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**GUNFIRE COMPUTER**

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6 Claims. (Cl. 235—61.5)

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This invention relates to calculating devices, and particularly to an improved mechanism of simple, portable character for determining in a rapid and graphic manner functions based upon a plurality of variables. The invention is of particular utility in connection with the control of gunfire, and/or the evasion of the gunfire of an enemy, in naval warfare.

An important object of the invention is to provide such a device which is of very simple and rugged construction, which is readily portable, and which furnishes in a clear and easily readable manner, a positive indication as to the zones within which the fire of guns of predetermined types may be expected to be effective or ineffective against armored ships, under given conditions as to armor and target angle.

Other objects and advantages will be apparent upon consideration of the present disclosure in its entirety.

In the drawing:

Figure 1 is a perspective view of a completely assembled device incorporating the principles of the present invention, indicating its relative size as it appears in use;

Figure 2 is a plan view of the same;

Figure 3 is an end view thereof;

Figures 4 and 5 are cross-sectional views taken substantially on the lines 4—4 and 5—5 respectively of Figure 2 and looking in the direction of the arrows; and

Figure 6 is a fragmentary sectional perspective view showing the adjustable securing means for the tapes.

Referring now to the drawings, the supporting body of the device may advantageously be formed of moulded plastic or other relatively light but stiff construction, and is generally designated by the reference numeral 1. Its top surface is adapted to accommodate any one of a plurality of interchangeable flat charts as 2, which may be formed of plastic sheet material. Screws (undesigned) may be used to secure the chart, as shown.

A pair of slidably adjustable indicator tape assemblies are looped over the body 1, lengthwise thereof and in parallel relation, each accommodated in suitably positioned slots 4, 5, formed in the ends of the body. The slotted areas have smoothly rounded bottoms to permit easy sliding of the tapes. An index tab 6, 7, carried by each tape assembly also serves as a finger piece for convenient manipulation thereof. The left-hand tape assembly is generally designated 10 in Figure 2. The upper half of such tape assembly is lined in the drawing to represent the color red, while the lower half is lined to represent the color green. The upper and lower sections of the right-hand tape assembly, 11, are reversed as to color arrangement, the upper section of such tape assembly being green, and the lower section red. While this distinctive color arrangement is of convenience in the manipulation of the device, it is of course a matter of choice and subject to variation.

Cooperating with the right-hand tape assembly 11, is a deck armor scale generally designated 14, graduated in deck armor thickness, the scale increasing from top to bottom of the chart. At the left of the tape assembly 10,

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and adapted to cooperate with both tapes, is a range scale, 15, which also increases from top to bottom of the chart. The range scale forms one ordinate, which may be considered the abscissa, of a coordinate system. The other ordinate of the system represents target angle, graduated across the top of the chart as indicated at 17. Target angle may be defined as the angle between the line of fire and the heading (fore and aft) of the target ship. This target angle decreases from left to right as viewed in the drawing. Plotted on the coordinate system thus established are curves 21, 22, 23, 24, 25, each representing the penetration resistance of conventional armor plate of a given thickness, assuming the plate to be disposed vertically, at the represented range and target angle. The curves and ranges will vary with different guns and projectiles, different charts being used, as will be apparent. The representative chart illustrated in Figure 2 is laid out for a 12"/45 caliber rifle firing a 953-pound projectile at an initial velocity of 2569'/sec. Curve 21 represents vertical armor of 5" thickness, and curves 22, 23, 24, and 25 represent progressively thicker armor plate, the thickness of which is indicated upon each of the curves. It will be noted that the thickness of the vertical armor plate, as represented by the curves, decreases from the top toward the bottom of the chart assembly, and that this arrangement is the reverse of the deck armor thickness arrangement upon the scale 14.

Scale 14 indicating deck armor penetration and its related scale 15 indicating target range together with the curves for vertical armor penetration are obtained basically from test firing data. In such tests projectiles are fired at different thicknesses of armor plate and at varying angles of impact with respect to the plate and the degree of penetration is noted. The data from these tests is then compiled in the form of charts.

Each tape section is adjustably secured together at its ends by means of a simple string fastening as indicated at 9.

The device is operated by setting the marker 7 for deck penetration opposite the figure on the scale 14 representing the known or estimated target deck thickness, and the marker 6 for side penetration at the point corresponding to an abscissa through the intersection of that one of the curves 21 to 25 inclusive which corresponds to the known or estimated target vertical armor thickness with the target angle ordinate. When set in the above manner both markers or tabs, 6, 7 may be read against the range scale 15 (which is indicated in thousands of yards), an indication being thus furnished as to the respective limits of the zones within which the projectile may be expected to penetrate, both as to deck and vertical armor.

The marker 7 may remain set in position for a given target, while the marker 6 must of course be changed with variations of target angle. In each case the red section of the tape lies opposite that portion of the range scale throughout which penetration may be expected, while the green section of the tape lies opposite that portion of the range scale representing the zone throughout which the armor plate may be expected to resist penetration. Under many conditions the red tapes will fall short of meeting, leaving a medial area representative of an "immunity zone" indicated by the fact that green sections of both tapes lie opposite the corresponding section of the range scale. The instrument, when adjusted to the prevailing conditions, will be seen to show at a glance the vulnerability of both horizontal and vertical armor plate to gunfire of a given class, throughout the range of the gun.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

## I claim:

1. A calculating device of the character described comprising a chart, a linear range scale and a linear deck armor scale thereon, said scales being graduated to advance in the same direction longitudinally of the chart, a series of indicia indicating the penetration resistances of variant vertical armor thicknesses at a given target angle and arranged in order of increasing magnitudes, said indicia being progressively arranged longitudinally of the chart in order advancing in a direction opposite said scales, a pair of longitudinally movable indicators one arranged to cooperate with said series of indicia and the other with said deck armor scale, and both with each other, each of said indicators being arranged to cooperate with said range scale, said indicators having warning portions which when overlapping indicate vulnerability to both vertical and horizontal attack.

2. A calculating device of the character described comprising an elongate chart having a linear scale graduated in deck armor thickness and advancing in one direction therealong, a coordinate system carried by said chart and having one ordinate, representative of range, extending longitudinally of the chart parallel to and advancing in the same direction as said scale, said system having another ordinate transverse to the first representative of target angle, a series of curves each representative of a different vertical armor thickness plotted on said system, each curve showing the penetration resistance of the armor represented thereby to projectiles of a given type, said curves being progressively arranged longitudinally of the chart in order advancing in a direction opposite to said scale, a pair of indicators movable longitudinally of said chart one arranged to cooperate with said series of curves and the other with said deck armor scale, said indicators including warning portions relatively movable into side-by-side positional correspondence indicating vulnerability to both vertical and horizontal attack.

3. A calculating device as set forth in claim 2 in which said scale is aligned with the range ordinate of said system in such manner as to indicate the penetration resistance of deck armor of indicated thicknesses to projectiles of a given type at the corresponding ranges.

4. A calculating device as set forth in claim 2 in which said linear scale is aligned with the range ordinate of said system in such manner as to indicate the penetration resistance of deck armor of designated thicknesses to projectiles of a given type at ranges corresponding to those on the range ordinate, said indicators being movable longitudinally with respect to said ordinate and one adapted to cooperate with said curves and the other with said scale.

5. A calculating device as set forth in claim 2 in which said linear scale is aligned with the range ordinate of said system in such manner as to indicate the penetration resistance of deck armor of designated thicknesses to projectiles of a given type at ranges corresponding to those on the range ordinate, said indicators having warning portions extensible longitudinally of the chart parallel to said ordinate but from opposite ends thereof, one of said portions being adapted to cooperate with said curves and the other with said scale.

6. A calculating device as set forth in claim 2 in which said linear scale is aligned with the range ordinate of said system in such manner as to indicate the penetration resistance of deck armor of designated thicknesses to projectiles of a given type at ranges corresponding to those on the range ordinate, said indicators comprising looped tapes having portions extending over the face of the chart and each incorporating an index element and having distinctively marked safe and warning portions on opposite sides of said index element and advanceable therewith from opposite ends of the chart, said portions being movable parallel to and adapted to cooperate with said range ordinate, curves and scale.

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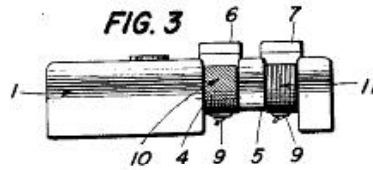
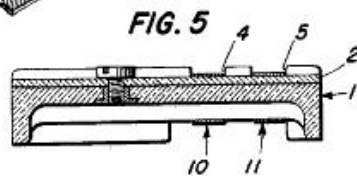
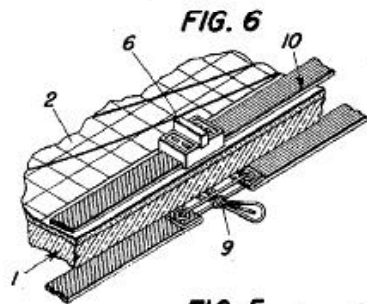
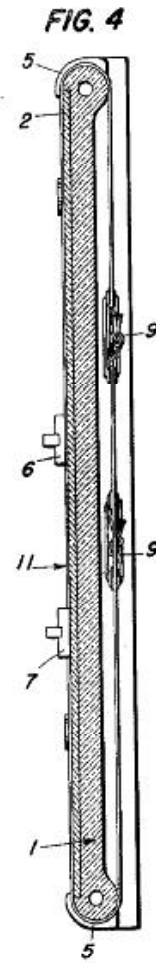
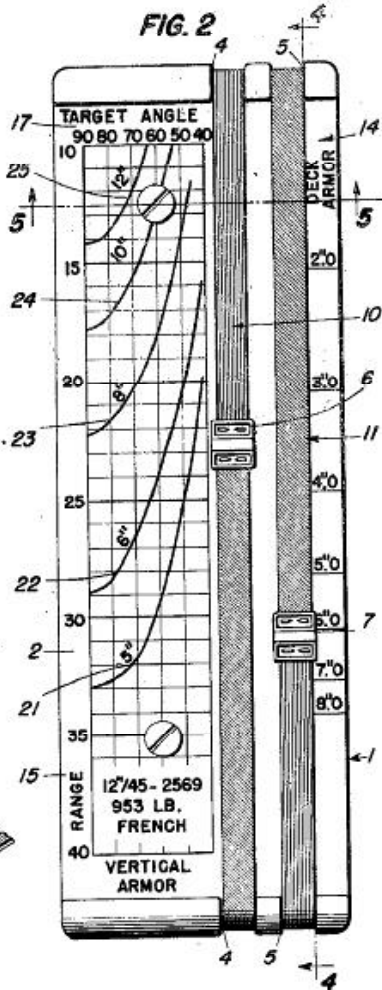
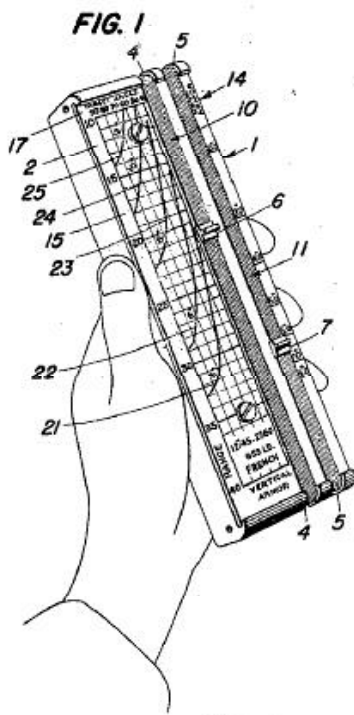
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