XR 1,346,273

A. DEL SOLAR.

TORPEDO DIRECTOR.

APPLICATION FILED MAY 19, 1917.

1,346,273.

Patented July 13, 1920.

2 SHEETS—SHEET 1.

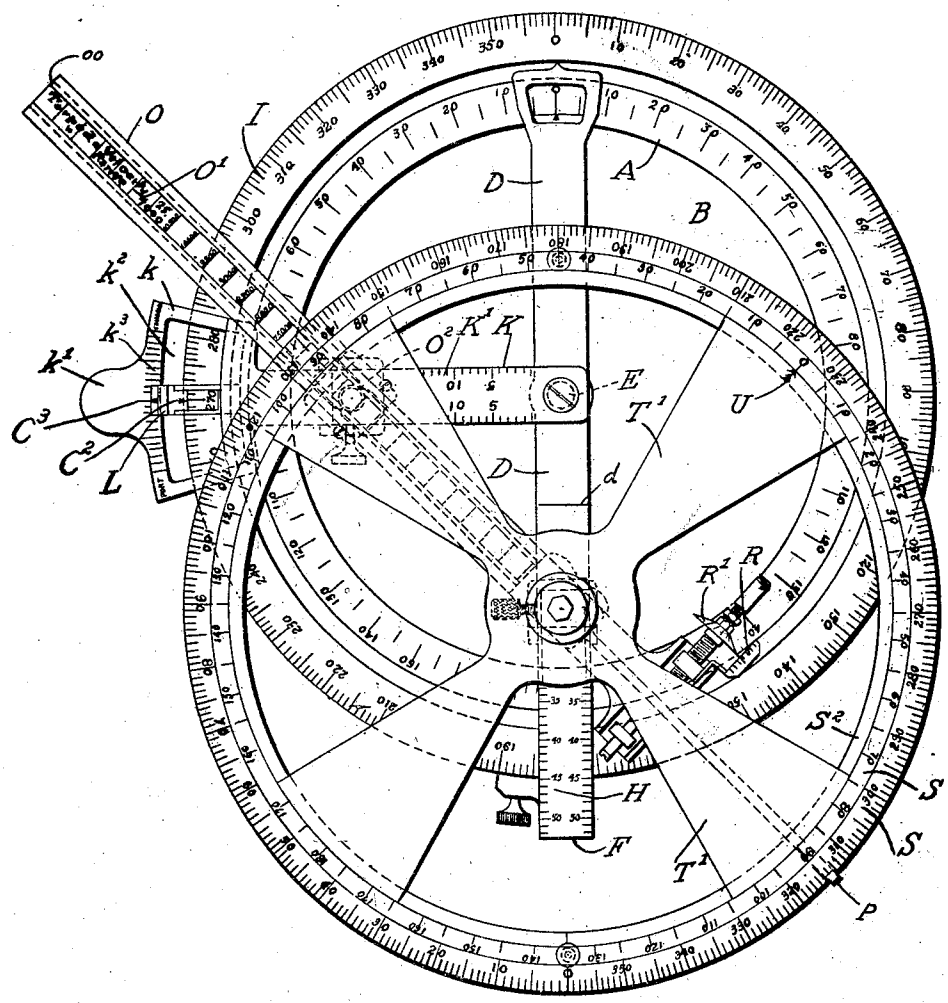


FIG. 1.

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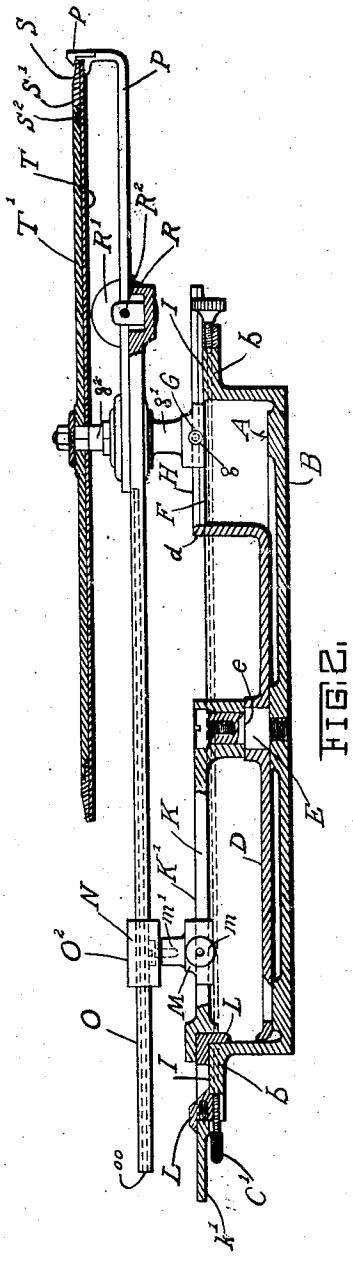


FIG. 2.

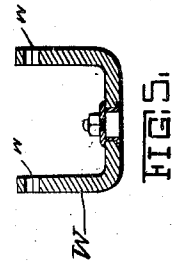


FIG. 5.

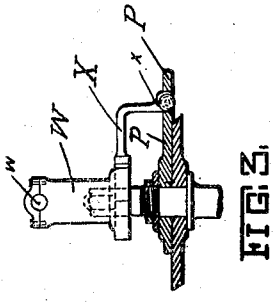


FIG. 3.

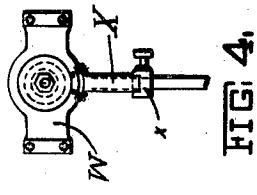


FIG. 4.

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ARISTIDES DEL SOLAR, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO ALFRED R. SHRIGLEY, TRUSTEE, OF BOSTON, MASSACHUSETTS.

TORPEDO-DIRECTOR.

1,346,273. Specification of Letters Patent. Patented July 13, 1920.

Application filed May 19, 1917. Serial No. 169,768.

To all whom it may concern:

Be it known that I, ARISTIDES DEL SOLAR, a citizen of the Republic of Chile, residing at Boston, county of Suffolk, Commonwealth of Massachusetts, have invented certain new and useful Improvements in Torpedo-Directors, of which the following is a specification.

This invention relates to torpedo control, and particularly to a device for ascertaining the proper movement of discharge of a torpedo. While the particular device herein described and disclosed is primarily adapted and intended for use in connection with the launching of torpedoes, the principles involved are undoubtedly applicable to analogous usages, and my invention is not to be limited to torpedo usage alone, even though for the purpose of setting forth and defining my invention I may be obliged to employ description and explanation in the more specific terms of this particular use.

The particular device of this application is intended for use in the indication of the proper relative position in which an enemy ship must be at the moment of discharge of the torpedo to make a hit. Various instruments have been devised for this purpose, and such instruments have been in use to a greater or less success.

There have been heretofore some devices developed for this purpose which have been used with more or less success in different navies. The usual principle of these devices is a triangulation having at its angles the point of sight, the position of enemy ship and the position of hit. In all these devices, so far as I am aware, the apparatus has included some form of sighting device angularly adjustable with reference to the keel, the angle of the sighting piece being determined by the adjustment of its guides, one in a line parallel to the enemy course and one usually in some line substantially fore and aft of the torpedo carrier.

These general features are, I believe, fundamentally correct, and my device to this limit of extent involves the same method of observation, but with certain somewhat radical changes and with certain additional and supplemental features which combine to produce greater accuracy in result and a broader field of utility.

In this art accuracy is of vital importance, on account of the importance of the operation. The torpedo is an expensive weapon, and a weapon carried in limited supply, so that a very high efficiency in its use is of greatest importance.

The factors to be dealt with in any such device where the interception of the course of an enemy ship by a torpedo is to be figured are the course and speed of the enemy ship, the course of the torpedo carrier, the speed of the torpedo, the range of the torpedo, the angle of discharge of the torpedo, the rudder set of the torpedo, the drift of tide or current and the correction of sight line due to manipulation of the steering wheel of the vessel.

The problem of producing such device is further complicated by the factor that the torpedo control may be directed either from a point of vantage, such as a bridge, from which the enemy ship may be directly sighted, or indirectly, as through a submarine periscope where no direct sighting is possible. It is further desirable to provide for various corrections and indications, all of which I have provided for by my invention, as will be fully hereinafter set forth.

It is desirable that an instrument of this type be adaptable for either direct or indirect sighting, so that the instrument may be shifted from below decks to bridge, or vice versa, and be quickly and readily adapted for operation in the position of its use.

As illustrative of my invention I have shown a form of device found well adapted to practical use and which well illustrates the principles involved. Throughout specification and drawings like reference characters are used to indicate corresponding parts, and in the drawings:

Figure 1 is a plan view of a device in accordance with my invention equipped for below deck use, as in a submarine.

Fig. 2 is a side elevation of the same, partly in section.

Fig. 3 is a side elevation of a telescopic mount for converting the instrument for above deck usage.

Fig. 4 is a plan view of the telescopic mount, and

Fig. 5 is a transverse sectional view through the bearings of such a mount.

My device consists in its preferred form of a base B having a graduated circle of torpedo angle formed thereon and suitably

graduated in degrees. The matter of the graduation of this circle as well as the graduation of other parts of this instrument may be varied according to practice in the navies of different countries, in the form shown the graduations being clock-wise through 360°, instead of being graduated as in the case of the United States Navy through 180° starboard and port.

The torpedo circle A may be conveniently formed on an annular raised portion on the bottom of the dished portion of the base B. The circle A is preferably scaled from 0 to 180° in both directions. The base is set with the 0 mark and the 180° mark in the true fore and aft line of the keel of the ship and the 0 mark toward the bow thereof. This circle will read the true angular relation to the bow of the ship.

Coöperating with the circle A is a bar D which I shall designate as the torpedo bar. This bar D is pivoted on a stud E disposed in the center of the circle A, and hence also in the true fore and aft line of the keel of the ship.

Adjustment relative to the scale A may be made for the angle of the torpedo tube with reference to the fore and aft line of the ship or for any adjustment of the 0 angle of the torpedo, or for the resultant, so that the bar D when properly set is parallel to the course of the torpedo in the water.

The end of the torpedo bar D is upturned at *d* above the level of the top of the base flange *b* and continued with an alined horizontally disposed extended piece F, shown in elevation in Fig. 2, to more clearly illustrate the slide piece G, which is movably mounted thereon with reference to a scale H on the surface of said slide, which scale is graduated outwardly of the circle, to wit rearwardly of the ship when the instrument is in position.

These graduations read in knots per hour, indicating different torpedo speeds so that the device may be set for the speed of the particular torpedo which is to be discharged.

Upon the lip or flange *b* of the base B is graduated a circle I. In the form shown it is formed directly on the top of the lip *b*.

On the central stud E and bearing on a shoulder *e* thereof is mounted an arm K which is termed the enemy bar. This bar is intended to be disposed parallel to the course of the enemy ship against which the torpedo is to be directed. The bar K is provided at its outward end with a projecting plate *k* having a finger hold k^1 and an opening k^2 through which the graduations of the sight circle I are visible.

Within the opening *k* is mounted a piece L which is held by a spring catch *l* to the head *k*, so as to be movable therewith when otherwise unrestrained. The piece L is also provided with a positive locking piece l^1 by which the piece L may be positively engaged with the rim *b* when the enemy bar K is originally set in its position of parallelism with the course of the enemy ship, which adjustment is made by bringing the center mark l^2 opposite the graduation of the sight circle I, as for example in Fig. 1 opposite the 270° in which case the enemy ship would have been sighted on the port bow approaching at exactly right angles to our course.

The catch *l* being a yielding catch and therefore inferior in its holding power to the positive screw stop l^1, the enemy bar *k* may be varied through a suitable distance, for example 10° in either direction without disturbing the original setting of the piece L for the enemy course, thus permitting for a compensation for temporary slight variation of our own course as might be constantly occurring in case of heavy sea on either quarter. For this purpose the head piece *k* is graduated as at k^3 for readings referable to an indicator point l^3.

The graduations k^3 correspond to the graduations of compass demarcation, so that the officer in control may instantly correct from the compass each slight temporary deviation from course, so that the relative position of enemy course to our course will be maintained constantly. The enemy bar K is graduated at K^1 from the center outwardly in indication of knots per hour, so that the slide M which is mounted thereon may be set for the speed of enemy ship. The slide M is held by a mill head screw *m* and carries on a raised post m^1 a guide piece *n* which is swiveled on the post m^1.

Carried on a post g^1 on the slide block G which is locked by a screw *g* is the sight bar O. This sight bar O passes through the slide block N and gives the alinement for the point in the enemy's course which the enemy ship must occupy at the moment of discharge of the torpedo in order that the torpedo may intercept the enemy ship.

Mounted on a further extension of the post *g* of the slide G is a pointer arm P adjustable relative to the bar O through a screw R with a graduated head R^1 and a scale R^2 which provides for correction of tidal influence on the torpedo and for the angle of parallax resultant from the angular gyroscope set of the torpedo, and the parallax error due to the distance of the torpedo tube from the director.

In the instrument thus far described, if properly set and handled, the bar O points to the position which the enemy ship must occupy at the moment of discharge of the torpedo in order to make a hit. In below deck use it is obvious that an actual sighting of this bar O cannot be had. Furthermore, in all usual submarine structures it is not convenient and usually impossible to place the center of the instrument in the

vertical axis of the periscope, so that the angle of the tube to the center of the periscope is no longer the true angle of that tube to the center of sight in the instrument, and the instrument reading must therefore be corrected by an adjustment.

For this purpose the end of the bar P is carried up as a pointer p for reference to a second circle S mounted on a spoked carrier T which has a supplemental part T^1 adapted to overlie the inner flange s of the circle S in assemblage. The carrier T is fixed on the squared top of the stud extension g^2 and is formed as an upper and lower plate T^1 and T^2 between the peripheries of which is movably mounted a ring S.

The ring S has a double series of graduations S^1 and S^2. The outer one S^1 adjacent the pointer p has graduations corresponding to the sight circle I, but graduated from opposite point, to wit, clockwise from 0 to 360°, with the 0 at six o'clock of the clock face. This provides for the correct reading of the pointer p which will thus indicate on the scale S^1 that degree of enemy position which would be indicated by a pointer radially run from the pivot E parallel to the sight bar O, which would thus cut the circle of sight S at the true degree of horizon which would correspond with the reading of the periscope.

The scale S^1 is on the outer face of the circle S which is slightly beveled, while concentrically within it on the flattened top of the ring is a set of graduations S^2 reading from 0 to 180° in both directions, which are read referable to a pointer mark U arbitrarily located on one of the spokes of the carrier T. The scale S^2 provides for a corrective setting of the secondary sight circle S according to the angle of the torpedo correction made by moving the bar D.

The exact location of this pointer is immaterial except that it and the scale should be so disposed that when 0 of the scale S^2 is opposite the pointer mark U the secondary sight circle S should have its 0 at six o'clock of the instrument, or in other words on the aft end of the fore and aft axis of the instrument.

In case the torpedo tube is not a bow tube, as the example for which the arrangement shown in Fig. 1 is set, then obviously setting the torpedo bar D at the angle of the torpedo tube will vary the sight bar O from that position which it would occupy if the torpedo tube was a bow tube. For example, if the torpedo was to be fired from a starboard bow tube set at 45°, then the torpedo bar D would be turned to the starboard half way between the 40° and 50° mark, which would of course move the sight bar O laterally inasmuch as it is pivotally mounted on the torpedo bar D.

In order therefore to correct what would otherwise be an error in the reading of the pointer P the secondary sight circle S is so moved in the direction opposite to that in which the torpedo bar D has been moved until the inner graduations S^2 show half way between the 40° and 50° opposite the pointer U. This will correct the reading of the pointer P on the secondary sight graduations S^1 which will then indicate the exact degree of horizon on which the enemy ship must be sighted to make the hit.

The above constitute the general operations and adjustments, but there are at least two other factors for which adjustment must be made. These are the resultant drift of the torpedo in case of cross tide or the like, and secondly the angle of parallax which is variant depending upon the distance of the enemy ship and the distance from the director to the tube or the radial distance for a torpedo under zero control or the resultant of any or all three.

These two corrections may be made by separate adjustment or by a single net adjustment of the pointer bar P relative to the sight bar O. This will add or subtract from the scale reading just that amount necessary to allow for the drift or angle or the net correction of the tube. In the form shown I accomplish this by the adjustment screw valve R having a vernier head and scale R^1 R^2.

The foregoing gives the use of my instrument for below deck. For use above deck, as for example on the bridge, the secondary sight scale is not necessary, as it is possible from the bridge to sight the enemy ship directly. For above deck use therefore, it is usually preferable to substitute for the secondary sight circle equipment a telescope equipment. For this purpose the spider mount T with the sight circle S is removed from the stud g^2 and in its place a trunnion mount W having bearings w for a telescope, (not shown) is substituted.

The mount W has a tail piece X provided with a clamp x adapted to overlie and be clamped to the sight bar extension P, so that the telescope mount may not only turn with the sight bar O but be given the adjustment for tide or parallax. The ship is observed through the telescope and the torpedo fired at the moment she registers on the crossed basis.

It will be borne in mind that as the torpedo has a limit of range, it is necessary that the point in the enemy's course at which the enemy ship is sighted when the torpedo is to be fired may be too great to effect a hit. The distance at which the enemy ship may be sighted when the torpedo is fired depends upon its distance at that moment, and the relation of its course to that which the torpedo is to take. If the interception of the line of the enemy's course with the line of

the torpedo's course is at a point in excess of the range of the torpedo, no hit would be effected and the torpedo lost.

It therefore becomes necessary to know at the moment when the enemy ship is sighted, and it is desired to launch the torpedo whether the enemy ship is at a distance so that it will be within the range of the torpedo if fired. As different torpedoes have different ranges and different speeds, it is necessary to have means by which these facts may be determined. This I accomplish by longitudinally channeling the sight bar O with an undercut grooving *oo* within which may be slipped a strip of card board or celluloid O^1.

I provide as many of these slips as there are torpedoes of different range or speed, either or both, or blank strips of celluloid may be provided so that they may be graduated for any torpedo. Each strip O^1 has an indication of the range and speed of the torpedo with which it is to be used, and I scale each strip according to the range and speed of the torpedo. These scales are to be read with reference to a pointer mark O^2 on the slide N of the enemy course bar.

When the instrument has been properly set with the proper scale O^1 in place, the officer in charge of the instrument while waiting for the enemy ship to come into the indicated position when the torpedo must be discharged, notes the enemy's distance as reported to him. By reference to the position of the pointer O^2 on the scale O^1 he is able to judge in advance whether the enemy ship will probably be within range, and if at the moment of fire the enemy ship is announced to be at a distance greater than the limit indicated on the scale O^1 he will withhold the discharge of the torpedo and wait until on another adjustment the enemy appears on the point of sight and within range.

By locating the scale on the sight bar, I am able on account of its guided relation on the slide N on the enemy course bar K to use a graduated scale which will show for the actual speed of the torpedo as set on the scale H of the bar D the limit of actual distance within which the enemy must be at time of point of sight in order to have the enemy ship within the actual range of the torpedo on its course.

This scaling may be very simply effected by measuring the distance between the center of the pivot post E and the center of the pivot post g^1 of the slide G on the torpedo bar D with said slide set with the given speed of the torpedo. This distance is measured off and marked on the card from the center of the pivot post g^2, so that when the card is in place the maximum range at the given speed indicated on the strip O^1 will be the same distance from the center of the post g^2 as the post g^2 is from the center of the post E.

This distance on the strip representing the known limit of range in yards, may be subdivided and the various proportional ranges marked off. Where the graduations for the enemy course bar begin laterally of the pivot E, as is preferable so that the slide may be brought to zero for a straight ahead shot without interfering with the post E, then care must be taken in measuring the distance between the points to provide for the slight correction which would be thus required.

As this calculation is perfectly simple the strips furnished with my device may be marked off by the torpedo officer for the speeds and ranges of torpedoes which he carries in his torpedo equipment.

Various modifications in the parts, their mountings and graduations may obviously be made, all without departing from the spirit of my invention if within the limits of the appended claims, and likewise my invention my be used or applied in use otherwise than as specified.

What I therefore claim and desire to secure by Letters Patent is:—

1. In a torpedo director, a graduated base circle, a second graduated circle adjustably mounted thereon, a graduated slide member pivoted to and radially adjustable with respect to said base circle and circumferentially adjustable with respect to the second circle, a second slide member radially adjustable on the base circle, and a pointer bar pivotally connected to the last named slide member and slidably and pivotally connected to the other slide member.

2. In a torpedo director, a graduated base circle, a second graduated circle adjustably mounted thereon, a graduated slide member pivoted to and radially adjustable with respect to said base circle and circumferentially adjustable with respect to the second circle, a second slide member radially adjustable on the base circle, and a pointer bar pivotally connected to the last named slide member and slidably and pivotally connected to the other member, and means for indicating enemy alinement to said second slide member.

3. In a torpedo director, a graduated base circle, a second graduated circle adjustably mounted thereon, a graduated slide member pivoted to and radially adjustable with respect to said base circle and circumferentially adjustable with respect to the second circle, a second slide member radially adjustable on the base circle, and a pointer bar pivotally connected to the last named slide member and slidably and pivotally connect-

ed to the other slide member and graduated with reference to one of said slide members in terms of limitation of range.

4. In a torpedo director, a graduated base circle, a second graduated circle adjustably mounted thereon, a graduated slide member pivoted to and radially adjustable with respect to said base circle and circumferentially adjustable with respect to the second circle, a second slide member radially adjustable on the base circle, and graduated from its center rearwardly for torpedo speed, and a pointer bar pivotally connected to the last named slide member and slidably and pivotally connected to the other slide member, and a sight element pivotally connected with said second named slide and graduated in scale limitation of range.

5. In a torpedo director, a graduated base circle, a second graduated circle adjustably mounted thereon, a graduated slide member pivoted to and radially adjustable with respect to said base circle and circumferentially adjustable with respect to the second circle, a second slide member radially adjustable on the base circle, and graduated from its center rearwardly for torpedo speed, and a pointer bar pivotally connected to the last named slide member and slidably and pivotally connected to the other slide member, and a sight element pivotally connected with said second named slide and graduated in scale limitation of range, and means for indicating enemy alinement to said second named slide member.

6. A torpedo director comprising a graduated base circle, a central pivotal mount, a second graduated circle mounted thereon, a slide pivoted axially of said first-named circle and radially graduated from said pivot rearward, a second slide movable on said central pivot for circumferential reference to said second-named circle and graduated radially outward for enemy speed, and a sight bar having pivotal relation to said first-named slide and guided relation to said second-named slide.

7. A torpedo director comprising a graduated base circle, a central pivotal mount, a second graduated circle mounted thereon, a slide pivoted axially of said first-named circle and radially graduated from said pivot rearward, a second slide movable on said central pivot for circumferential reference to said second-named circle and graduated radially outward for enemy speed, and a sight bar having pivotal relation to said first-named slide and guided relation to said second-named slide, and means coöperative with said sight bar for indicating enemy alinement.

8. A torpedo director comprising a base having a graduated base circle, a central pivotal mount, a second graduated circle adjustably mounted thereon, a slide pivoted axially of said first-named circle, a second slide movable on said central pivot for circumferential reference to said second-named circle, a sight bar having pivotal relation to said first-named slide and guided relation to said second-named slide, a third circle pivoted for circumferential adjustment on said first-named slide, and an indicator in extended alinement from said sight bar for indicative reference to the graduations of said third-named circle.

9. A torpedo director comprising a base having a graduated base circle, a central pivotal mount, a second graduated circle adjustably mounted thereon, a slide pivoted axially of said first-named circle, a second slide movable on said central pivot for circumferential reference to said second-named circle, a sight bar having pivotal relation to said first-named slide and guided relation to said second-named slide, a third circle pivoted for circumferential adjustment on said first-named slide and an indicator in extended alinement from said sight bar for indicative reference to the graduations of said third-named circle, and an adjustable connection between said indicator and said sight bar.

10. In a torpedo director, a base, a bar pivoted thereon graduated in scale of torpedo speed, a second bar mounted thereon and graduated in ship speed, a slide on each bar adjustable with reference to said graduations, a sighting member pivoted on said torpedo bar slide, and guided in said second slide, said sighting member having a scale thereon disposed in relation of maximum range, said course bar being graduated proportionately for a given torpedo speed.

11. In a torpedo director, a pair of adjustable slide members, a third member pivoted to one and guided in the other, said member having a scale of maximum enemy distance referable to a pointer, said second slide being graduated in subdivisions proportionately for a given torpedo speed.

12. In an instrument of the class described, a mount, a graduated torpedo speed bar pivoted thereon, a graduated enemy course bar, a slide on each bar, a sighting member pivoted on said torpedo bar slide and in guided relation to said enemy course bar slide, and a scale of maximum enemy distance on said sighting member referable to a pointer, said course bar slide graduated from said torpedo bar slide in lineal unitary subdivisions proportional for given torpedo speed.

13. In an instrument of the class described, a torpedo slide, an enemy course slide, a sighting member pivoted on said torpedo slide and in guided relation to said enemy course slide, and a scale of maximum enemy distance on said sighting member referable to a pointer, said enemy course slide

graduated from said torpedo bar slide in lineal unitary subdivisions proportional for given torpedo speed.

14. In an instrument of the class described, a graduated circle and an enemy course bar mounted for circumferential movement thereon, an enemy course piece having limited relative movement with said course bar, and a lock for fixing said piece on said circle.

15. In an instrument of the class described, a graduated circle and an enemy course bar mounted for circumferential movement thereon, a supplemental lock for setting an enemy course piece in a circumferential position and having a limited potential relative movement thereto, a superior lock for fixing said piece relative to said circle, and an inferior lock between said enemy course piece and said course bar for permitting said limited movement of said enemy piece to said supplemental lock.

16. In an instrument of the class described, a graduated circle, a torpedo tube bar pivoted centrally thereof, a sight bar pivoted on said tube bar, a sight element and a scaled adjustment between said sight element and said sight bar providing angular corrective adjustment between said tube piece and said sight element.

17. In an instrument of the class described, a sight bar circumferentially movable relative thereto, a sight element and a scaled adjustment between said sight element and said sight bar providing angular corrective adjustment between said sight bar and said sight element.

18. In an instrument of the class described, having circumferential graduations and a central pivot, a radial enemy course bar on said pivot, and means for locking said enemy course bar for a limited movement relative to said circumferential graduations.

19. In an instrument of the class described, a support, a torpedo direction element adjustably mounted in relation thereto, an enemy course element also adjustably mounted thereon, each of said elements adjustable relative to graduated speed indicia, a pointer bar carried by said elements for indicating enemy position, a sight element associated with said sight bar and having adjustable relation thereto, and an adjuster therefor having scaled indicia for corrections of parallax and for drift.

20. In an instrument of the class described, having circumferential graduations, and a central pivot, a radial enemy course bar on said pivot, and means for locking said enemy course bar for a limited movement relative to said circumferential graduations, a sight element and a corrective angular adjustment between said sight element and said sight bar.

21. In an instrument of the class described, a support, a torpedo direction element adjustably mounted in relation thereto, an enemy course element also adjustably mounted thereon, each of said elements adjustable relative to graduated speed indicia, a pointer carried by said slides for indicating enemy position, a sight element associated with said sight bar and having adjustable relation thereto, and an adjuster therefor having scaled indicia for corrections of parallax and for drift.

In testimony whereof I affix my signature in presence of two witnesses.

ARISTIDES DEL SOLAR.

Witnesses:
ALFRED R. SHRIGLEY,
MAY A. BRANNACK.