Dec. 19, 1939. R. ALKAN 2,183,530

SIGHTING APPARATUS WITH AUTOMATIC CORRECTION

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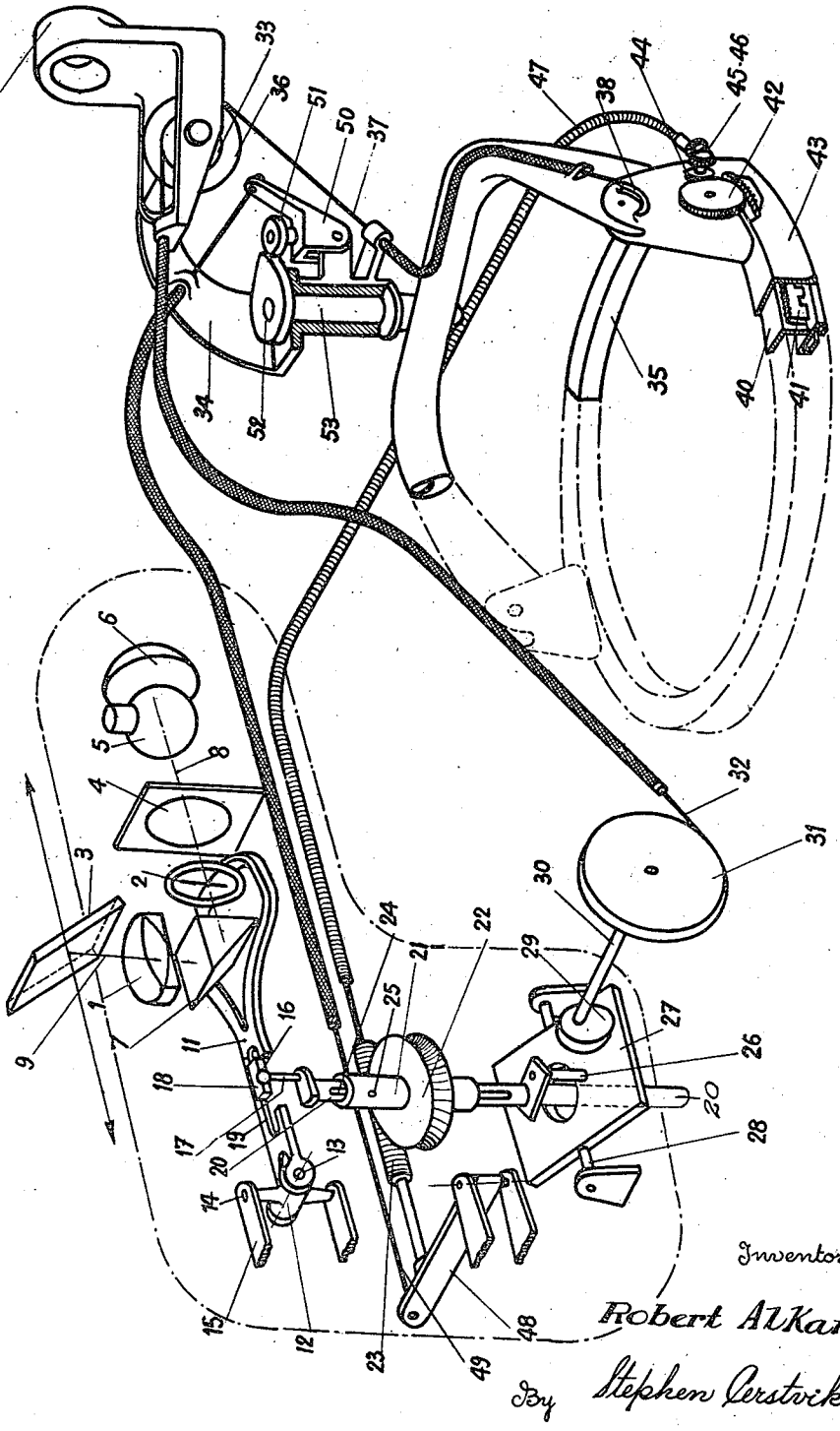

Fig. 1

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Fig. 2

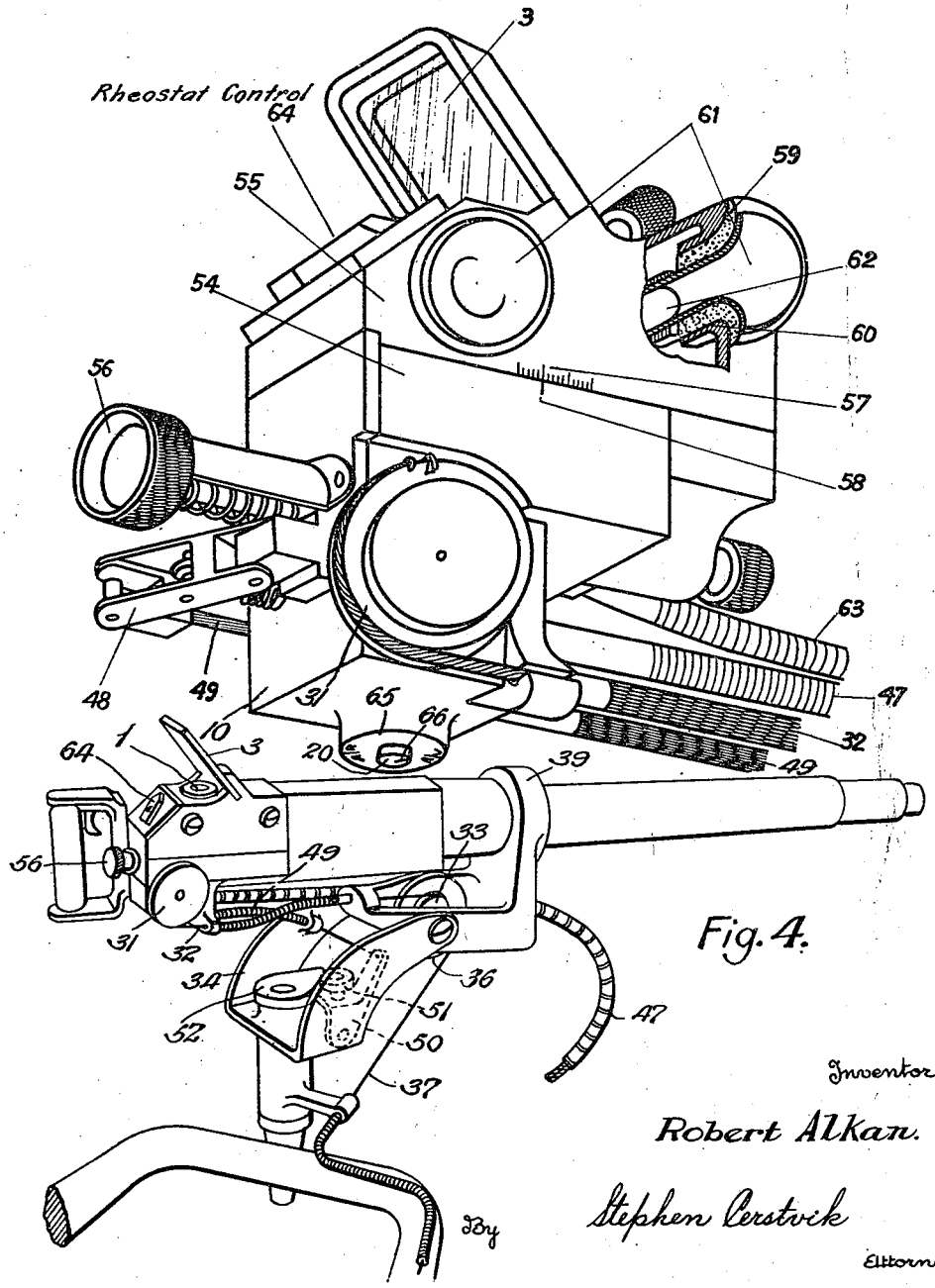

Fig. 4.

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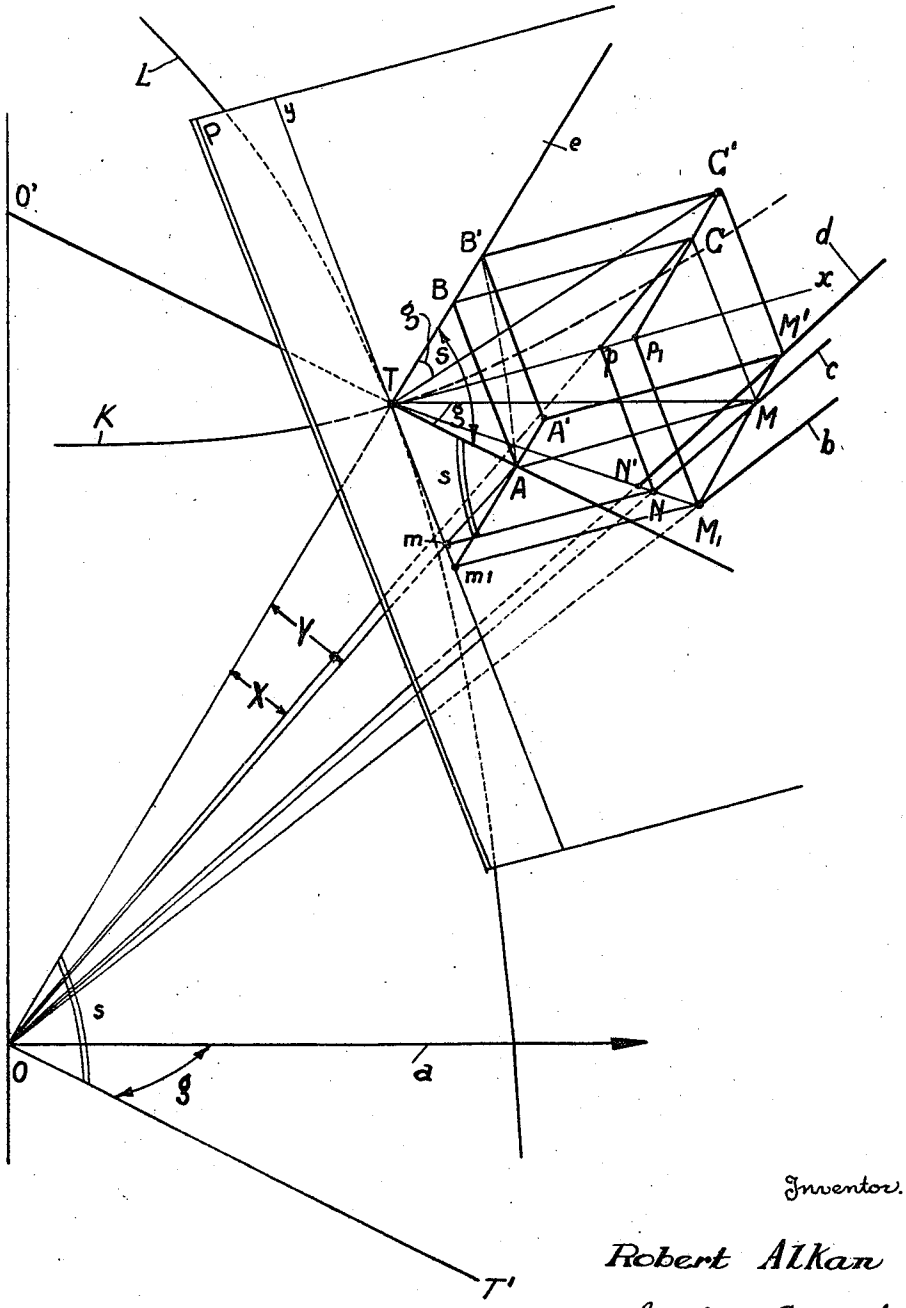
Fig. 3



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2,183,530

UNITED STATES PATENT OFFICE

2,183,530

SIGHTING APPARATUS WITH AUTOMATIC CORRECTION

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Application January 26, 1937, Serial No. 122,464
In France February 7, 1936

17 Claims. (Cl. 33—49)

The present invention relates to sighting apparatuses with automatic correction, of the nature used for fire arms, such as machine guns and, more particularly, to those of such apparatuses as used on aircrafts.

Broadly stated, the main object of the invention is to provide, better than previously, for the accuracy and efficiency of the fire, as well as for the convenience of the firing operation, in spite of increasing difficulties incident to higher and higher flying speed of present day aircrafts.

Sighting apparatuses capable to produce shooter speed corrections or, in other words, capable of correcting aiming errors due to the speed of the craft carrying the arm for different directions of fire, are generally constituted by a line of sight which may comprise an aiming or sighting telescope adapted to be actuated manually or automatically for displacement with respect to the arm, by means of a mechanism materializing and composing the speed vector of the craft and that of the projectile, which mechanism effects the correction for errors due to the speed of the craft, i. e., it gives to the barrel of the arm such orientation that the resultant of the initial speed of the projectile with respect to the gun barrel and the proper speed of the craft passes through the target.

Mechanisms of the type referred to above present different drawbacks, the most important of which is that the aiming direction cannot be defined with sufficient accuracy, due to practical difficulties of construction and to complexity of the means necessary for transmission of relative movements of the arm and the sighting apparatus. Furthermore, the field within which fire correction is possible is limited because the range of movement of different parts of the mechanism is limited by the supporting means thereof. Finally, these devices are not adapted for night-time operation.

Accordingly, another object of the present invention is to provide a sighting apparatus capable of automatically correcting, for different directions of fire, errors due to the speed of the craft on which the arm is carried, in which the drawbacks of known apparatuses of this kind, such as referred to above, are eliminated.

Another object of the invention is to provide in or combine with a sighting apparatus of the transparent collimator type proper, means to produce the necessary aiming correction for the compensation of firing errors due to the speed of the craft carrying the arm, whatever may be the azimuth and the site, and this without changing the relative position of the sighting apparatus with respect to the arm.

A further object of the invention is to provide a sighting apparatus of the transparent collimator type which is adapted to be mounted rigidly on an arm and in which the aiming correction is made by suitable displacement of a movable member in the optical system of the apparatus.

A further object of the invention is to provide a sighting apparatus adapted for rigid mounting on and for automatic aiming correction of an arm which correction is effected by displacements of a movable member, such as a reticule, in the optical system of the same and in which the displacements of said movable member with respect to the sighting apparatus casing rigidly fixed on the arm are produced by means of a mechanism controlled by the movements of the arm in site and in azimuth relative to the craft.

A still further object of the invention is to provide an aiming or sighting apparatus adapted for rigid mounting on and for automatic aiming correction of an arm, which correction is effected by displacements of a movable member such as a reticule in the optical system of the same and in which the displacements of the movable member or reticule in the optical system of the apparatus are controlled by a mechanism provided with means capable of summing up the site and azimuth angles respectively of the arm relative to its support and of said support relative to the craft.

A further object of the invention is to provide a sighting apparatus of the above kind with means permitting the adjustment thereof for different speeds of the craft.

A still further object of the invention is to provide a sighting apparatus of the above kind, in which the distance between a universal Cardan attachment of the reticule supporting member to the instrument casing and the axis of rotation and of translation of a control shaft connected thereo, is made adjustable to provide a compensation for different speeds of the craft.

A further object of the invention is to provide a sighting apparatus of the above type in which the optical system of the sight and the center of oscillation of the reticule are respectively arranged in such a manner that the center of the reticule in its displacements describes a portion of spherical surface having its concavity facing the same way as that of the focal surface of the collimator object glass.

A still further object of the invention is to pro-

vide, in combination with a fire arm such as a machine gun mounted on an orientable turrent, a novel sighting apparatus adapted for rigid mounting on the arm and for automatic correction of aiming errors due to the speed of the craft carrying the arm, for various orientations of the arm relative to the direction of the craft, by displacements of a movable member such as a reticule in the optical system of the apparatus, and means providing operative connections for actuating said movable member in accordance with relative movements of the arm with respect to its support on the turret and of said support with respect to the craft.

A further object of the invention is to provide in a device or in a combination of the above kind, the amplitudes of movements of various cable and flexible shaft connections large enough to limit the defects in the accuracy of reproduction of movements by these means so that errors are within the admissible limits.

A further object of the invention is to provide a device of the type specified with suspension and securing means capable of reducing the effects of shocks and accelerations due to the firing of the arm.

The above and other objects and advantages of the invention will appear more fully hereinafter from the detailed description and annexed drawings showing one preferred form of embodiment of the invention, it being understood that these drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

On the drawings:

Figure 1 is a perspective diagrammatic view showing different elements of a sighting apparatus with automatic correction, according to the present invention;

Figure 2 is a perspective diagrammatic view showing an external aspect of a sighting apparatus according to the invention;

Figure 3 is a diagram intended to facilitate the explanation of the geometric principle of the invention in space; and

Figure 4 is a perspective view illustrating the unit of Fig. 2 mounted on a gun which is inserted in place on the gun mount.

Referring now to the drawings, the sighting or aiming apparatus according to the invention is intended to provide a line of sight for a fire arm, such as a machine gun mounted on a turret or, in general, on a movable support on the craft.

According to the invention, this sighting apparatus is constituted by the combination of a transparent collimator with means adapted to produce therein automatically all corrections of errors due to the speed of the craft carrying the arm, and to the various orientations of the arm relative to the direction followed by the craft. The line of sight thus obtained presents the advantage to be collimated to infinity, i. e., it does not require from the operator the alignment of two sights fixed on the arm with the point to be aimed at, the line of sight of the collimator is automatically oriented in the proper direction taking into account the correction for the speed of the craft and the relative orientation of the arm with respect to the direction of the craft. It results that this apparatus advantageously combines means for permitting the correction of the firing errors due to, on one hand, the speed and the direction of movement of the target, and on the other hand due to the speed of the craft carrying the arm and to the relative orientation of the same with respect to the direction of the craft.

The theory of operation of the device will be better comprehended by an explanation of the diagrammatic representation as illustrated in Fig. 3.

Referring to Fig. 3, O designates the origin of co-ordinates attached to the craft carrying the fire-arm, O—*a* designates the direction of the speed of the craft, O—*c* designates the ideal line of sight such as would be obtained with perfect correction of errors due to the speed of the craft carrying the arm, and O—*e* is the direction of the firing line.

By designating by the vector OT the initial speed V_o of the bullet in direction and in amount, the extremity T of this vector may describe a sphere around the origin O this sphere S is designated in Fig. 3 by its meridian L and parallel K passing through point T for a given position of the vector OT.

Angle *g* denotes the angle of azimuth and angle *s* the angle of sight.

By tracing through T a vector TM equipollent to the speed Va of the craft, the ideal line of sight, taking into account the correction to be used for firing following OT, will be defined by the straight line OM passing through the extremity of the vector TM.

With a view to obtaining a solution with rather simple mechanisms, the vector TM is reduced to a reference system of three axes at right angles intersecting at T and fixed with respect to the arm, namely:

1. T*x*—tangent to the parallel of the sphere S passing through T.
2. T*y*—tangent to the meridian of the sphere S passing through T.
3. OT—line of fire.

The two axes T*x* and T*y* are thus in a plane P perpendicular to the barrel arm and tangent at T to the sphere S; *p* and *m* are projections on the axes T*x* and T*y* respectively, of a point N where the straight line OM intersects with plane P, and X and Y are angles which the straight lines O*p* and O*m* make respectively with the line of fire OT.

To bring the line of sight from OT to OM, it is necessary to materialize simultaneously the correction angles in azimuth X and in sight or elevation Y, the tangents of which are equal respectively to:

$$\tan X = \frac{Tp}{OT}$$

Since triangles OT*p* and OBC are similar:

$$\frac{Tp}{OT} = \frac{BC}{OB}$$

From an inspection of Fig. 3 it is seen that $BC = Tp_1$ and $OB = OT + TB$.

Hence:

$$\tan X = \frac{Tp_1}{OT + TB}$$

In triangle TMA, the angle TAM is a right angle and angle MTA equals *g*, as O'TA is parallel to OT'.

TM = V*a* or velocity of the craft
AM = TM sin *g*

but AM = BC = Tp_1
Hence:

$Tp_1 = Va \sin g$

Angle BTA=s as TB is OT extended and O'TA is parallel to OT'.

$OT=V_o$

Then, since angle TBA is a right angle and angle BTA=s

$TB=TA\cos s$
$TA=TM\cos g$

Hence:

$OT+TB=V_o+TM\cos g\cos s$

Hence:

$$\tan X=\frac{Va\sin g}{V_o+Va\cos g\cos s}$$

$$\tan Y=\frac{Tm}{OT}$$

Since triangles OTm and OBA are similar:

$$\frac{Tm}{OT}=\frac{BA}{OB}$$

From an inspection of Fig. 3 it is seen that:

$BA=Tm_1$ and
$OB=OT+TB$

Hence:

$$\tan Y=\frac{Tm_1}{OT+TB}$$

In triangle TAm_1 angle Tm_1A is a right angle, while in triangle TAM, angle TAM is a right angle,

Hence:

$Tm_1=TA\sin s$
$TA=TM\cos g=Va\cos g$
$Tm_1=Va\cos g\sin s$

As before:

$OT+TB=V_o+Va\cos g\cos s$

Hence:

$$\tan Y=\frac{Va\cos g\sin s}{V_o+Va\cos g\cos s}$$

These quantities can be materialized but with great mechanical complications which make it impossible to obtain a device capable of sufficient accuracy. Therefore, the following method has been considered:

If point M is orthogonally projected on the plane P, its projection M_1 in said plane falls very near the point N and, therefore, for the first approximation, one could use the line OM_1 as the line of sight.

As a matter of fact, this method replaces point N, which is an ideal conical projection of point M on plane P by orthogonal projection M_1 of point M on the same plane and would let the errors subsist which in certain cases cannot be neglected.

In fact, however, designated by p_1 and m_1 the projections of point M on the axes Tx and Ty and by X_1 and Y_1 the angles made by straight lines Op_1 and Om_1 with line of fire OT, the tangents of angles X_1 and Y_1 will have the following expressions:

$$\tan X_1=\frac{T_{p1}}{OT}=\frac{Va\sin g}{V_o}$$

$$\tan Y_1=\frac{T_{m1}}{OT}=\frac{Va\cos g\sin s}{V_o}$$

This shows that this method, while giving exact values for the numerators of tangents of X and Y, neglects in the denominators of said expression the term: $Va\cos g\cos s$, which may introduce, in the value of said tangents, errors which cannot be neglected.

Therefore, in accordance with the present invention, the mechanism has been provided which does not give exactly the direction of the orthogonal projection OM_1 of point M but materializes a direction OM' which approaches much more closely to the ideal direction of sight given by line OM. It is in accordance with this principle, which forms an object of the invention, that the apparatus described has been invented.

The values of the tangents of the angles determining the point M' can be determined as follows:

In the plane eTx a line TC' is drawn, having a length proportional to Va and making an angle g with the line T—e. From point C' a line C'—M' is drawn parallel to axis T—y having a length proportional to V$a\cos g\sin s$. Parallel lines M'—A' and C'—B' are then drawn from the points M' and C' respectively. If we represent the angle B'OC' by X' and the angle B'OA' by Y' we obtain in the same manner as described above for the point M

$$\tan X'=\frac{Va\sin g}{V_o+Va\cos g}$$

$$\tan Y'=\frac{Va\cos g\sin s}{V_o+Va\cos g}$$

The values of these tangents are therefore seen to be substantially similar to those obtained for the theoretically perfect line of sight O—M.

As shown in Fig. 1, the transparent collimator sight comprises a lens or object glass 1, a reticule 2 placed in the focus of said lens, and a transparent sighting glass 3 at 45°, permitting a simultaneous observation of the target and of the reticule, which latter appears projected on the target, being illuminated through a diffusing screen 4 by a lamp 5 provided with a reflector 6.

For rendering easier the construction of the mechanism which is described below, the normal collimator structure is advantageously changed by means of a reflecting prism 7 which divides the apparatus into two parts having their axes at right angles, one part comprising the reticule 2, the screen 4 and the lamp 5 with its reflector 6 aligned following an axis 8 parallel to the gun barrel, and the other part comprising the object glass or lens 1 and the transparent sight glass 3 aligned following an upwardly extending axis 9 perpendicular to the gun barrel. The various elements of the optical system and of the mechanism of the sight are mounted within a casing 10 which is adapted to be rigidly fixed on the arm, as it will appear hereinafter.

According to the invention, the corrections of the aiming adjustments of the fire are produced by displacing the reticule 2 with respect to the optical elements or, more specifically, the optical system of the collimator, in accordance with the speed of the craft carrying the arm and its data adapted to be introduced into the collimator, i. e., the orientation of the arm relative to the direction of the craft. This orientation is obtained by separation and composition of the arm's two coordinates, one, azimuth angle or direction, and the other site angle or elevation. For this purpose, the reticule 2 is secured on a support member 11 provided at one end with a universal Cardan attachment 12 mounted on the wall of the casing 10. The universal attachment 12 is made preferably of two articulations 13 and 14 at right angles, the exterior of which is constituted by an axis having its extremity rotatably mounted in bearing members 15 secured to the casing 10. The support member 11 of the reticule 2 is further provided with a slid-

ing universal ball joint 16 providing an operative connection between said member and one extremity of a control crank pin 17. This sliding universal ball joint is constituted by a slider 18 guided in a slot 19 in the reticule supporting member 11 and providing a socket for the ball-shaped end of the control pin 17.

The position of the reticule 2 is completely determined by the relative position of the sliding ball joint 16 and the universal attachment 12 of the reticule supporting member 11 to the casing 10. The control pin 17 for the reticule supporting member 11 is fixed on the upper extremity of a vertical control shaft 20 in eccentric relation with respect to the axis of this shaft. The control shaft 20 has the direction of its axis fixed with respect to the gun and is adapted for rotation about its axis and for sliding displacement parallel thereto, in accordance with the movements of the arm, respectively in azimuth and site relative to the craft. For this purpose, the shaft 20 is mounted to slide in and to rotate with a sleeve 21 provided with a worm gear 22 meshing with a control worm 23, the shaft 20 being made rotatable with the worm gear 22 by means such as a longitudinal groove and pin connection 24—25, as indicated on the drawings, allowing the sliding of the shaft 20 within the sleeve 21.

To control the position of the sliding shaft 20 along its axis, the same is provided at its lower extremity with a second eccentric pin 26 which is adapted to bear against a rocking or inclinable plate 27 pivoted by means of two trunnions such as 28 in bearing members fixed in the casing. The axis of oscillation of the plate 27 is perpendicular to and intersects the axis of the control shaft 20 and is parallel to the longitudinal axis of the apparatus, i. e., to the axis of the diffusing screen 4. The inclination of the plate 27 is determined by a cam or an eccentric 29 mounted on a shaft 30 itself controlled by a pulley 31. In order to set the inclination of the plate 27 in accordance with the elevation or site angle of the arm, the pulley 31 is connected by a sheath covered cable 32 with another pulley 33 pivotally carried by the support 34 of the arm and in order that the inclination of the plate 27 be determined also by the elevation angle of the support with respect to its supporting turret 35 carrying the whole device, the pulley 33 is rigidly connected to another pulley 36 which latter is connected by a sheath covered cable 37 to a winding sector 38 itself secured to the turret. It will be seen that, upon inclination of the arm fixed in the ring 39, the cable 32 will wind up and unwind from the pulley 31, depending on the elevation angle of the arm with respect to its support 34, whilst pulley 36 will itself rotate as a result of the winding up of the cable 37 on the sector 38 in accordance with the elevation angle of the support 34 with respect to the turret 35.

Thus, the reticule 2 will be actuated by the axial displacement of the shaft 20, in accordance with the angle of elevation of the arm relative to its support 34 and the angle of elevation of said support with respect to the turret 35. The actuation of the reticule 2 in accordance with the azimuth angle of the arm with respect to the direction of the craft is accomplished by imposing on the shaft 20 a rotation depending upon said angle which may be composed of two angles, one of the turret with respect to the craft and the other of said support 34 with respect to the turret 35.

In order to cause the angular position of the shaft 20 and the crank pins about the axis thereof to depend on the azimuth angle of the turret 35, the fixed bearing ring 40 of the latter is provided with a rack 41 in mesh with a gear 42 carried by a movable ring 43 of the turret, which gear controls through a multiplying pinion 44 and a train of bevel pinions 45—46, the rotation of flexible shaft 47 connected to worm 23, which engages the worm wheel 22 on the sleeve 21 receiving the control shaft 20.

In order to render the orientation of the reticule furthermore dependent upon the azimuth angle of the support 34 with respect to the turret 35, the worm 23 is adapted for sliding movement with respect to its axis. This movement of the worm 23 and the position thereof along its axis is controlled by a spring (not shown) causing the worm to bear against a lever 48 connected by a sheathed cable 49 to a rocker 50 pivoted on the support 34 of the arm and carrying a roller 51 bearing against a cam 52 carried by an extremity of an axle 53 fixed on the turret and serving as azimuth pivot axis for the support 34 of the arm.

It will be understood that the rotation of the worm gear 22 may be effected both by a rotation of the worm 23 in accordance with the variations of the azimuth position of the turret relative to the craft, and by a sliding axial movement of the same worm which acts then in the manner of a rack and imparts to the worm gear 22 a rotation depending on the variation in azimuth position of the support 34 with respect to the turret 35.

It is understood that various elements of the mechanism and particularly the transmission ratios of the various leverage and gear train connections will be proportioned in such a manner that errors in the transmission due to friction and to deformation of cables such as 32, 37, and of the flexible shaft 47, will result in variations of the position of the reticule smaller than the limit of admissible errors for the accuracy to be attained.

As the necessary aiming corrections increase with the speed of the craft, it is necessary to take into account these variations which may be accomplished by varying the proportionality factor of displacements of the reticule. For this purpose, the center of the universal Cardan attachment 12, which connects the reticule supporting member 11 to the casing, is made adjustable with respect to the rest of the mechanism. This adjustment is obtained by dividing the casing of the instrument in two half-sections 54 and 55 respectively (Fig. 2) which are adapted for relative movement one with respect to the other by means of a sliding connection therebetween (not shown). In order to facilitate this adjustment, the same is controlled by a manually operated set screw provided with a control knob 56 and indicating means 57, 58 are provided for reading the relative position of the two sections of the mechanism. The indicating means may comprise a scale 57 on one of said casing half-sections, cooperating with an index 58 on the other of said casing half-sections. The optical system and the bearing members 15 of the universal Cardan attachment 12 are made parts of the upper half portion 55 of the casing, whilst the rest of the mechanism is entirely supported by the lower half portion 54 of said casing.

In order to provide for easy affixing of the apparatus on a fire arm or on a depending part of the same, and in order to protect at the same time the mechanism from shocks and trepidations, one of the half-portions of the casing is provided with an elastic suspension formed by rubber rings 59 adapted to be fitted into holes provided in the lateral walls of the casing, which holes are prolongated interiorly by sleeves 60 in order to provide a large bearing surface without increasing the outside dimensions. The rubber rings are fitted with internal metallic sleeves 61 for the purpose of facilitating the passage of securing bolts and preventing adherence of the rubber. These sleeves are maintained suitably spaced by spacing elements 62. In spite of this resilient suspension, it is desirable to make the movable elements of the instrument as light as possible, especially the reticule supporting member 11 which will be made of an extremely light alloy and may be extensively perforated.

In order to facilitate night operations, the lamp 5 will be fed by protected cable 63 through a rheostat provided with a control 64 permitting adjustment to any desired value of the degree of illumination. For instance, in case of sighting on but slightly illuminated objects, the illumination must be very weak. On the contrary, in the day time, in sunlight, the uncoloured glass sight 3 will be replaced by smoked glass. In such a case, the visibility may be further improved by surrounding glass 3 with dark or coloured windscreens which may be mounted either on the collimator itself or on an independent support.

The sliding control shaft 20 may be extended through an opening in the lower casing wall 65 so that its extremity extends out of said opening. By providing said extremity of the shaft with a visible index 66, it is possible to have a direct indication of the angular position of the shaft about its axis without necessitating the opening of the casing.

In Fig. 4 the sighting mechanism is shown as mounted on a gun, which gun in turn is mounted in ring 39 whereby the gun and sighting mechanism may be orientated and the proper corrections automatically made by means of the connections as set out above.

The invention provides thus an improved sighting apparatus adapted more particularly for use in or in combination with fire arms, such as machine guns on aircrafts, and providing automatic shooter speed aiming corrections.

The apparatus according to the invention makes use of a combination of a transparent collimator sight adapted to be rigidly secured on the arm, with automatic means for producing therein shooter speed corrections by displacing within the sight a movable member of the optical system, such as the reticule of the collimator, which is displaced following two perpendicular directions in the focal plane of said optical system in accordance with the orientation of the arm with respect to the direction of the craft and more specifically in response to the orientation of the arm with respect to its support and the orientation of said support with respect to the craft.

While only one embodiment of the invention has been illustrated and described, particularly adapted to a machine gun, it is to be specifically understood that it is not to be limited to such use and may be employed in connection with other fire arms mounted on an adjustable support on the craft.

It will also be apparent to those skilled in the art that various changes in the form and arrangements of the present invention may be made without departing from the scope of the invention. Reference is therefore to be had to the appended claims for a definition of the limits of said invention.

What I claim is:

1. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts, combining in a single apparatus adapted for rigid mounting on an arm a collimator sight with means for automatic shooter speed correction, said means comprizing a collimator, a movable reticle in the optical system of the collimator, and means for displacing said reticle relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last named means comprising a control shaft adapted to rotate about and to slide along its axis in accordance with the movements of the arm in azimuth and in elevation relative to the craft, respectively, a movable support for said reticle having a universal attachment to a fixed point on the direction of said optical axis of the system, and a sliding universal connection with said control shaft.

2. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts, combining in a single apparatus within a casing adapted for rigid mounting on an arm a transparent collimator sight with means for automatic shooter speed correction, said means comprizing a movable reticle in the optical system of the collimator, and means for displacing said reticle relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last named means comprizing a movable support for said reticle, having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm and adapted to rotate about and to slide along its axis, a sliding universal connection between said shaft and said reticle supporting member, a sleeve journalled in the instrument casing and receiving slidably but not rotatably said control shaft, and means for rotating said sleeve in response to relative movements of the arm in azimuth with respect to the craft to impart corrective displacements to said reticle.

3. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts, combining in a single apparatus within a casing adapted for rigid mounting on an arm a transparent collimator sight with means for automatic shooter speed correction, said means comprizing a movable reticle in the optical system of the collimator, and means for displacing said reticle relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last named means comprizing a movable support for said reticle having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm and adapted to rotate about and to slide along its axis, a sliding universal connection between

said shaft and said reticle supporting member, a sleeve journalled in the casing and slidably but not rotatably receiving said shaft, means for rotating said sleeve in response to relative movements of the arm in azimuth with respect to the craft and means for controlling axial displacement of said shaft relative to said sleeve in accordance with relative movements of the arm in elevation with respect to the craft.

4. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts, combining in a single apparatus within a casing adapted for rigid mounting on an arm a transparent collimator sight with means for automatic shooter speed correction, said means comprizing a movable reticle in the optical system of the collimator, and means for displacing said reticle relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last named means comprizing a movable support for said reticle having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm and adapted to rotate about and to slide along its axis, a sliding universal connection between said shaft and said reticle supporting member, a sleeve journalled in the instrument casing and means comprizing a worm gear mechanism including a worm gear on the sleeve and a worm journalled in the casing for rotating said sleeve in response to relative movements of the arm in azimuth with respect to the craft.

5. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts, combining in a single apparatus within a casing adapted for rigid mounting on an arm a transparent collimator sight with means for automatic shooter speed correction, said means comprizing a movable reticle in the optical system of the collimator, and means for displacing said reticle relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last named means comprizing a movable support for said reticle having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm and adapted to rotate about and to slide along its axis, a sliding universal connection between said shaft and said reticle supporting member, a sleeve journalled in the instrument casing and receiving slidably but not rotatably said control shaft, and means comprizing a worm gear mechanism including a worm gear on the sleeve and a worm journalled within the casing for rotating said sleeve in response to movements of the arm relative to the craft in azimuth and means comprizing a crank pin on the lower extremity of the control shaft and a rocking plate pivotally mounted in the casing, against which said crank pin is adapted to bear, for controlling the axial position of the shaft in accordance with the movements of the arm in elevation with respect to the craft.

6. A sighting apparatus for use in or in combination with a fire arm installed on a dirigible craft by means of a support allowing azimuthal movements of the arm about an axis carried by a turret itself movable in azimuth relative to the craft, said sighting apparatus combining in a single apparatus within a casing adapted for rigid mounting on an arm a transparent collimator sight with means for automatic shooter speed correction, said means comprising a movable reticule in the optical system of the collimator, and means for displacing said reticule relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last named means comprising a movable support for said reticule having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm, and adapted to rotate about and to slide along its axis, a sliding universal connection between said shaft and said reticule supporting member, a sleeve journalled in the casing and receiving slidably but not rotatably said control shaft, and means for rotating said sleeve in response to the azimuth rotation of the arm on its support on the turret, and of said support together with the turret relative to the craft.

7. A sighting apparatus for use in or in combination with a fire arm installed on a dirigible craft by means of a support allowing movements of the arm in azimuth and in elevation relative thereto and carried by a turret itself movable in azimuth relative to the craft and allowing movement of said support in elevation with respect thereto, said sighting apparatus comprising, within a casing adapted for rigid mounting, on the arm, a transparent collimator sight and means for automatic shooter speed correction, said means comprising a movable reticule in the optical system of the collimator sight and means for displacing said reticule relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last-named means comprising a movable support for said reticule having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm and adapted to rotate about and to slide along its axis, a sliding universal connection between said shaft and said reticule supporting member, a sleeve journalled in the casing and receiving slidably but not rotatably said control shaft, means for rotating said sleeve in response to the azimuth rotation of the arm on its support on the turret and of said support together with the turret relative to the craft, and means for controlling axial displacement of said shaft in response to the movement in elevation of the arm with respect to its support on the turret and of said support with respect to the turret and hence with respect to the craft.

8. A sighting apparatus for use in or in combination with a fire arm installed on a dirigible craft by means of a support allowing movements of the arm in azimuth and in elevation relative thereto and carried by a turret itself movable in azimuth relative to the craft, and allowing movement of said support in elevation with respect thereto, said sighting apparatus combining, within a single casing adapted for rigid mounting on the arm, a transparent collimator sight with means for automatic shooter speed correction, said means comprising a movable reticule in the optical system of the collimator sight and means for displacing said reticule relative to the optical axis of said system in accordance with relative

movements of the arm in elevation and in azimuth with respect to the craft, said last-named means comprising a movable support for said reticule having a universal attachment to a fixed point in the casing on the direction of said optical axis of the system, a control shaft having a fixed direction with respect to the casing and hence to the arm, and adapted to rotate about and to slide along its axis, a sliding universal connection between said shaft and said reticule supporting member, a sleeve journalled in the casing and receiving slidably but not rotatably said control shaft, and means comprising a worm gear mechanism including a worm gear on said sleeve and a worm journalled within a casing for rotation about its axis and for sliding axially thereto to rotate said sleeve in response to relative movements in azimuth of the arm relative to its support on the turret and of said support with the turret relative to the craft, and means comprising a crank pin on the lower extremity of the control shaft and a rocking plate pivotally mounted in the casing against which said crank pin is adapted to bear, for controlling the axial position of the control shaft in accordance with movements in elevation of the arm with respect to its support on the turret and of said support with respect to the turret.

9. In combination, a fire arm installed on a dirigible craft, a support, means mounting said arm on said support for movement in azimuth and in elevation relative thereto, a turret, means mounting said turret on said craft for movement in azimuth relative thereto, means comprising a vertical supporting axle mounting said support for movement in elevation relative to said turret, a sector mounted on said turret, a sighting apparatus rigidly secured on said arm and combining in a single casing a collimator sight with means for automatic shooter speed correction, said means comprising a movable member in the optical system of said collimator sight, means for displacing said member relative to the optical axis of said system and means providing operative connections from said turret and said support of the arm to the displacing means of the movable member, comprising a flexible shaft for actuation of said movable member in the sighting apparatus in response to rotation of the turret, means for actuating said movable member in response to azimuthal rotation of the arm and its support on the turret, including a cable and a rocking lever, a roller mounted on said lever, a cam secured to said vertical supporting axle and in contact with said roller for actuating said cable, and a flexible sheath covered cable for actuation of the movable member in the sighting apparatus in response to the movement in elevation of the arm relative to its support on the turret and of said support with respect to the craft, said cable being actuated on one hand by said sector upon the vertical movement of the arm support relative to the turret, and means for actuating said cable in response to vertical movement of said arm with respect to its support.

10. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts combining in a single apparatus adapted for rigid mounting on the arm, an optical sight with means for automatic shooter speed correction, said means comprising a movable element in the optical system of the sight, means controlled by the movements of the arm in elevation and in azimuth relative to the craft for actuating said element to impart corrective displacements thereto, and means for varying the ratio of actuation to movement for different speeds of the craft.

11. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts combining in a single apparatus adapted for rigid mounting on the arm an optical sight with means for automatic shooter speed correction, said means comprising a movable element in the optical system of the sight, means controlled by the movements of the arm in elevation and in azimuth relative to the craft for actuating said element to impart corrective displacement thereto, and means for varying the proportionality factor movement to actuation for adjusting the apparatus for different speeds of the craft.

12. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts combining in a single apparatus adapted for rigid mounting on an arm a collimator sight with means for automatic shooter speed correction, said means comprising a movable reticule in the optical system of the collimator sight, means including a variable leverage mechanism controlled by the movements of the arm in elevation and in azimuth relative to the craft for actuating said movable reticule to impart corrective displacement thereto, and means for varying the amount of leverage for adjusting the apparatus for different speeds of the craft.

13. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts, combining in a single apparatus adapted for rigid mounting on an arm a collimator sight with means for automatic shooter speed correction, said means comprising a movable reticule in the optical system of the collimator sight, means for displacing said reticule relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, said last-named means comprising a movable support for said reticule having a universal attachment to a fixed point on said optical axis of the system, a control shaft having a fixed direction with respect to the arm and adapted to rotate about and to slide along its axis in accordance with the movements of the arm in elevation and in azimuth relative to the craft, said support having a sliding universal connection with said shaft, and means for varying the distance between the universal attachment of the reticule supporting member and the axis of the control shaft for providing a compensation for different speeds of the craft.

14. A sighting apparatus for use in or in combination with fire arms installed on dirigible crafts combining in a single apparatus adapted for rigid mounting on an arm a collimator sight with means for automatic shooter speed correction, said means comprising a movable reticule in the optical system of the collimator sight, means including adjustable movement multiplying means for displacing said reticule relative to the optical axis of said system in accordance with relative movements of the arm in elevation and in azimuth with respect to the craft, and means for varying the degree of multiplication to provide a compensation for different speeds of the craft and means for indicating the degree of said adjustment.

15. An automatic gun sight for a dirigible craft, comprising a turret mounted for movement in azimuth with respect to said craft, a gun mount carried by said turret, means supporting

said mount on said turret for movement in elevation and in azimuth with respect thereto, gun sighting means comprising an optical element, means mounting said element for motion in elevation and in azimuth, means connecting said optical element and said mount whereby the motions in elevation and in azimuth of said mount and element are coordinated, and means connecting said element and turret whereby the motion in azimuth of said turret produces movement in azimuth of said element.

16. In combination with a universal gun mount carrying a gun for movement in elevation and in azimuth, sighting means for said gun comprising an optical system including a reticule, means for forming an image of said reticule in the field of view in which the target is observed, and means responsive to the movement of said gun in elevation and azimuth for moving said image in coordination with the movements of said gun.

17. In combination with a universal gun mount carrying a gun for movement in elevation and in azimuth, sighting means for said gun comprising an optical system including a transparent sighting element through which the target is viewed, a reticule, means for forming an image of said reticule on said transparent element, whereby the image of the reticule is brought into the field of view in which the target is observed, and means responsive to the movements of said gun in elevation and in azimuth for moving said image in elevation and in azimuth.

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