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A. BARR ET AL

ANTIAIRCRAFT FIRE CONTROL APPARATUS

Filed Dec. 26, 1922

FIG. 1.

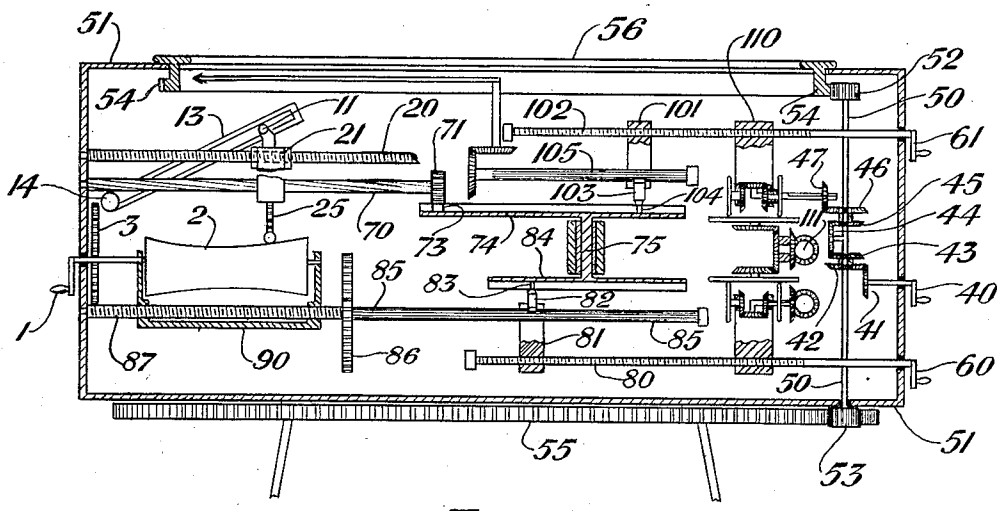
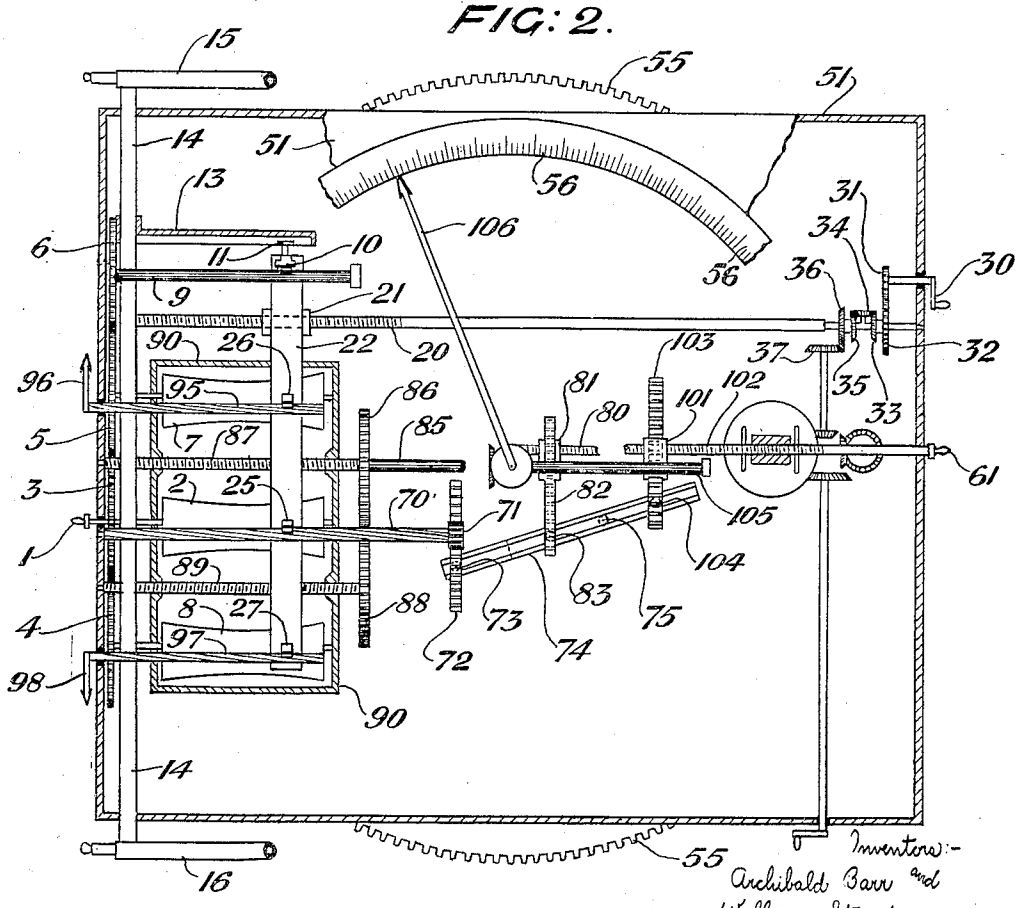


FIG. 2.



Inventors:-
Archibald Barr and
William Stroud,
by
Fowler and Smith,
Attorneys.

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ARCHIBALD BARR AND WILLIAM STROUD, OF ANNIESLAND, GLASGOW, SCOTLAND, ASSIGNORS TO BARR AND STROUD, LIMITED, OF GLASGOW, SCOTLAND.

ANTIAIRCRAFT FIRE-CONTROL APPARATUS.

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To all whom it may concern:

Be it known that we, ARCHIBALD BARR and WILLIAM STROUD, subjects of the King of Great Britain and Ireland, and both of Caxton Street, Anniesland, Glasgow, Scotland, have invented new and useful Improvements in Antiaircraft Fire-Control Apparatus, of which the following is a specification.

This invention relates to improved apparatus for use in obtaining the requisite data for anti-aircraft gunnery.

Apparatus according to this invention comprises, (1) sighting apparatus; (2) an element to be set in accordance with the known height of the target at the instant of observation operating to control the angle of sight of the sighting apparatus; (3) a variable speed drive controlling the position of (2) to keep the sighting apparatus directed on the target for angle of sight, and give the value of the horizontal range and v (velocity of approach along the horizontal range and in the vertical plane containing target and observer on a selected scale); (4) a device (say a multiple cam or equivalent) one variable of which (say rotation) is set according to the height of the target, while the second variable (say translation) is set by (3) according to the horizontal range of the target, the device being so constructed as to produce motion according to T (time of flight); (5) means for multiplying the speed given by (3) by T so as to give the product v T; (6) means for setting (4) by an amount v T given by (5), associated with mechanism for giving or exhibiting the quadrant or tangent elevation and the fuse number, this mechanism being rotatable, say, in accordance with the height of the target and movable with the device (4) in accordance with the horizontal range of the target; (7) a variable speed drive controlling the azimuthal position of the sighting apparatus and thereby giving ω (angular velocity); and (8) means for multiplying ω by T given by (4) so as to give or exhibit the product ω T.

In the description which follows it will be assumed that the aircraft is moving in a straight line with uniform speed at a constant height H and that the observing station is near the gun.

In the first instance the invention will be described as applied to the case of indirect gun fire on land and the problem will be considered under two headings: (1) motion in the vertical plane containing the observing station, and (2) motion at right angles thereto.

In case (1) the aircraft will be assumed to be flying at a constant speed V at a constant height H in the vertical plane containing the observing station. H is measured by a suitable height finder. With the height known, the speed V may be determined after a known manner.

Given H and V, the quadrant elevation Q E of the gun and the required fuse setting F can be calculated by reference to a chart embodying the requisite data for the firing of the gun. By this invention the required values of Q E and F for the predicted position of the aircraft, are obtained by mechanism continuously and instantaneously.

An example of construction according to this invention will now be described with reference to the accompanying drawing, in which:—

Figure 1 is a sectional elevation and Figure 2 is a broken plan partly in section of an instrument, each partly diagrammatic.

The known height H is set off by rotating handle 1 with reference to a fixed scale (not shown). A time-of-flight multiple cam 2 is fixed to the shaft of 1 to which is also fixed toothed wheel 3 gearing with toothed wheels 4, 5 and 6 fixed to their respective shafts. Multiple cam 7 is fixed to the shaft of 5, and multiple cam 8 is fixed to the shaft of 4. A long pinion rod 9 fixed to the shaft of 6. Gearing with 9 is a rack 10 (suitably guided) carrying a pin 11 engaging in a slot of an arm 13 rigidly fixed to rod 14 carrying telescopes 15 and 16, one at each end. Thus as the height is set off by turning handle 1 the multiple cams 2—for time of flight—7—for quadrant elevation—and 8—for fuse indication—are all simultaneously rotated while the pin 11 is raised or lowered, thus increasing or decreasing the angle of sight of 15 and 16. 20 is a long screw, carrying nut 21 to which is fixed a transverse bar 22 supporting guides for the rack 10 and guides for three plungers 25, 26, 27 resting on multiple cams 2, 7, 8, respectively.

A handle 30, see Figure 2, is provided for initially setting the position of nut 21 by the rotation of screw 20 so that the angle of sight of the two telescopes 15, 16 may

correspond to that of the target. This handle 30 is shown for clearness on the right hand side of the case and away from the telescopes; it would, however, be situated in proximity to the observer at one of the telescopes, say 15.

Fixed to the shaft of 30 is a toothed wheel 31 gearing with wheel 32 fixed to one element 33 of a differential gear 33, 34, 35. The spindle of jockey element 34 is fixed to screw 20, and bevel 35 is fixed to a bevel 36 gearing with a bevel 37 which can be driven mechanically in either direction at an adjustable rate. Thus the observer at 15 adjusts handle 30 to suit the initial angle of sight of the target and then adjusts the rate of rotation of 37 so that the angle of sight continues to correspond to that of the target. Meantime the observer, say, at telescope 16 is provided with similar means for the initial setting of the azimuthal position of the case and with an adjustable drive for maintaining that position. The initial setting is done by means of handle 40, the parts 40 . . . 47 corresponding to the parts 30 . . . 37 already discussed. In this case the variable drive comes from 47 and the spindle of jockey 44 is fixed to shaft 50 whose bearings are fixed to the case 51. Pinion wheels 52 and 53 are fixed to shaft 50, pinion 52 gearing with a large toothed wheel 54 carrying dial 56, while pinion 53 gears with a large toothed wheel 55 fixed relatively to the ground; the number of teeth of the various wheels 54 and 55 and associated pinions 52 and 53 being such that dial 56 remains fixed relatively to wheel 55 and therefore relatively to the ground.

The variable drives shown are of well known type and are not described in detail. Handle 60 (situated conveniently for the observer at telescope 15) is operated so as to furnish the value of v, i. e., the velocity of approach along the horizontal range and in the vertical plane containing target and observer upon the selected scale, while handle 61 (situated conveniently for the observer at telescope 16) is operated so as to furnish the value of the angular velocity ω.

Thus at the commencement of operations the observer at telescope 16 adjusts the handle 40 for initial azimuthal position; meantime the observer at 15 adjusts handle 30 for initial angle of sight when the telescopes will be directed on the target. By adjustments of the variable drive handles 61 for azimuthal angular velocity and 60 for linear velocity of approach, the telescopes should keep on the target at all events for a short time.

The velocities ω and v require to be multiplied by T, the time of flight. Multiple cam 2 is constructed to give the value of the time of flight. Therefore, if 2 is rotated for the known height while the plunger 25 is translated by screw 20 so as to correspond to the actual horizontal range of the target, the motion of plunger 25 will be in accordance with T. In the mechanism illustrated the horizontal position of the plunger 25 can be arranged to correspond to the actual position of the target. Plunger 25 is provided with a sloping rack gearing into a spiral pinion 70 to which is fixed pinion 71 gearing with a rack 72 carrying a pin 73 engaging in a slotted arm 74 which has a fulcrum at 75.

Handle 60 which sets off the variable drive for v by means of screw 80 carries a nut 81 supporting a rack 82 to which is fixed a pin 83 working in a slot in an arm 84, Figure 1, which is rigidly attached to the slotted arm 74 pivoted about the fulcrum 75. The rack 82 gears with a long pinion rod 85, the rotation of which is a measure of the product v T because the displacement of pin 73 from its zero position is a measure of T and the displacement of nut 81 and therefore of pin 83 from its zero position is a measure of v. The rotation of pinion rod 85 is communicated to toothed wheel 86 and screw 87 (both rigidly fixed to 85). Wheel 86 gears with wheel 88 fixed to left-handed screw 89. The gearing is such that the two screws 87 and 89 (if of equal pitch) rotate equally in opposite directions. Platform 90 carrying the three multiple cams is translated by the rotation of screws 87 and 89 through a distance v T with reference to the plungers 25, 26 and 27. These plungers will therefore now rest upon portions of the multiple cams corresponding to the predicted position of the target. Plunger 26 gearing with spiral pinion 95 to which is fixed pointer 96 can in this way be arranged to indicate the quadrant elevation upon a fixed circular scale (not shown); while plunger 27 gearing with spiral pinion 97 carrying pointer 98 can be arranged to indicate the number of the fuse.

To obtain the value of ω handle 61 is rotated operating screw 102 whereby nut 110 is translated and shifts the position of a variable speed device (indicated generally) in a known manner, and as shaft 111 is driven at a constant speed by suitable mechanism, the bevel wheel 47 is caused to rotate at an adjustable speed forwards or backwards and this motion is communicated by gear 53, engaging with 55, which is fixed, and drives the frame 51 carrying the mechanism which is mounted to turn asimuthally.

The product ω T is obtained in a similar fashion. Thus, when motion in accordance with the value of ω is set off by handle 61 thereby turning screw 102 which translates nut 101 carrying rack 103 provided with pin 104 which engages in the slotted arm 74, and as rack 103 gears with long pinion rod 105, the motion of 105 is a measure of ω T.

This motion is communicated by bevel wheels to the pointer 106.

In the case of direct gun fire the Q E cam 7 can be replaced by a cam arranged to give tangent elevations (T E). The angular correction for deflection about a vertical axis will still be as before ω T as given by the deflection of the pointer 106 with reference to 51. In this case there will be no necessity to provide a dial 56 fixed with reference to the ground so that the parts 52 and 54 may be removed, a fixed scale being attached to the case so that the deflection may be read by the pointer 106 upon this scale.

For use on board ship, it is necessary that the axis of the apparatus shall be maintained vertical and further that a diametral line upon the upper flat circular face of 51 shall be maintained in a fixed direction in space.

We claim:—

1. Apparatus comprising (1) sighting apparatus, (2) an element to be set in accordance with the known height of the target at the instant of observation operating to control the angle of sight of the sighting apparatus; (3) a variable speed drive controlling the position of (2) to keep the sighting apparatus directed on the target for angle of sight and give the value of the horizontal range and v (velocity of approach along the horizontal range and in the vertical plane containing target and observer on a selected scale); (4) a device having one variable capable of being set according to the height of the target, and a second variable capable of being set by (3) according to the horizontal range of the target, the device being so constructed as to produce motion according to T (time of flight); (5) means for multiplying the speed given by (3) by T so as to give the product of v T; (6) means for setting (4) by an amount v T given by (5), associated with mechanism for giving the quadrant or tangent elevation and the fuse number, this mechanism being movable, in accordance with the height of the target and movable with the device (4) in accordance with the horizontal range of the target; (7) a variable speed drive controlling the azimuthal position of the sighting apparatus thereby giving ω (angular velocity); and (8) means for multiplying ω by T given by (4) so as to give or exhibit the product ω T.

2. Apparatus comprising (1) sighting apparatus, (2) an element to be set in accordance with the known height of the target at the instant of observation operating to control the angle of sight of the sighting apparatus; (3) a variable speed drive controlling the position of (2) to keep the sighting apparatus directed on the target for angle of sight, and give the value of the horizontal range and v (velocity of approach along the horizontal range and in the vertical plane containing target and observer on a selected scale); (4) a multiple cam capable of being set rotationally according to the height of the target, and of being set by translation by (3) according to the horizontal range of the target, the device being so constructed as to produce motion according to T (time of flight); (5) means for multiplying the speed given by (3) by T so as to give the product of v T; (6) means for setting (4) by an amount v T given by (5), associated with mechanism for giving the quadrant or tangent elevation and the fuse number, this mechanism being movable in accordance with the height of the target and movable with the device (4) in accordance with the horizontal range of the target; (7) a variable speed drive controlling the azimuthal position of the sighting apparatus thereby giving ω (angular velocity); and (8) means for multiplying ω by T given by (4) so as to give or exhibit the product ω T.

3. Apparatus comprising (1) sighting apparatus, (2) an element to be set in accordance with the known height of the target at the instant of observation operating to control the angle of sight of the sighting apparatus; (3) a variable speed drive controlling the position of (2) to keep the sighting apparatus directed on the target for angle of sight, and give the value of the horizontal range and v (velocity of approach along the horizontal range and in the vertical plane containing target and observer on a selected scale); (4) a multiple cam having one variable capable of being set according to the height of the target, and a second variable capable of being set by (3) according to the horizontal range of the target, the device being so constructed as to produce motion according to T (time of flight); (5) means for multiplying the speed given by (3) by T so as to give the product of v T; (6) means for setting (4) by an amount v T given by (5), associated with two additional multiple cams for giving the quadrant or tangent elevation and the fuse number, these cams being variable in accordance with the height of the target and variable with the second variable of device (4) in accordance with the horizontal range of the target; (7) a variable speed drive controlling the azimuthal position of the sighting apparatus thereby giving ω (angular velocity); and (8) means for multiplying ω by T given by (4) so as to give or exhibit the product ω T.

4. Apparatus comprising (1) sighting apparatus, (2) an element to be set in accordance with the known height of the target at the instant of observation operating to control the angle of sight of the sighting ap-

paratus; (3) a variable speed drive controlling the position of (2) to keep the sighting apparatus directed on the target for angle of sight, and give the value of the horizontal range and v (velocity of approach along the horizontal range and in the vertical plane containing target and observer on a selected scale); (4) a multiple cam capable of being set rotationally according to the height of the target, and of being set by translation by (3) according to the horizontal range of the target, the device being so constructed as to produce motion according to T (time of flight); (5) means for multiplying the speed given by (3) by T so as to give the product of v T; (6) means for setting (4) by an amount v T given by (5), associated with two additional multiple cams for giving the quadrant or tangent elevation and the fuse number, these cams being rotatable in accordance with the height of the target and translatable with the device (4) in accordance with the horizontal range of the target; (7) a variable speed drive controlling the azimuthal position of the sighting apparatus thereby giving ω (angular velocity); and (8) means for multiplying ω by T given by (4) so as to give or exhibit the product ω T.

ARCHIBALD BARR.
WILLIAM STROUD.