33-236. OR 1,362,683 SR

Draftsman

A. DEL SOLAR.

TORPEDO DIRECTOR.

APPLICATION FILED SEPT. 6, 1917.

1,362,683.

Patented Dec. 21, 1920.

2 SHEETS—SHEET 1.

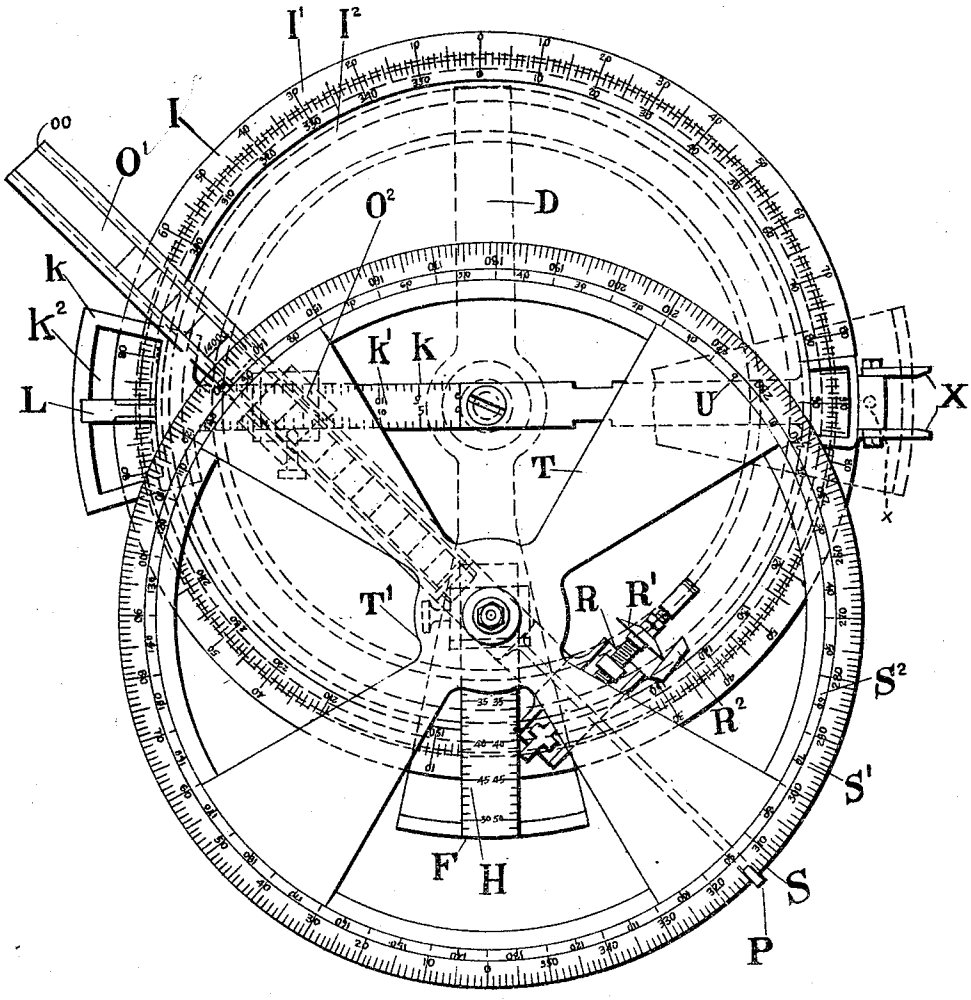


FIG. 1.

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1354

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See 1,346,273

3. ZP

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2 SHEETS—SHEET 2.

FIG. 2.

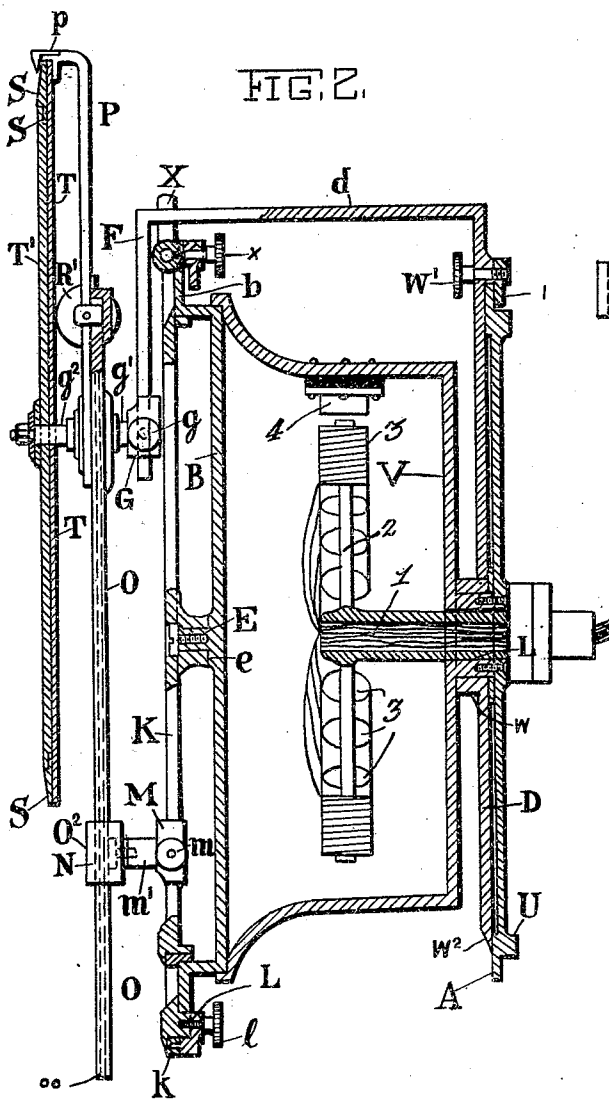


FIG. 3.

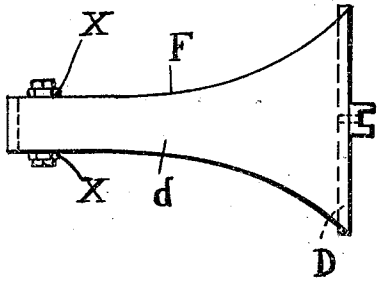


FIG. 4.

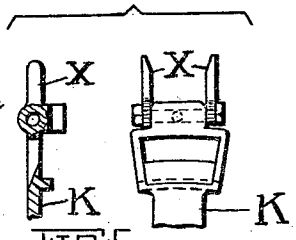
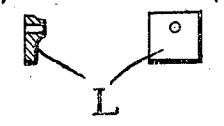


FIG. 5.



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UNITED STATES PATENT OFFICE.

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

TORPEDO-DIRECTOR.

1,362,683. Specification of Letters Patent. Patented Dec. 21, 1920.

Application filed September 6, 1917. Serial No. 190,030.

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 the automatic control of torpedo directors. The purpose of such a structure is to indicate the relative position in which an enemy ship must be at the moment of the discharge of a torpedo to perfect a hit. In this device the enemy course bar, so-called, is to be set and maintained parallel with the course of the enemy which, considered in the instrument itself, amounts to an angular adjustment in relation to the fore and aft line of the ship firing the torpedo.

One of the difficulties in handling any such instrument is the matter of constant adjustment and re-adjustment made necessary by variation in course of the ship. This is true of any ship, and particularly true of a submarine. Unless adjustment is immediately and accurately made for every movement of the ship from its course, the accuracy of the aim is correspondingly disturbed and the torpedo misses its mark.

The constant adjustment of the enemy course bar involves the presence of an extra man and makes it necessary to watch each deviation from course, correct the setting of the enemy course bar, or all substantial deviations from course, and vary the enemy course bar for all slight deviations. This introduces a serious possibility of error, especially under service conditions, and particularly in case a submarine is operating submerged.

It is only necessary to bear in mind that the captain of the torpedo boat or submarine in maneuvering for position or in avoiding the enemy's fire will be required to change his mind from moment to moment and to vary his course with no time to make his changes known to the operator of the torpedo director. The same thing is true, although to a somewhat less degree of course, where through the manipulation of the steering wheel almost imperceptible changes in heading are made which, while hardly noticeable to the heading observer, may seriously affect the line of sight.

My present invention involves maintaining of the position of the enemy course bar parallel to the course of the enemy, independently of its relation to the fore and aft line of the ship, so that whether the course be varied or whether the course be altered, it will constantly and continuously maintain its factor in the angular set of the sight bar, as long as the enemy's course is unchanged.

The construction of my device and its operation will be fully described in the specification which follows. Throughout the specification and drawings like reference numerals will be employed to indicate corresponding parts, and in the drawings:

Figure 1 is a plan view of a torpedo director in accordance with by invention, the parts being arbitrarily moved to more clearly expose underlying construction.

Fig. 2 is a vertical section through my device.

In illustration and explanation of my device I have shown it equipped with the secondary sight circle for below deck use.

In the present form of my invention I provide a base U which may be fixed in any suitable place, and upon which is mounted a casing V having a cylindrical stem v fastened centrally of the base U. On the stem v is rotatably mounted as a bearing, a collar w of an arm D provided with a lock screw W^1 by which it may be permanently set on the base U. The base U is graduated at A on which the end w^2 of the arm w reads as a pointer.

The graduated circle A is the torpedo circle which is in the form shown scaled from zero to 180° in both directions, the zero and the 180° mark being set in the true fore and aft line of the keel of the ship with the zero mark toward the bow thereof. This circle will therefore read in true angular relation to the fore and aft line of the ship.

The bar D which is termed the torpedo bar is intended to be set at the angle of the tube from which the torpedo is to be discharged, or at the angle the gyro is set, and it therefore lies parallel to the course of the torpedo in the water. The end of the torpedo bar is extended upwardly at d above the level of the base flange b and then returned radially inward over itself, as at F. The part F is graduated from its inner end outwardly as at H, these graduations reading in knots per hour and indicating the

speed of different torpedoes so that the slide G may be set by the screw g for the speed of the particular torpedo which is to be discharged.

Upon the casing V is fixed the plate B which is formed as a shallow dished member provided with a surrounding lip or flange 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 and an opening k^2 through which the graduations of the sight circle I are visible. Within the opening k^2 is mounted a piece L which is held by a set screw l to the head k, so as to be movable therewith when otherwise restrained.

These graduations of the sight circle I are preferably numbered in two usual navigation series I^1 and I^2, which permit the reading to be reported in terms of quarter or in terms of angle to the north.

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. If provided with a telescope, the ship would be so sighted. 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 and T^1 between the peripheries of which is movably mounted the 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 points, to wit, clockwise from zero to 360° with the zero at six o'clock of the clock face and with its zero—180° line always parallel with the fore and aft line of the ship. 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 center of the periscope 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 zero 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^1. 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 zero of the scale S^2 is opposite the pointer mark U the secondary sight circle S should have its zero 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 gyro control or the resultant of any or all three.

These three 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.

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 *oo* 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 the 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.

With the above understanding of the construction and operation of my device it will be seen that if the enemy bar K be in true

parallelism with the course of the enemy at the moment of discharge, a hit should be certain. As heretofore pointed out, considerable difficult is experienced in keeping a ship so steadily on its course that the predetermined angle of the enemy course is concentrated. In other words, each variation of the torpedo carrier tends to bring the enemy course bar K out of its position of parallelism to the enemy course. Even slight variations due to current or the slight movement in the steering gear may produce a variation from parallel which multiplied by the considerable distance of range produces a serious error.

Furthermore, considerable variation of course is usually necessary, especially in action, and even these deliberate variations in emergencies and under excitement are difficult to report accurately and to make adjustment fall properly. I therefore have made provision for automatic compensation for variation from the determined course, so that the enemy bar K will be maintained in parallelism with the enemy course regardless of the swinging of the ship.

I accomplish this by floating that portion of my apparatus which relates to the enemy course, to wit, the scaled plate B and enemy course bar K, so that it may move indepedently of the base V which is of course in fixed relation to the ship. The control of these floating elements may be variously effected, but it is preferably controlled with relation to a fixed and variable point, such as the true north.

For the purpose of illustration, and as a highly efficient means of effecting this result, I have shown and located within the casing V the mechanism of a gyro compass repeater, such as is used with the gyroscopic control in a ship's system, and which consists of the motive elements which, through suitable train of gearing, not necessary to be shown, rotates the plate B and with it the enemy bar K which has been fixed in any predetermined initial position by the set screw 1. As here shown a shaft 1, which is preferably hollow to accommodate the lead wires for the magnets is journaled in suitable bearings in the casing V. Fast on shaft 1 is a spider or other appropriate support 2 for a plurality of electro-magnets 3, which are adapted to coöperate with an armature 4 mounted upon and insulated from the casing V.

As the motive element is rotated by the transmitted impulse of the central control, the plate B will be turned at every deviation of the ship from its course, and the enemy course bar K thus shifted to effect a readjustment of the sight bar O. In this manner the enemy course bar is kept constantly parallel to whatever angle she may turn and the accuracy of the torpedo is correspondingly increased.

Where the north is the point of control selected, it is obvious that the angles of my torpedo director become relatively compass angles, and the scales I^1 and I^2 may be read in compass indications by locking the torpedo bar D in the fore and aft line of the ship and swinging the enemy course bar K into parallelism with it in which position it may be locked by turning up the ears X on the end of the enemy course bar. The ears X may be set in either position by means of a screw x. The screw x when set up to tighten its clamp enters a recess in the cross piece of the ears X and must therefore be released to free the plate B before the ears X can be turned up when the device is to be used as a compass.

When in this position with the screw l released, the plate B is free to rotate under its control so that the compass indications may be read from the pointer L of the enemy bar, which has been set to point toward the bow of the ship and hence points the course. In this manner the bearings may be taken or verified at any time by any officer at any torpedo station or ship.

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 may 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 pointer bar pivotally connected to the last named slide member, and means for automatically maintaining said first named slide member in constant relation to an arbitrarily selected point of control.

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, a pointer bar pivotally connected to the last named slide member and slidably and pivotally connected to the other slide member, a lock for fixing said first-named slide to said adjustably mounted circle, and means for adjustably rotating said adjustably mounted circle to maintain its position relative to an arbitrarily selected point of control.

3. GEOMETRICAL INSTRUMENTS.
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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, a pointer bar pivotally connected to the last named slide member and slidably and pivotally connected to the other slide member, and means for maintaining said first named slide member in a fixed direction in azimuth.

4. In a torpedo director, a graduated circle, a slide adjustable relative thereto, an element of constant directive tendency, and an operative connection between said element and said slide for maintaining said slide in a fixed direction in azimuth.

5. A torpedo director, a graduated circle, a graduated slide adjustable relative thereto, means for locking said slide to said circle, an element of constant directive tendency, and an operative connection between said element and said slide for maintaining said slide in a fixed direction in azimuth.

6. In a torpedo director, relatively adjustable graduated circles, means for setting said circles in a predetermined relation, and a control mechanism of constant directive tendency for adjustably maintaining said circles in a fixed direction in azimuth.

7. In a torpedo director, a graduated circle and a slide adjustable relative thereto, and means for adjustably maintaining said slide in a fixed direction in azimuth.

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

ARISTIDES DEL SOLAR.

Witnesses:
MARION F. WEISS,
AGNES V. O'CONNELL.