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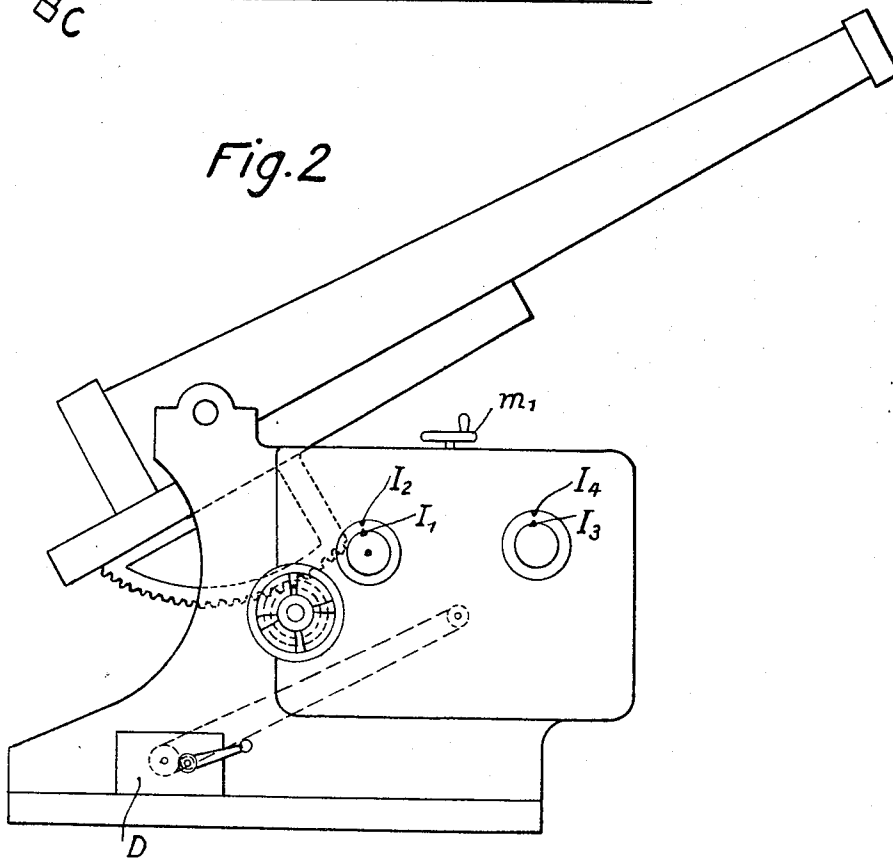
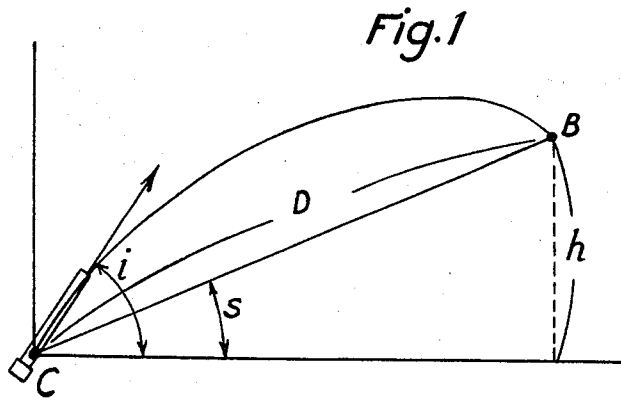
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APPARATUS FOR AIMING GUNS

Filed July 29, 1931

2 Sheets-Sheet 1



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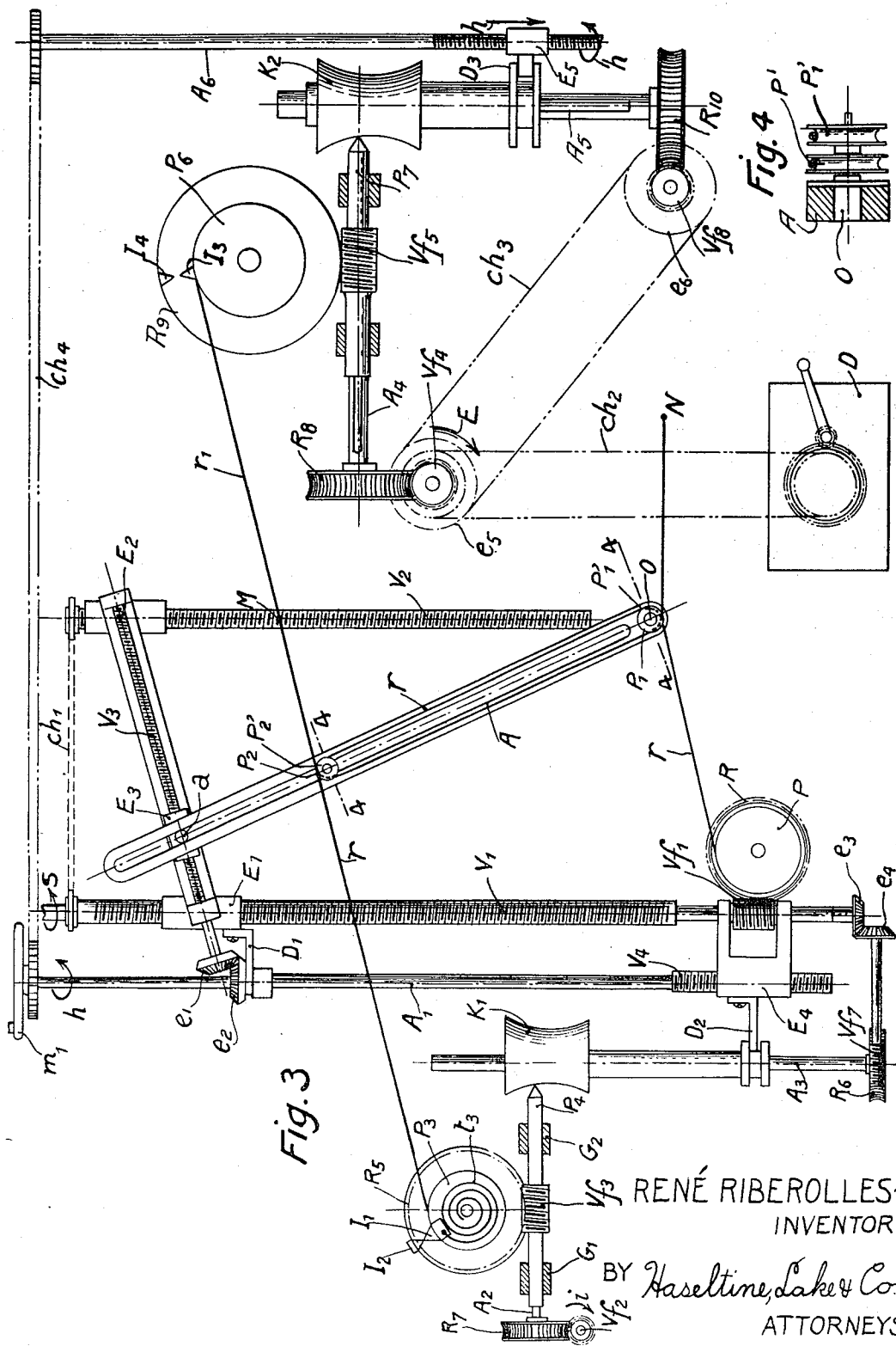
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UNITED STATES PATENT OFFICE

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APPARATUS FOR AIMING GUNS

René Riberolles, Paris, France

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in France August 6, 1930

12 Claims. (Cl. 235—61.5)

The object of the present invention is to enable artillery guns to be aimed in a convenient and accurate manner.

Its object in particular is:

1. To determine the inclination of the gun when the altitude and the site angle of the target to be reached are known.
2. To determine the fuse setting of the projectile when the altitude and the site angle of the target are known.

A device for aiming guns according to the invention presents the characteristic features which will appear from the following description and principally from the claims attached at the end of this description.

The preferred form of the invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a general firing diagram permitting the data of the problem to be obtained.

Figure 2 is a general arrangement of the gun in elevation with its elevating hand wheel.

Figure 3 shows an elevation of the mechanisms adapted to permit the inclination of the gun and the fuse setting of the projectile to be determined as a function of the altitude and the site angle.

Figure 4 is a section taken along the lines 4—4 in Figure 3.

The manner in which the various quantities to be obtained are inter-related in the various mechanisms will first be described in a general manner.

In Figure 1, C is the gun, and B the target; if i is inclination of the gun to the horizontal, s the site angle and h the altitude of the target, it is known that we can write f , f_1 , f_2 designating complex functions:

1. $i=f(s, h)$ or
2. $i=s+f_1(s, h)$ or again
3. $i=s+f_2(h, i)$

It has often been proposed to resolve the first formula by means of a camoid actuated as a function of h and s . Similarly the other formulæ have previously been resolved by adding together two movements, one reproducing the site angle s , by gearing of any kind, and the other reproducing f_1 or f_2 by camoids actuated as a function of h and s or i . The Formulæ 2 and 3 have the advantage over the first that the camoids have smaller variations than the camoid resolving the Formula 1.

The applicant has established the analogous formula:

$$4. \quad i = s + \frac{Ch - C_1 h + f_3(h, s)}{s}$$

where C and C_1 are constants; the application of this formula is one of the main features of the invention as well as the particular manner described

hereinafter, in which the addition of the terms is effected.

The complex part.— $f_3(h, s)$ will be obtained as stated above by means of a camoid actuated automatically as a function of two variables defining the position of the target, such as h and s for example.

Further, if E is the fuse setting corresponding to the distance D of the target, we have in the first place:

$$E = f_4(h, s)$$

f_4 being a complex function.

But it is known that in normal guns it is always sought to make the fuse setting graduation coincide with the bursting distance D of the gun, on the ground or at a certain altitude, so that the fuse setting can be represented approximately by the distance D, and we are naturally led to write, with a coefficient of approximate proportionality:

$$5. \quad E = D + f_5(h, D) \text{ or}$$

$$6. \quad E = D + f_6(h, E)$$

These formulæ are identical in form to the Formulæ 2 and 3, and in them the complex functions may always be obtained by means of camoids actuated as a function of h and D, or h and E.

One of the characteristic features of the invention in this connection consists in replacing D by an approximately equivalent value

$$\frac{h}{s}$$

and in finally writing:

$$7. \quad E = C_2 \frac{h}{s} + f_7(h, E);$$

C_2 being a constant.

In the embodiments described hereinafter, another characteristic application of the invention consists in employing a common mechanism for the terms containing

$$\frac{h}{s}$$

in the Formulæ 4 and 7.

The determination of the individual elements, inclination and fuse setting, is, according to the invention, effected in the following manner:

(a) *Inclination of the gun (Figures 2, 3 and 4)*

It is assumed that the site angle s is determined separately by means which do not form part of the present invention.

A is an oscillating member such as a slotted link pivoted about a point O. The rotation of this link about this point is controlled by a shaft a engaging in the slot in the link and rigid with the nut E_3 of a screw V_3 .

The latter is mounted upon a carriage carrying

two nuts E_1, E_2 actuated as a function of the site angle s by a first mechanism formed by two parallel screws V_1, V_2 . For this purpose the control for the movement in site s acts upon one of the screws V_1 for example, and a sprocket chain ch_1 or an equivalent connection connects together the screws V_1 and V_2 .

The screw V_3 carries a toothed wheel e_1 meshing with another toothed wheel e_2 . The latter is splined so that it can slide upon the shaft A_1 forming a second mechanism, which is connected to the movement in altitude h by any suitable hand control m_1 .

A driving pin D_1 penetrating into a circular groove in the toothed wheel e_2 compels the latter to follow the movements of the carriage E_1 and to remain in engagement with e_1 .

The link A carries two circular guides P_1, P_2 . The first of these has its centre on the shaft O . The second is fixed at an arbitrary point on the longitudinal axis of the link.

Transmission means are actuated by the link A . These transmission means are formed for example by a first band r which passes over the guides P_1, P_2 . This band is attached on the one hand to a pulley P rigid with a toothed wheel R driven by a worm Vf_1 keyed so as to slide along the extension of the first screw V_1 .

The first band r is also attached to a pulley P_3 provided internally with a tension spring t_3 and carrying a first pointer or index member I_1 .

The arrangement is such that the direction of the band r between P_2 and P_3 is parallel to V_3 . The direction of the latter screw is itself preferably chosen in such a way that the extreme positions of the link A will be equally inclined to the screw V_3 .

Let M be the point of intersection of the direction of the band when produced and the axis of the second screw V_2 .

We have:

$$\frac{P_2M}{aE_2} = \frac{OM}{OE_2}$$

where

$$P_2M = \frac{mh}{ns} OM$$

m and n being constants. As OM is fixed, it is thus seen that:

$$P_2M = C \frac{h}{s}$$

C being a constant.

The pulley P to which the first band r is attached, is connected to the site movement s under the action of the first worm Vf_1 . The latter is itself driven by a nut E_4 mounted upon the fourth screw V_4 rigid with the shaft A_1 turning as a function of h . Finally, the wheel R can turn through $s - C_1h$, by choosing suitable scales.

Consequently, in all, the first pointer or index member I_1 rigid with the spring controlled pulley P_3 , which is driven by the first band r , will move through

$$s + C \frac{h}{s} - C_1h$$

The control for the inclination or elevation i of the gun acts upon a third mechanism formed by a second worm Vf_2 driving a wheel R_7 , the shaft A_2 of which is splined to, but slides in a push rod P_4 .

Connecting means connect the push rod P_4 to the first and to the second mechanism; for ex-

ample, a camoid K_1 is keyed so as to slide upon a shaft A_3 . This shaft A_3 is connected to the first mechanism by a worm wheel R_6 meshing with a worm Vf_7 driven by toothed wheels e_3e_4 , the toothed wheel e_4 being rigid with the first screw V_1 .

Further, the first camoid K_1 is adapted to slide upon its shaft A_3 under the action of a finger D_2 rigid with the nut E_4 . This finger D_2 is rigid with the nut E_4 driven by the screw V_4 .

The camoid K_1 thus transmits the combined movements of the first and second mechanisms to the push rod P_4 .

The profile of this camoid is such that it moves the push rod P_4 by an amount proportional to the term $f_3(h, s)$ in Equation 4.

On this push rod is keyed a third worm Vf_3 driving a worm wheel R_5 which carries a second pointer or index member I_2 .

The rotation of the latter may therefore be proportional to:

$$i - f_3(h, s)$$

If we operate on the control of the inclination of the gun in order to bring the pointers or index members I_2 and I_1 into coincidence, it is seen that we have at this moment equalized the rotations of these pointers and that we have consequently equated:

$$i - f_3(h, s) = s + C \frac{h}{s} - C_1h,$$

which translates the Equation 4.

Thus, if the pointers I_2 and I_3 had been made to coincide by operating on the mechanism controlling the inclination of the gun, the latter will have been given at this moment an inclination which corresponds to the values of site angle and altitude recorded by the devices in conformity to the first of the objects of the invention.

It is to be noted that it is known to obtain a quotient of the form of

$$\frac{h}{s}$$

by means of a combination of nuts controlling a link, but one characteristic feature of the present invention consists in the particular combination of this system with the other mechanisms, and more particularly in indicating the rotation of the link by the use of a band passing over two circular guides, one fixed to the shaft of the link and the other to a point on this link, the band being thus capable of making additional displacements which are strictly independent of the movement of the link.

It is also to be noted that actually the guide P_2 does not describe a straight line P_2M , but a circular arc of which P_2M is the chord. Scales may be chosen in such a way that the rotation of the link A will be sufficiently small for the difference between the arc and the chord to be negligible. It may also be taken into account strictly by the shape given to the preceding camoid K_1 and this forms another feature of the invention.

(b) Determination of the fuse setting (Figures 2, 3 and 4)

Transmission means such as a second band r_1 superposed on the first band r in Figure 1, or guides P_1', P_2' mounted upon the link A and having the same axes as the guides P_1 and P_2 , receive the movements of the link A . But instead of being attached to a pulley such as P the second band r_1 will be attached to a fixed point N . It is

seen that a pulley mounted like P_3 in Figure 1 and carrying a third pointer or index member I_3 can displace the latter by the amount corresponding to the term

$$C_2 \frac{h}{s}$$

in Equation 7.

Further, the fuse punch or fuse setter D drives, for example by means of a chain ch_2 , a fourth mechanism formed by a fourth worm Vf_4 driving a worm wheel R_8 and a shaft A_4 splined so as to slide in the push rod P_7 . Connecting means connect the push rod P_7 to the second and to the fourth mechanisms; for example, a second camoid K_2 is mounted by means of a sliding key or by hexagonal engagement on a shaft A_5 . This shaft A_5 is driven by the fourth mechanism by means of a chain ch_3 .

A shaft A_6 connected to the hand operated mechanism m_1 controlling the movement in altitude by means of a chain ch_4 drives a nut E_5 . The nut E_5 carries a finger D_3 which makes the second camoid K_2 slide on its shaft A_5 .

The push rod P_7 carries a worm Vf_5 driving a worm wheel R_9 ; a fourth pointer or index member I_4 concentric with the first pointer or index member I_3 is rigid with the wheel R_9 .

It is thus seen that the wheel R_9 and consequently the fourth pointer or index member I_4 can turn through:

$$E - f_1(h, E)$$

If I_4 and I_3 are made to coincide this rotation will be made equal to that of P_6 , and we will have:

$$E - f_1(h, E) = C_2 \frac{h}{s}$$

or

$$E = C_2 \frac{h}{s} + f_1(h, E)$$

E is thus clearly the fuse setting which corresponds to the site angle and the altitude recorded since it verifies Equation 7.

It has been obtained automatically by actuating the mechanism controlling the fuse punch or fuse setter D in such a way as to make a pointer connected to this control coincide with another pointer controlled by the elements recorded above, in conformity to the second object of the invention.

What I claim is:

1. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a link member oscillating about a pivot on said apparatus and connected to both said first and second mechanisms and controlled thereby, transmission means receiving the combined movements of both the first and second mechanisms and the oscillating link member, a first index member actuated by said transmission means, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, connecting means interposed between the second index member and the two first mechanisms in order to transmit to the second index member an additional movement proportional to the movements of the first mechanism and of the second mechanism, the coincidence of the second index mem-

ber with the first index member corresponding to the required elevation or inclination of the gun.

2. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a link member oscillating about a fixed pivot on said apparatus and connected to both said first and second mechanisms and controlled thereby, a first guide rigid with the oscillating link member at its pivotal point, a second guide movable on the oscillating link member, a connecting band bearing upon the first and second guides so as to receive the combined movements of the first and second mechanisms and of said oscillating link member, a first index member actuated by said connecting band, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, connecting means interconnecting the second index member to the first two mechanisms and transmitting to the second index member an additional movement proportional to the movements of the first and second mechanisms, the coincidence of the second index member with the first index member corresponding to the required elevation of the gun.

3. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a sliding arm articulated upon a fixed pivot on said apparatus and connected to the first and second mechanisms so as to be operable thereby, transmission means receiving the combined movements of both the first and second mechanisms and of the sliding arm, a first index member actuated by said transmission means, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, connecting means interposed between the second index member and the first two mechanisms and said sliding arm in order to transmit to said second index member an additional movement proportional to the movements of the first mechanism and of the second mechanism, the coincidence of the second index member with the first index member corresponding to the required elevation or inclination of the gun.

4. In an apparatus for aiming a gun, a screw associated with site setting means so as to be rotatable thereby, a second screw driven by said first screw, a shaft associated with altitude setting means so as to be rotatable thereby, a link member oscillating upon a fixed pivot, means connecting said first and said second screws with the oscillating link member, means connecting said link member to said shaft, which latter rotates in altitude, transmission means receiving the combined movements of the first screw and connected to the site setting means, of said shaft connected to the altitude setting means and of said oscillating link member, a first index member actuated by said transmission means, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, and connecting means connecting said

second index member directly to said first screw which is associated with the site setting means, and to said shaft associated with the altitude setting means, which connecting means transmit to said second index member an additional movement proportional to the movements of said first screw associated with the site setting means, and to the movements of the shaft associated with the altitude setting means; the coincidence of the second index member with the first index member corresponding to the required elevation of the gun.

5. In an apparatus for aiming a gun, a screw associated with site setting means so as to be rotatable thereby, a second screw driven by said first screw, a shaft associated with altitude setting means so as to be rotatable thereby, a link member oscillating upon a pivot, a first nut screwed upon the first screw and shiftable thereby, a second nut mounted upon the second screw, a carriage carried by both the first and second nuts, a third screw borne by said carriage, a first gear rigid with the third screw, a second gear meshing with the first gear and solely driven by the shaft associated with the altitude setting means, a third nut threaded upon said third screw driving the oscillating link member, transmission means receiving the combined movements of the first screw, of the first shaft, and of said oscillating link member, a first index member actuated by said transmission means, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, and connecting means connecting said second index member directly to the first screw and to said shaft, which connecting means transmit to said second index member an additional movement proportional to the movements of the first screw associated with the site setting means and to the movements of the shaft which is associated with the altitude setting means, the coincidence of the second index member with the first index member corresponding to the required elevation of the gun.

6. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a link member oscillating about a fixed pivot on said apparatus and connected to both said first and second mechanisms and controlled thereby, a screw associated with and controlled by said second mechanism, a nut driven by said screw, a worm carried by said nut and operated by said first mechanism, a pulley driven by said worm, a guide rigid with the oscillating link member at its point of oscillation, a second guide movable on said oscillating link member, a connecting band connected to said pulley and bearing upon said first and second guides in order to receive the combined movements of both the first and second mechanisms and said link member which is controlled by the latter, a first index member actuated by said connecting band, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, connecting means connecting said second index member with the first and second mechanisms, which connecting means transmit to the second index member an additional movement proportional to

the movements of the first and second mechanisms, the coincidence of the second index member with the first index member corresponding to the required elevation of the gun.

7. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a link member oscillating about a fixed pivot on said apparatus and connected to both said first and second mechanisms and controlled thereby, transmission means receiving the combined movements of both the first and second mechanisms and the oscillating link member, a first index member actuated by said transmission means, a first worm associated with the elevating means of the gun so as to be rotatable thereby in following the movement of the gun in elevation, there being elevating means, a shaft actuated by said first worm, a push rod slidably splined upon said shaft, connecting means connecting said push rod with said first mechanism and said second mechanism, which connecting means transmit to said push rod a combined movement proportional to the movement of the first and second mechanisms, a second worm rigid with said push rod, a second index member actuated by said second worm in order to associate said second index member with and move the same by the site setting means, altitude setting means and elevating means of the gun, the coincidence of said second index member with said first index member corresponding with the required elevation of the gun.

8. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a link member oscillating about a pivot fixed on said apparatus and connected to both said first and second mechanisms and controlled thereby, transmission means associated with both said first and second mechanisms and said oscillating link member so as to receive the combined movements thereof, a first index member actuated by said transmission means, a third mechanism following the movement of the gun in elevation, there being elevating means, a second index member actuated by said third mechanism, a shaft actuated by said first mechanism and provided with a camoid slidably splined thereon so as to positively rotate therewith and also caused to slide upon said shaft by means of said second mechanism following the gun movement in altitude, which camoid transmits to the second index member an additional movement proportional to the movements of the first and second mechanisms, the coincidence of said first and second index members corresponding with the required elevation of the gun.

9. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, means for setting the fuse of a projectile, an oscillable member pivoted at a fixed point upon said apparatus and associated with both the first and second

mechanisms and controlled thereby, transmission means adapted to receive the movements of said oscillable member, a fuse setting mechanism associated with said means for setting the fuse of the projectile, a fuse setting index member associated with the transmission means and controlled thereby, a second fuse setting index member actuated by said fuse setting mechanism, connecting means interposed between said second fuse setting index member and said second mechanism comprising a shaft carrying a slidable camoid which is keyed thereon so as to be positively rotatable with said shaft, a worm gear mounted upon said shaft, a worm meshing with said worm gear, a push rod in contact with said camoid, and rotatable means associated with said connecting means in the form of a second worm gear and a second shaft, a worm engaging said second worm gear and connected to said first worm, and a rotatable screw connected to said first mechanism and having a nut thereon adapted to longitudinally shift said camoid, which interposed connecting means are controlled by said fuse setting means and impart to said second fuse setting index member an additional movement proportional to the combination of the movements of said second mechanism and said fuse setting mechanism, the coincidence of the second fuse setting index member with the first fuse setting index member corresponding to the required fuse setting of the projectile.

10. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a third mechanism including a pair of parallel interconnected and rotatable screws associated with said first mechanism following the movement of the gun in site, a fourth mechanism including a shaft generally parallel with said screws and following the movement of the gun in altitude, an oscillable member pivoted at a fixed point upon said apparatus and controlled by said screws and said shaft, a first fuse setting guide rigid with said oscillable member at the point of oscillation thereof, a second fuse setting guide movably disposed on said oscillable member, a fuse setting band which is fixed at one end and bearing both upon the first fuse setting guide and also upon the second fuse setting guide, in order that said fuse setting band will receive the movements of said oscillable member, a first fuse setting index member actuated by said fuse setting band, a fuse setting mechanism associated with aforesaid means for setting the fuse of the projectile, a second fuse setting index member actuated by said fuse setting mechanism, connecting means interposed between said second fuse setting index member and aforesaid second mechanism and imparting to the second fuse setting index member an additional movement which is proportional to the combination of the movement of said second mechanism with the movement of the fuse setting mechanism.

11. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, a third mechanism

including a pair of parallel interconnected and rotatable screws associated with said first mechanism following the movement of the gun in site, a fourth mechanism including a shaft generally parallel with said screws and following the movement of the gun in altitude, an oscillable member pivoted at a fixed point upon said apparatus and controlled by said screws and said shaft, a first fuse setting worm actuated by the means for setting the fuse of the projectile, a fuse setting shaft actuated by said fuse setting worm, a fuse setting push rod slidably splined upon said fuse setting shaft so as to positively rotate with the shaft, a second fuse setting worm rigid with said push rod, a first fuse setting index member actuated by said second fuse setting worm, connecting means interposed between said fuse setting push rod on the one hand and both the second mechanism and the fuse setting mechanism on the other hand, which connecting means imparts to said fuse setting push rod an additional movement proportional to the combination of the movement of the second mechanism with the movement of the fuse setting mechanism, a second fuse setting index member also actuated by said second fuse setting worm, which second fuse setting index member follows the combined movements of the gun in altitude and the setting of the fuse, the coincidence of the second fuse setting index member with the first fuse setting index member corresponding to the required fuse setting of the projectile.

12. In an apparatus for aiming a gun, a first mechanism following the movement of the gun in site, a second mechanism following the movement of the gun in altitude, there being site setting means and altitude setting means associated with the gun and respectively connected to said first and second mechanisms, means for setting the fuse of a projectile, a third mechanism including a pair of parallel interconnected screws associated with the site setting means and following the gun movement in site, an oscillable member pivoted at a fixed point upon the apparatus and controlled by one of said screws, a fourth mechanism including a rotatable shaft associated with the altitude setting means so as to follow the movement of the gun in altitude and also controlling said oscillable member, transmission means adapted to receive the movements of said oscillable member, a fuse setting index member actuated by said transmission means, a fuse setting mechanism including a worm and a worm gear both meshing therewith and having a second worm rotatable with said worm gear, which fuse setting mechanism follows the movements of the fuse setting means of the gun, a second fuse setting index member actuated by the fuse setting mechanism, an auxiliary fuse setting shaft actuated by the fuse setting mechanism, a fuse setting camoid slidably splined on said auxiliary fuse setting shaft so as to be positively rotatable with the same shaft and slidable thereon by actuation from the second mechanism following the movement of the gun in altitude, which camoid imparts to the second fuse setting index member an additional movement proportional to the combined movements of the second mechanism and the fuse setting mechanism, the coincidence of the second fuse setting index member with the first fuse setting index member corresponding to the required fuse setting for the projectile.