J. S. WILSON AND W. E. DALBY.

SIGHTING OF GUNS AND APPARATUS FOR USE THEREIN.

APPLICATION FILED AUG. 7, 1917.

1,308,134.

Patented July 1, 1919.

3 SHEETS—SHEET 1.

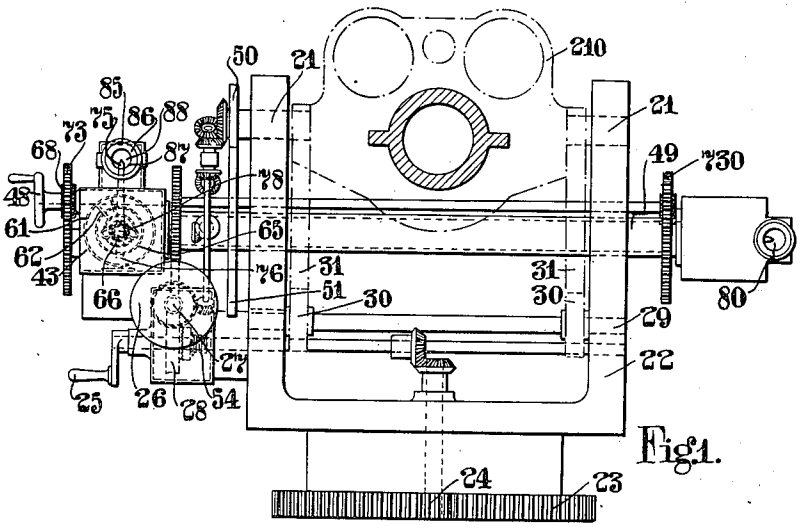


Fig.1.

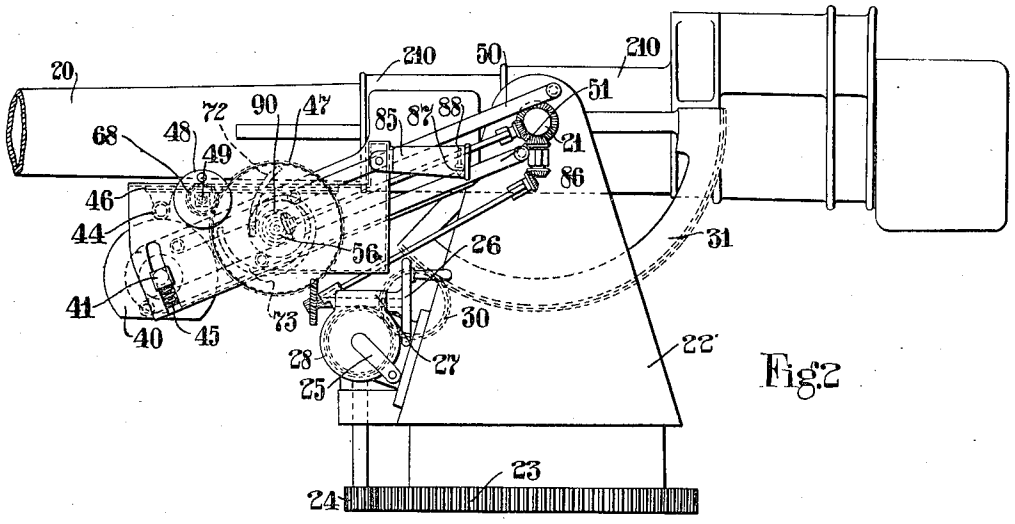


Fig.2.

INVENTORS.

John S. Wilson

BY Wm E. Dalby

By Spear, Middleton, Donaldson & Spear

ATTORNEYS

J. S. WILSON AND W. E. DALBY.

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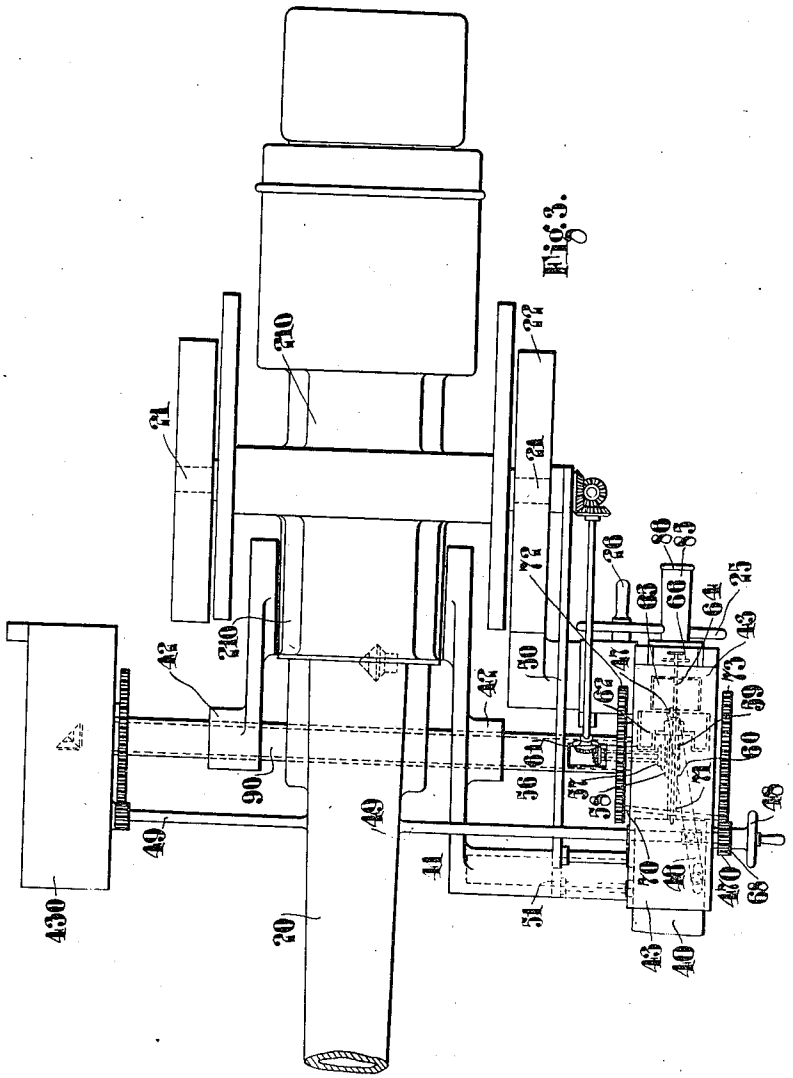
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3 SHEETS—SHEET 2.

Fig. 3.



INVENTORS

John S. Wilson

Wm E. Dalby

BY

by Spear, Middleton, Donaldson & Spear

ATTORNEYS

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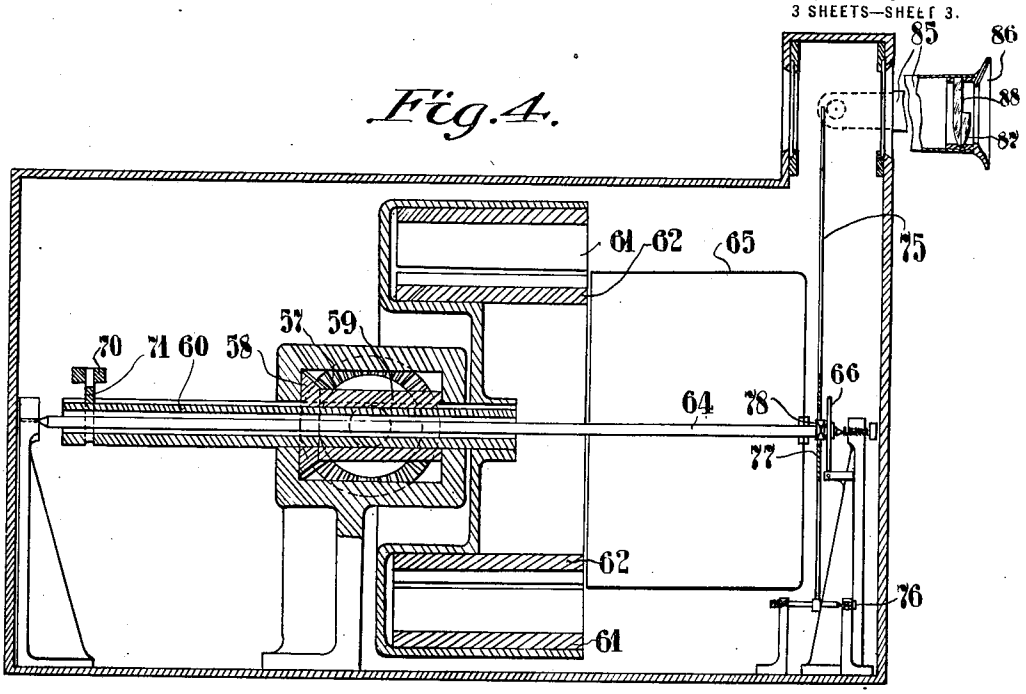
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3 SHEETS—SHEET 3.

Fig. 4.



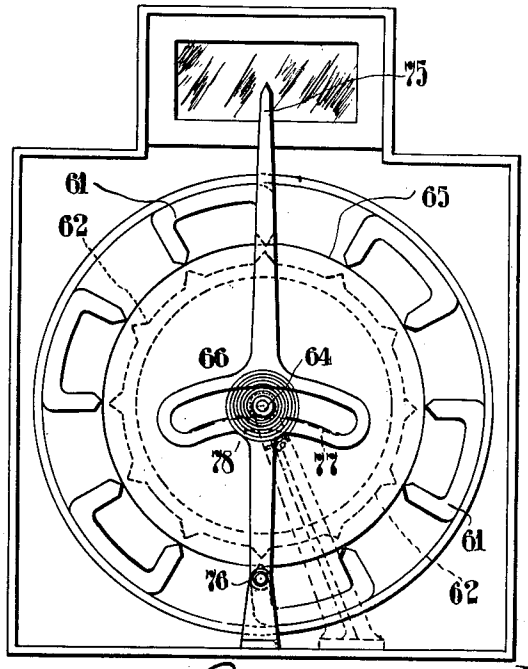


Fig. 5.

INVENTORS
John S. Wilson
William E. Dalby

By Spear, Middleton & Donaldson Spear
ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN SIGISMUND WILSON, OF WESTMINSTER, AND WILLIAM ERNEST DALBY, OF EALING, LONDON, ENGLAND, ASSIGNORS OF ONE-THIRD TO SIR W. G. ARMSTRONG-WHITWORTH AND COMPANY, LIMITED, OF NEWCASTLE-UPON-TYNE, ENGLAND.

SIGHTING OF GUNS AND APPARATUS FOR USE THEREIN.

1,308,134. Specification of Letters Patent. Patented July 1, 1919.

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To all whom it may concern:

Be it known that I, JOHN SIGISMUND WILSON, a subject of the King of Great Britain and Ireland, and residing at 29 Denbigh street, Westminster, London, S. W. 1, England; and I, WILLIAM ERNEST DALBY, a subject of the King of Great Britain and Ireland, and residing at 37 Madeley road, Ealing, London, W. 5, England, have invented certain new and useful Improvements in or Relating to the Sighting of Guns and Apparatus for Use Therein, of which the following is a specification.

The present invention relates to apparatus for sighting guns on moving targets and the object of the invention is to provide apparatus whereby, on the sighting line being directed toward the object aimed at, the gun shall be automatically directed.

The invention provides means whereby, taking into account the radial distance or range of the object aimed at, its angle of sight, the jump of the gun, the vertical curvature of the trajectory of the projectile, the lateral drift of the projectile and the angular movement of the target, the necessary adjustments shall be automatically performed.

The object aimed at may have any angle of sight either in elevation or depression and may be traveling in any direction with any velocity, and the invention is applicable especially to anti-aircraft guns.

The invention consists in sighting apparatus for sighting a gun on a moving object comprising two pairs of sighting elements controlled by a speed indicator, one pair being arranged for sighting vertically and the other pair for sighting laterally, one pair of sighting elements being set automatically by the elevating of the gun in one case and the other by the training of the gun in the second case to allow respectively for the corrections in tangent elevation and in lateral deflection for the speed of the target, substantially as described.

The invention also consists in the improved apparatus for sighting guns hereinafter described.

First, suppose the gun to be set and fixed at a certain angle of elevation. A stationary object anywhere on the trajectory of the projectile will be hit on the gun being fired. But the angle between the axes of the gun and of the telescope directed at the object varies both in its vertical and lateral components, the said components each depending on the angle of sight of the target and on the range. The muzzle velocity of the projectile, as well as the above-mentioned characteristics of the gun and projectile, being known from calculation or experiment, the data so furnished enable the said component angles to be calculated for all ranges and angles of elevation. The said data are embodied in two cams, each of three dimensions (called hereinafter the "vertical" and "lateral" cams), which by suitable mechanism determine the correct angle between the axes of the gun and telescope. Thus, suppose the object to be at a range of 3,000 yards, and at an angular elevation of 45 degrees; if the gun is laid so that the axis of the telescope is brought on to the object, while the range scale is set at 3,000 yards, then the appropriate angle between the gun and telescope or other line of sight has been automatically determined, so that on the gun being fired the projectile hits the object.

Referring to the accompanying diagrammatic drawings:—

Figure 1 is a rear elevation of a gun mounting having sighting apparatus according to a modification of the invention.

Fig. 2 is a side elevation of the same.

Fig. 3 is a plan of the same.

Fig. 4 is a side elevation of the box containing sight regulating mechanism on an enlarged scale; while

Fig. 5 is a rear elevation of the box.

According to the invention the operations of moving the gun about the horizontal axis and about the vertical axis are performed by separate operators, each of whom, in turning his particular handle for moving the gun, at the same time automatically alters the inclination of the line of sight to the axis of the gun, as may be necessary for hitting the object. A third operator may be employed to set the time of flight cams from the range communicated to him by an operator with a range finder, or the range cams may be set automatically from the range finder.

According to the form of the invention illustrated, a gun 20 is mounted in a cradle on trunnions 21, on a pedestal 22, which is

rotated about a vertical axis by means of pinion 24 and fixed spur wheel 23. The rough training of the gun about the vertical axis is effected by the handle 25, a finer adjustment being provided by the hand wheel 26, which rotates the worm 27 gearing with a worm wheel 28. An overrunning device is provided, by which, when the coarse adjustment is being employed, the worm 27 and worm wheel 28 may remain at rest. The elevating gear also comprises a similar coarse and fine adjustment driving the shaft 29, which rotates the quadrant 31 through the pinion 30, thus moving the gun and its cradle about the trunnions.

The lateral sights are carried in a box 43, and the vertical sights in a box 430. The two sight boxes are rigidly connected by the hollow shaft 90 free to turn in bearing 42, see plan, fixed to the cradle 210. The shaft and sight boxes turn until roller 44, connected to a lever 46 pivoted at 47 in sight box 43, rests on the range cam 40. Contact is maintained between the roller and the surface of the cam by the spring 45, Fig. 2, arranged in an apron in front of the cam so that it pushes from the fixed axis of the range cam down on to the sight box 43. This mechanism and connection therefore give freedom for relative angular movement between the sight boxes and the gun cradle by the turning of the range cam relatively to the roller 44.

The range cam itself is fixed to a shaft 41 free to turn in a bearing fixed to the cradle 210, see plan. The range cam is prevented from turning relatively to the frame 22 by the parallel bars 50 and 51. It will be seen from this connection that when the cradle is elevated the range cam 40 goes up with it but does not turn relatively to the gun frame by reason of its connection with the parallel bars 50 and 51, and in consequence there is relative motion between it and the roller 44.

The range cam is formed so that this relative motion automatically sets the sight box 43 (and therefore 430) relatively to the cradle to give the sight boxes the tangent elevation appropriate to the elevation.

The cam is a three dimensioned one and a profile section along a plane containing the axis is formed so that as the roller 44 is moved along substantially parallel to the axis of the range cam the sight box 43 (and therefore 430) is turned to give the tangent elevation corresponding to the range for the particular elevation at which the cradle happens to be set. The movement of the roller 44 along the longitudinal surface of the cam is done by lever 46 pivoted to sight box 43 at pivot 47. The roller is carried on the end of this lever. The lever is connected by a screwed nut 470 to the cross shaft 49 which is screwed along a sufficient length in the box 43 to give the range of movement of the lever 46 required. Cross shaft 49 is turned by the handwheel 48. A range plate is associated with the hand wheel so that it is turned by the gun layer to a definite angular position for a given range. Thus the turning of the wheel 48 moves roller 44 to a longitudinal position on the cam corresponding to the range.

But for a given range the tangent elevation diminishes as the elevation increases. As already explained cam 40 turns relatively to the roller 44 as the gun is elevated. The profile of the cross section of the cam is formed to give the correct angle of tangent elevation for a given range as the elevation is changed.

We do not claim this range cam as part of our invention because we are aware that a range cam has been used before for a similar purpose. The range cam, however, forms part of the regulating mechanism by which the sights are set, mechanism which includes in addition to the range cam 40 carried by the cradle 210 on the shaft 41, and the trunnion 90 in the bearings 42 mentioned above, mechanism consisting of an over-running clutch 54 and a system of shafts and gear wheels about the axis of the trunnion 21 leading to a bevel wheel 56.

When the fine adjustment of the training gear is in operation, by reason of the operator turning the hand wheel 26, the motion in addition to being communicated to the gun through the overrunning clutch 54, is communicated by a system of rods and gear wheels about the axis of the trunnion to the wheel 56, which rotates a bevel wheel 57, engaging with the bevel wheel 58, on a boss sleeve 59 (Fig. 3) keyed to but capable of sliding on a sleeve 60, which carries a permanent magnet 61, having a number of poles, and an inner armature 62. Between the magnet poles and the armature there is mounted a metallic cup 65, carried on the spindle 64, and restrained from rotation by a light spring 66 and also preferably damped, the whole forming a magnetic speed indicator.

The angular displacement of the cup from its initial position is made proportional to the time of flight, the speed of the target and in addition a correction must be applied to allow for the difference in the angular velocity of the gun mounting about a vertical axis and the angular velocity of the line of sight. The gun must be trained about a vertical axis at an angular velocity equal to the angular velocity of the line of sight divided by the cosine of the angle of elevation. This is a well known relation.

The angular displacement of the cup and therefore the pointer 75 which forms one of the sighting elements in the line of collimation depends upon the speed of rotation of the ring of magnets 61—62 and the depth

to which the magnets are pushed over the cup 65. The angular displacement of the cup we make proportional to the speed at which the line of sight is following the target by the gearing above explained. The depth to which the magnets are pushed over the cup we make proportional to the cosine of the angle of elevation and to the time of flight jointly. This joint proportionality is secured by means of the bar 70 pivoted on the sleeve 60 which carries on its end the magnets. One end of this lever 70 receives a movement proportional to the cosine of the angle of elevation from the cam groove formed in the disk 72, the disk being prevented from turning as the gun is elevated by connecting it to the parallel bars 50 and 51, while simultaneously the other end receives a movement proportional to the time of flight from the cam groove in the disk 73. This cam is turned by the hand wheel 48 through the pinion 68 so that the operation of setting the wheel to the range also sets the cam to the corresponding time of flight. In this way through the motions impressed on the ends of the lever the sleeve is moved along so that the magnets engage the cup proportionally jointly to the time of flight and to the cosine of the angle of elevation.

The motion of the cup 65 is communicated to the pointer 75, which is pivoted at 76, by a rack 77, engaging with the pinion 78 on the shaft carrying the cup. It will be seen that instead of the gear shown for communicating the motion of the hand wheel 26 to the pinion 58 driving the magnet, any suitable flexible connection could be employed.

The actual line of sight is obtained by looking through the telescope 85 through the eye-piece 86. This eye-piece comprises half of lens 87, and half of a piece of plain glass 88. The lens 87 should be focused on the pointer 75, while the distant object aimed at is looked at through the plain glass. The whole of the telescope 85 is pivoted about a horizontal axis on the box 43, so that it cannot move about the axis about which the gun is turned for giving lateral direction.

The apparatus for operating the sights for elevation is similar to that above described for operating the sights for lateral direction, with the exception that instead of a vertical pointer, a horizontal pointer, as indicated at 80, (Fig. 1) is employed. Also, instead of using a time of flight cam in combination with a cosine cam, a time of flight cam alone is required.

The mechanism for sighting is pivoted about trunnions 90, which are slightly inclined to the trunnions of the gun, so that the same solid cam 40 serves both for correcting for elevation and drift.

The operation of the above described sighting apparatus is as follows:—

The gun crew comprises two gun layers, and an operator who sets the time of flight cams according to the range communicated, or if the range cams are set automatically, this operator may be dispensed with, the time of flight cams being set automatically from a range finder. One gun layer operates the gun elevating mechanism; the other operates the mechanism for directing the gun laterally. Each gun layer keeps his line of sights upon the object, operating the gun laying gear for this purpose. The two sights automatically take up the position corresponding to the corrected deflections in the vertical direction and in the plane of altitude.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

Sighting apparatus for sighting a gun on a moving object comprising in combination two pairs of sighting elements, a speed indicator controlling said pairs of sighting elements, one pair of said sighting elements being arranged for sighting in the vertical plane and the other pair for sighting laterally, means for automatically setting one element of one of said pairs by the movement of elevating the gun, means for setting one element of the other of said pairs by the movement of training the gun, to allow for the speed of the target, as set forth.

In testimony whereof we have affixed our signatures.

JOHN SIGISMUND WILSON.
WILLIAM ERNEST DALBY.