July 26, 1949. W. McK. HORTON 2,476,981

CALIBRATOR FOR LEAD-COMPUTING SIGHTS

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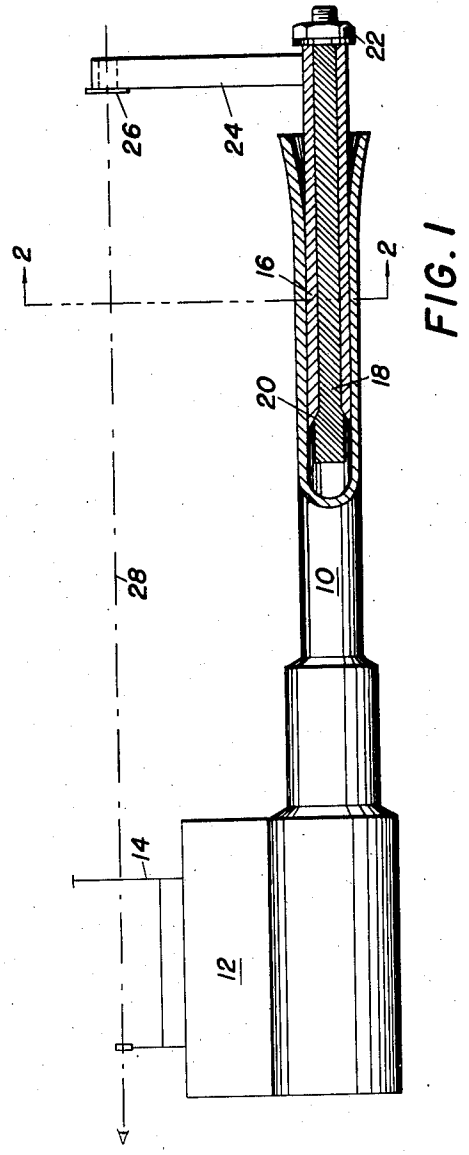


FIG. 1

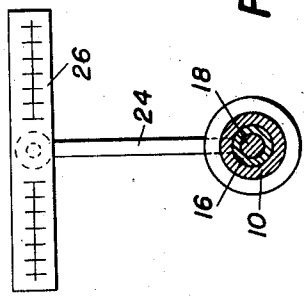


FIG. 2

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CALIBRATOR FOR LEAD-COMPUTING SIGHTS

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7 Claims. (Cl. 73—1)

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This invention relates to machine-gun sights, and more specifically to devices for calibrating the aiming corrections in azimuth and elevation that are introduced by a lead-computing sight when following a moving target.

An object of the invention is to facilitate the checking and calibrating of lead angles introduced by a gyroscopic lead-computing sight into the aiming of a machine gun to compensate for speed and direction of travel of a moving target, through the use of a device that is inexpensive to make, easy to use, accurate, and dependable.

Further objects and advantages of this invention, as well as its construction, arrangement and operation, will be apparent from the following description and claims in connection with the accompanying drawing, in which

Fig. 1 is a side elevation (partly in section) of a machine-gun barrel fitted with a lead-computing sight and with one form of the calibrating device that is the subject of this invention; and

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1.

It is pertinent to review the operation of a lead-computing sight as applied to the aiming of a machine gun, in order to establish the great utility of the present invention. Machine-gun barrel 10 is supported by a structure that permits the said barrel to be tilted up or down and turned to left or right at will, so that the said barrel can be aimed at a stationary or moving target. The said supporting structure is not concerned in this description and hence is omitted from the drawing. Lead-computing mechanism 12 is attached to gun barrel 10 and is adapted to carry a sight 14 through which the machine-gun operator views the target along the line of sight 28.

Lead-computer 12 usually embodies two direction-sensitive mechanisms, such as gyroscopes, one of which is responsive to each component of rotational movement of gun barrel 10, i. e., in azimuth or in elevation. Such rotational movement influences the respective gyroscope to "precess," or deviate from its original orientation, an amount that is a measure of the rate, or angular speed, of such rotational movement. Through appropriate mechanism that takes into account the ballistic characteristics of the projectiles fired from gun barrel 10, the said tendency to precess is expressed as a deflection of sight 14 with respect to gun barrel 10 through an angle the magnitude of which is substantially proportional to the aforementioned angular speed of rotational movement of gun barrel 10 and the direction of which is substantially opposite

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thereto. The object of so doing is to advance the gun barrel 10 ahead of the line of sight 28 in the direction of movement, so that projectiles fired from said gun barrel will intersect the anticipated path of the target simultaneously with the anticipated arrival of said target at such point of intersection.

The present invention provides simple apparatus for testing whether the above described automatic mechanism for causing the gun barrel to lead the line of sight is introducing the correct angle of lead.

The lead-computer could be calibrated by mounting said lead-computer on a fixture that can be rotated at predetermined speed in azimuth or in elevation, concurrently observing the amount of deflection that said lead-computing mechanism introduces into the orientation of sight 14. Such means, however, is not practicable for use in the field or aboard ship. In the past, when it has been necessary to check or calibrate said lead-computing sight, it has been the practice to lay out a series of aiming points, for example by marking at appropriate places on the ship's structure, and thereafter to set up a procedure for viewing said aiming points successively through sight 14 and recording the time intervals that elapse between the transit of line of sight 28 across successive aiming points, simultaneously recording the corresponding readings of azimuth or elevation obtained from protractor scales that are associated with the supporting structure for gun barrel 10. The resulting data were plotted in graphic form or tabulated, and analysis of the said data was made to determine the relationship existing between the rate of angular movement of the said gun barrel and the amount of deflection of line of sight 28. Obviously the foregoing procedure is laborious, cumbersome, time consuming, and difficult of accomplishment with sufficient accuracy, since several factors must be recorded simultaneously and must later be interpreted.

In contrast, the device disclosed in this specification greatly simplifies the procedure and increases the accuracy of results. Tube 16 is adapted to fit within gun barrel 10, said tube having an internal taper 20 at one end and being split longitudinally for a portion of its length adjacent to said end. Rod 18 carries a complementary external taper seating in taper 20 of tube 16, and is adapted to exert a wedging action on said tube by taking up on nut 22, thereby locking tube 16 in position within gun barrel 10. Bracket 24 is attached rigidly to tube 16 and

carries at its upper end a scale **26**, which is mounted rotatably on said bracket so that said scale can be disposed horizontally or vertically for checking respectively azimuth or elevation corrections introduced into line of sight **28** by lead-computer **12**. Other forms of the device can be used, as for example in director-control systems where lead-computer **12** is not attached to gun barrel **10**, but is mounted separately and directs the aiming of said gun barrel through electrical or other means of control. In such case scale **26** is supported by a bracket that is attached to a convenient point on the movable structure that includes lead-computer **12**, so that the said scale is in definite physical relationship to said lead-computer.

In use, the device is assembled to a gun barrel **10** by application of the tube **16** and rod **18**, or to a director by bracket, as hereinbefore described. Scale **26** is placed horizontally or vertically, its position being such as to indicate zero deviation in azimuth or elevation, respectively, of the line of sight **28**, when the machine gun or director is at rest.

The operation of the device is as follows: The line of sight being directed at any point on scale **26** when the gun barrel is motionless, some other point on the scale is selected by the operator to represent a moving target. The operator then proceeds to move the gun barrel in the direction opposite that of the selected point (target). At once the lead-computer moves the sight so that it lags the direction of the gun barrel. (In real operation this causes the gun to deliver bullets that are ahead of the line of sight but will later meet the real target in flight.) When the operator sees the "target" in the line of sight, he continues to move the gun barrel and so long as he moves it with constant angular velocity the line of sight remains fixed on the selected point (target) of the scale. While such constant-speed motion is being effected, an observer notes the length of time required to traverse a predetermined angular displacement in azimuth or elevation as the case may be. This observation involves only the manipulation of a stop-watch, starting such stop-watch when a selected protractor reading is indicated and stopping said stop-watch when another selected protractor reading is indicated. Since the selected index on scale **26**, to which said index the line of sight **28** was directed, is a measure of the amount of deviation introduced into said line of sight by lead-computer **12**, and since the speed of angular movement of gun barrel **10** is determined readily from indicated stop-watch time as related to the angular displacement traversed in such time, reference can be had to a prepared table for verifying the correctness of such amount of deviation of line of sight.

Operation of the device can be further simplified by providing scale **26** with indicia, each of which is designated by a figure representing a length of time, the location of each indicium being such as to determine an angle of deflection of line of sight **28** that ought to correspond (according to relationships previously derived either mathematically or empirically) to a rotational speed of gun barrel **10** such that a predetermined "standard" angular displacement of the said gun barrel will be traversed in said length of time. For example, a "standard" angular displacement of 30° may be established, and indicia can be placed on scale **26** at locations each of which corresponds to an angle through which the line

of sight ought to be deflected when the gun is moving at one of several speeds that are such as to cause said gun to traverse 30° in, for example, 5, 10, 15, 20, 25, or 30 seconds, the said indicia then being marked 5, 10, 15, 20, 25, and 30 respectively. In that event, it becomes necessary only to select a specific figure on scale **26**, for example "10," then to manipulate the gun to keep line of sight **28** directed at the selected figure, and lastly to determine by means of the aforementioned stop-watch whether exactly 10 seconds are required to traverse 30° while so doing.

In any event, whether such calibration is employed or a prepared table is employed, the result of the test indicates that the lead-computer is providing either the correct, or excessive, or insufficient, deviation in the line of sight **28**, and if adjustment is necessary it can be effected and the test can be repeated. A test run for one such check can be conducted easily in a minute or so after the device is assembled to the moving structure containing the lead-computer.

Scale **26** referred to hereinbefore need not be a conventional scale with a series of markings incorporated thereon, unless so desired for convenience in use, but can be merely any object that can serve as a viewing point or index to which to direct the line of sight **28**, provided such object can be mounted in definite spatial relationship to lead-computer **12** and provided further that the angular displacement of the line of sight **28** between said object and the position which such line of sight assumes when the lead-computer is not in motion can be determined.

Various modifications and changes can be made in the subject device without departing from the scope of the invention.

The invention described herein 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 method of testing the accuracy of direction-sensitive, lead-computing gun sight mechanism, said method comprising measuring the time during which the gun moves through a predetermined angle while maintaining the angle between the gun sight and the gun barrel fixed.

2. A method of testing the accuracy of direction-sensitive, lead-computing gun sight mechanism, said method comprising measuring the angle over which the gun moves during a predetermined time while maintaining the angle between the gun sight and the gun barrel fixed.

3. A method of testing the accuracy of direction-sensitive, lead-computing gun sight mechanism, said method comprising bringing the sight into line with an index attached to the gun and moving the gun so that the sight stays in line with the index and measuring the angular velocity of the gun.

4. A lead-computing sight calibrator for a gun comprising a tube adapted to be mounted in the barrel of such gun, means to secure said tube in such barrel, a bracket secured to said tube, and a scale mounted rotatably on said bracket.

5. A lead-computing sight calibrator for a gun comprising a tube adapted to be mounted in the barrel of such gun, a rod carried in said tube and adapted to secure said tube in such barrel, a bracket secured to said tube, and a scale mounted rotatably on said bracket and adapted to be positioned in the line of sight of such gun.

6. In a gun having a lead-computing sight, a

sight calibrator comprising a tube adapted to be mounted in the barrel of such gun, a rod carried in said tube and adapted to secure said tube in such barrel, a bracket affixed to said tube extending substantially normal to the axis of said tube, and a linear scale mounted rotatably on said bracket, said scale being adapted to lie in the line of sight of such gun.

7. In a gun having a lead-computing sight, a sight calibrator comprising a tube having an internal taper at one end and being split longitudinally for a portion of its length adjacent to said end, said tube being adapted to be mounted in the barrel of such gun, a rod having a complementary external taper carried in said tube, said rod wedging said tube against such barrel, a bracket affixed

to the other end of said tube, said bracket extending substantially normal to the axis of said tube, and a linear scale mounted rotatably on the end of said bracket distal said tube, said scale being positioned in the line of sight of such gun.

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