted on the pivot 75 is a lever 103 having at its upper end a pair of contact segments 77 and 78 separated by insulation 79 (see Fig. 4). Fixedly secured to the gimbal ring 71 is a contact arm 101 having a roller 102 at the end thereof adapted to make electrical contact with segments 77 and 78.

For supplying the force to move the stabilizing rudder in response to the actuation of the stabilizing mechanism there is provided an air cylinder 80 having a piston 81 which is mounted on a piston rod 67. One end of this piston rod is pivotally connected to one end of a link 66, the other end of which is pivotally connected to the double gear sector 41. The cylinder 80 is provided with valves 82 and 83 for controlling compressed air supplied through pipe 84. The valves 82 and 83 are controlled by solenoids 85 and 86 respectively. These solenoids are in electric circuit with a battery 87 and with the contact segments 77 and 78 through wires 90, 91, 92 and 93, the parts being connected as shown. The connection is such that when contact is made between arm 101 and segment 77 solenoid 85 is operated and when contact is made between arm 101 and segments 78 solenoid 86 is operated.

In order to effect the actuation of the stabilizing rudders an amount proportional to the amount of torpedo list, a follow-up system is provided which comprises a link 105 one end of which is pivotally connected to the piston rod 67. The other end of this link 105 is pivotally connected to one arm of a bell crank 106 which is pivoted to the support 107 at 108. The other arm of this bell crank is connected by link 109 to the lever 103.

Operation

While the torpedo is traveling along a straight course the roller 102 will be in engagement with the insulation 79. Under these conditions the solenoids 85 and 86 will be inoperative and the piston 81 will be disposed in central position with respect to the cylinder 80 as viewed in Fig. 1. Upon the effectuation of a sharp turn to the left as observed looking aft along the longitudinal axis of the torpedo, the water pressure acting through the center of buoyancy and the centrifugal force acting through the center of gravity will constantly produce a moment which will cause the torpedo to heel over in a counter-clockwise direction as seen in Fig. 4. This will cause the lever 103 to be shifted in a counter-clockwise direction a corresponding amount. The contact arm 101, however, will always remain in a fixed position with respect to the surface of the water regardless of any movement of the torpedo. Under the aforesaid condition the roller 102 will move into engagement with the segment 78 thereby energizing the solenoid 86 and causing the valve 82 to admit air to the left end of cylinder 80 thus actuating the piston 81 to the right. This carries the link 66 to the right causing the double gear sector 41 to rotate in a counter-clockwise direction. (Fig. 2.) Through the agency of the gear sector 38 and shaft 36 the stabilizing rudder 34 will be turned downwardly and through the agency the gear sector 39 and shaft 37 the rudder 35 will be turned upwardly as viewed in Fig. 3. This will produce clockwise rotative torque on the torpedo as observed looking aft and will continue until the torpedo is returned to its upright position.

It should be noted that the stabilizing rudders will be actuated a definite amount before returning to its normal position regardless of the degree of list of the torpedo. This will tend to produce the undesirable oscillation of the torpedo. To minimize this tendency the follow up device is actuated in response to the movement of the piston 81. As the piston moves to the right (Fig. 1) the link 105 rotates the bell crank in a clockwise direction (Fig. 4) thereby moving the link 109 to the left and the lever 103 in a clockwise

direction until the roller 102 is again in engagement with the insulation 79. It will be noted thereby that the piston 81 moves an amount proportional to the relative displacement of the lever 103 and the contact arm 101 effected by the heeling of the torpedo.

As the torpedo is gradually brought back to its upright position, the insulation 79 will follow the relative motion of the arm 101, due to the follow-up action just described, until the torpedo is in its upright position when the parts will again be in their normal position as shown in Fig. 4.

The invention has been described with particular reference to its application to a torpedo but it is obvious that it may be applied equally as well to any movable body such as an aircraft etc.

What is claimed is:

1. In a torpedo, a torpedo body, a rudder post mounted thereon, stabilizing rudders fixedly secured to said post, a depth control rudder loosely mounted on said post, means for rotating said post in response to the list of the torpedo, and means for actuating said depth control rudder in accordance with the depth of the torpedo.

2. In a torpedo, a torpedo body, a rudder post mounted thereon and carrying a pair of rudders in coaxial hinge relationship, one of said rudders being fixedly secured to said post and the other of said rudders being loosely mounted on said post and operable independently of the rotation of said post and separate means for actuating each of said rudders.

3. In a torpedo, a body, a fin secured to said body, a rudder post mounted on said fin, a pair of rudders hingedly secured to said post in coaxial hinge relationship and movable independently of each other, separate means for actuating each of said rudders and causing the same to exert control over said torpedo.

In testimony whereof I have hereunto set my hand.

JOHN HAYS HAMMOND, JR.