33-238. OR 2,404,379 SR

SEARCH ROOM

519

July 23, 1946. J. JAMES 2,404,379

SIGHT DIRECTOR

Filed Sept. 22, 1941 2 Sheets-Sheet 1

Fig. 1.

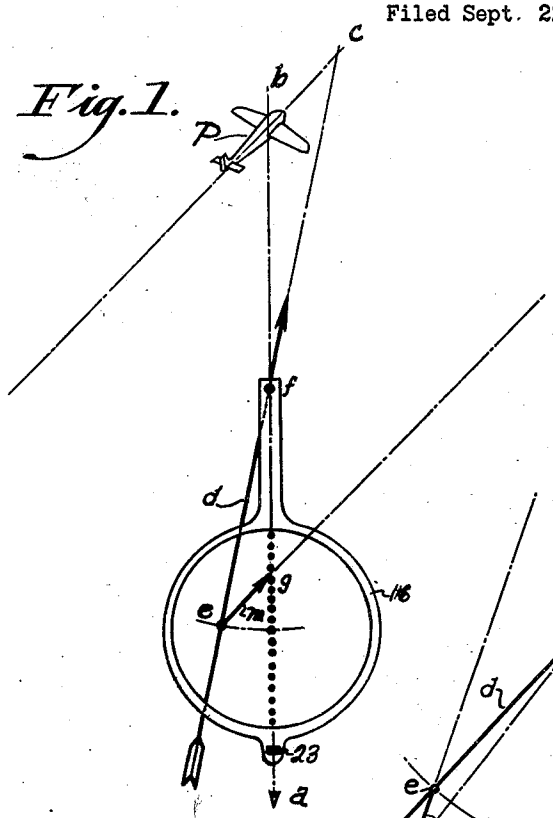


Fig. 3.

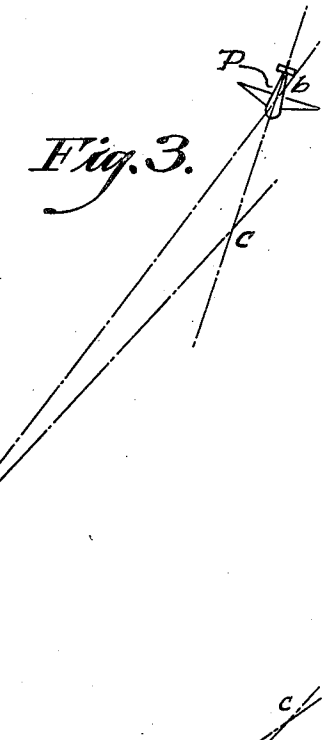


Fig. 2.

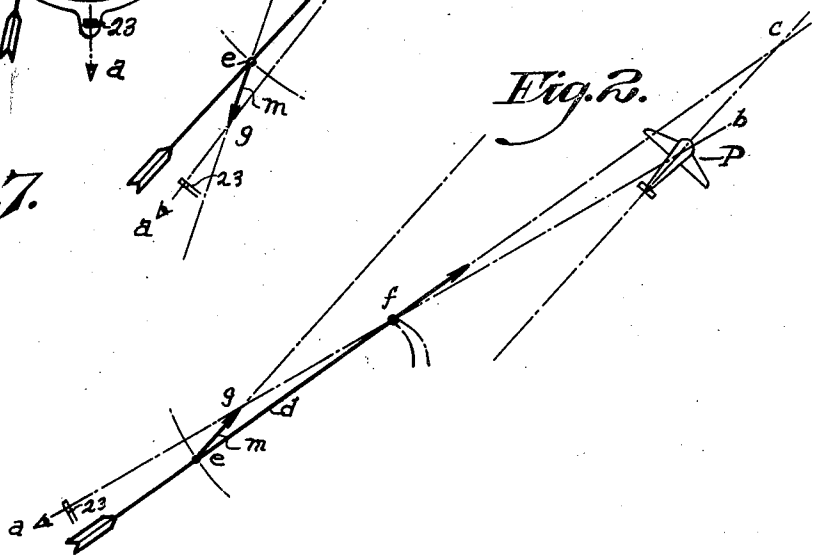
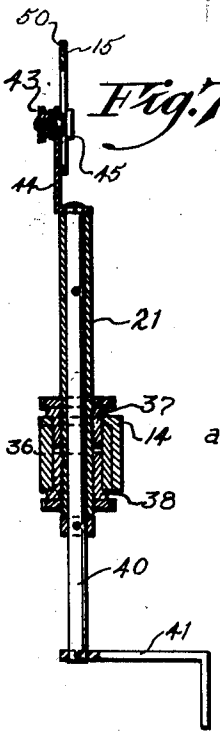


Fig. 7.



1495

Jules James
INVENTOR

BY K. C. Caldwell
ATTORNEY

2P

33. GEOMETRICAL INSTRUMENTS.
49
SEARCH ROOM

July 23, 1946. J. JAMES 2,404,379

SIGHT DIRECTOR

Filed Sept. 22, 1941 2 Sheets-Sheet 2

Fig. 4.

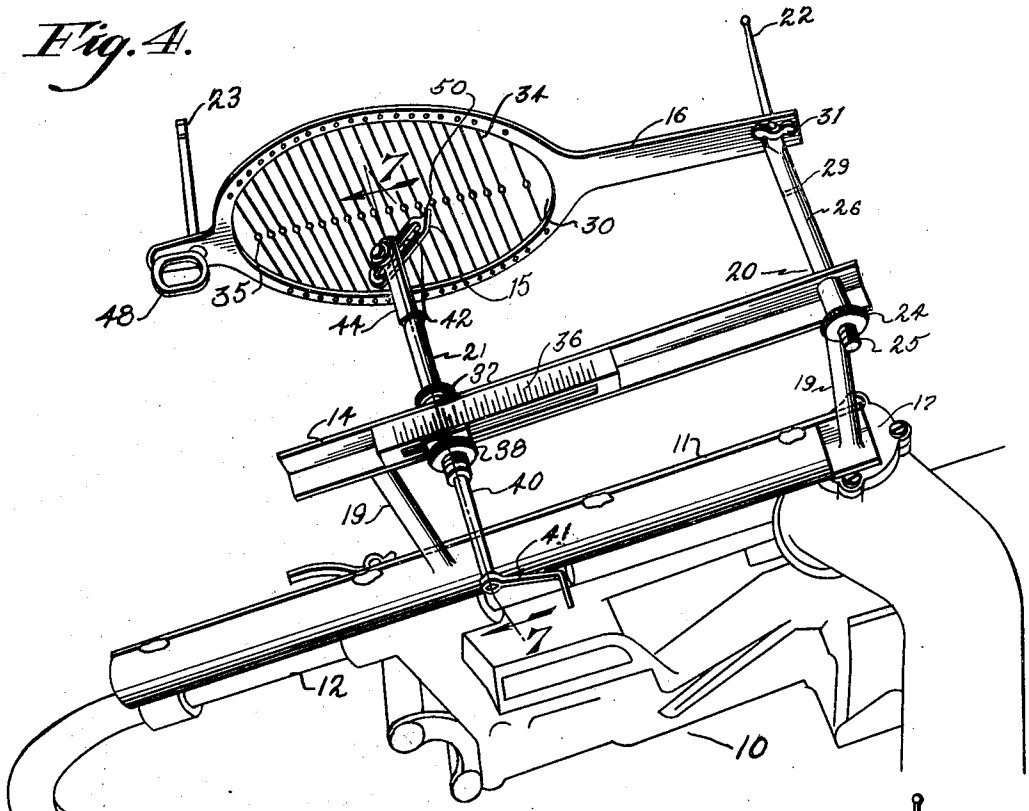


Fig. 6.

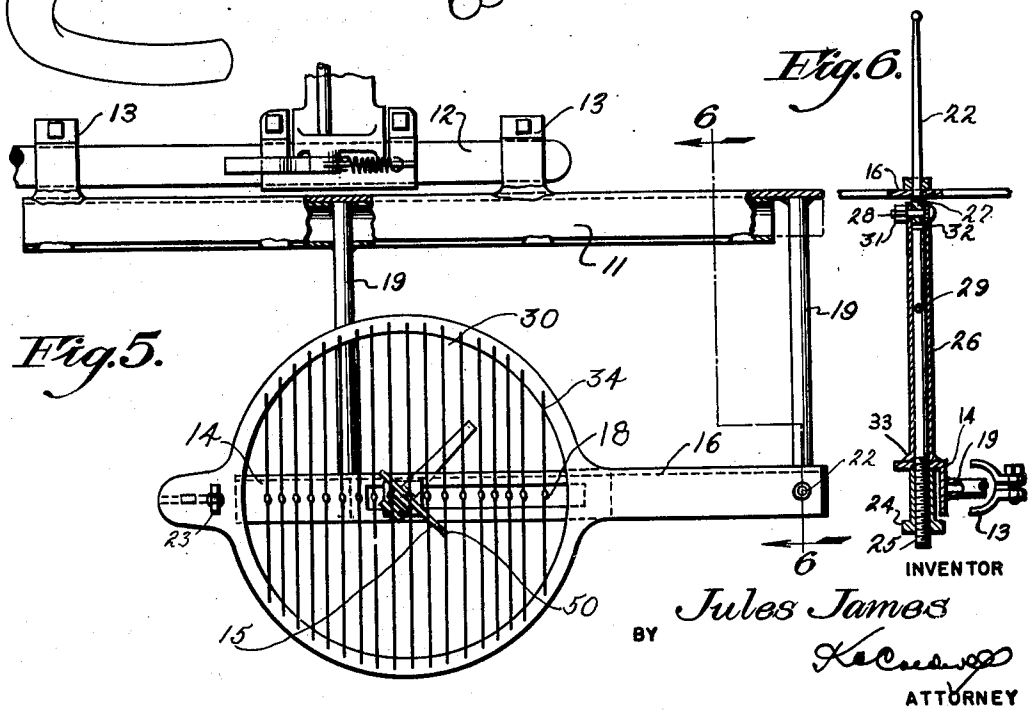


Fig. 5.

INVENTOR

Jules James

BY

ATTORNEY

33. GEOMETRICAL INSTRUMENTS.
49

Patented July 23, 1946 2,404,379

UNITED STATES PATENT OFFICE

2,404,379

SIGHT DIRECTOR

Jules James, United States Navy

Application September 22, 1941, Serial No. 411,886

6 Claims. (Cl. 33—49)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

This invention relates to a sight director for guns or torpedoes which will quickly and accurately compensate for the target direction and speed; the particular illustrated embodiment being designed primarily for use on an anti-aircraft gun.

The gun sight of my invention is adapted primarily for use at comparatively short ranges, and in the embodiment herein illustrated no compensation is introduced to correct for any variation in the trajectory caused by changes in range since the trajectories for the ranges at which the sight is primarily designed are relatively flat and the errors introduced are small. It is obviously apparent, however, that these errors could be compensated for by adjustments well known to the art.

In the prior art various ring sights have been used in order to more accurately determine the horizontal and vertical components of the angular offset of the bore of the gun from the line of sight to compensate for the target course and speed. In these sights, however, the corrections introduced are accurate only so long as the target's course is in a plane normal to the line of sight. If the target is in any plane other than the one normal to the line of sight, the gunner is required to estimate the component of the target's speed within this plane.

It is an object of my invention to provide a sight director which will take into consideration and compensate for the third dimension of the target's course and speed in determining the amount and direction of the angular offset of the axis of the bore from the line of sight.

It is a further object of the present invention to provide a simple, accurate fire control set-up which will greatly simplify the fire control problems.

It is a further object to provide a simple, accurate fire control set-up available for individual guns; so that, the individual gun crews would not be left to rely merely upon an estimation of the correct lead which they must give the target to compensate for its course and speed.

It is also an object of my invention to design an anti-aircraft gun sight which will indicate the proper amount and direction of angular offset of the bore of the gun from the line of sight to the target to compensate for the target's speed and direction of flight.

It is also a further object of my invention to provide a gun sight by which the vertical and horizontal components of the angular offset from

2

the line of sight may be determined from a consideration of a vector triangle, one side of which represents the target's direction and speed, another side representing the average velocity and direction of trajectory, while the third side is formed along the line of sight to said target.

A further object of my invention is to provide a sight director having a sight member which is secured to the gun at only one point so as to have freedom of movement relative to the gun in elevation and train.

It is also an object of this invention to provide a sight director for anti-aircraft fire control which is independent of the range of the target.

With the foregoing and other objects in view, the invention consists in the construction, combination and arrangement of parts hereinafter described and illustrated in the drawings, in which:

Fig. 1 is a diagrammatic plan view of the sight director, wherein the azimuth setting is shown.

Fig. 2 is a diagrammatic elevational view, wherein the target plane is sighted on a 45° climb.

Fig. 3 is a diagrammatic elevational view, wherein the target plane is sighted in a 70° dive.

Fig. 4 is a perspective view of the director looking from beneath on the right side elevation.

Fig. 5 is a fragmentary top plan view of the sight director with parts in section.

Fig. 6 is a vertical view taken on line 6—6 of Fig. 5, showing the double swivel coupling of the sight member; and

Fig. 7 is a vertical sectional view through the pointer shaft as taken on line 7—7 of Fig. 4.

Referring to the vector diagrams illustrating the fundamental principles of my device, the line *a*, *b* of Fig. 1, for example, represents the sight line to the target which establishes the base of the vector triangle *e*, *f*, *g*. The rear sight is indicated at **23** while the front sight, which coincides with the point *f* of the vector triangle, is otherwise indicated at **22** in the drawings. The sight member **16** is pivoted about the point *f* so that it may be moved in order to keep the target P in the line of sight *a*, *b*. The arrow *d* is parallel to or coincident with the axis of the bore of the gun, and therefore indicates the direction of the trajectory or the path of the bullet. The arrow *m* is pivoted about the point *e* so that it may continuously indicate the direction of flight of the target aircraft and its length *e*, *g* is set so as to represent the speed of the target. The pivotal point *e* of the arrow *m* is also set so that its distance from the pivotal point *f* is proportional to the muzzle

velocity of the bullet, the scale of proportionality being equivalent to the scale by means of which the length of the arrow *m* was laid off to equal the speed of the target aircraft.

As the gun is trained to bring the point *g* of the arrow *m* into the vertical plane of the line of sight, as established by the sight members **22** and **23**, the bore of the gun will be properly angularly offset in train an amount sufficient to correct for the lateral component of the speed of the target. The bullet will then intercept the target at the position indicated by the point *c* on the drawings.

Figs. 2 and 3 show diagrammatically the correction which must be applied to the elevational position of the gun to compensate for the vertical component of the target's speed. I have in these views diagrammatically illustrated the relative position of the elements forming the primary features of the director which establish the proper vertical angle between the line of sight and the axis of the bore of the gun.

In Fig. 2 the target aircraft P is shown in a 45° climb and the gun, as indicated by the arrow *d*, is elevated above the line of sight *a*, *b* an amount determined by the position of the arrow *m* which at all times parallels the direction of the target, and has a length proportional to its speed. In Fig. 3, however, the target P is shown in a dive, and therefore the gun is shown depressed below the sight line. In order to simplify the drawings, the sight member is pivoted at point *f*, which is also used to indicate the axis of the gun trunnions. It should be borne in mind when considering these diagrammatic representations that the heavy arrow *d* can be moved only by training and elevating the gun; but that the sight member **16** and the line of sight *a*, *b* may be moved about the pivotal point *f* both in elevation and train by any member of the gun crew to follow the target and keep it within the line of sight.

While I have selected separate views to show the azimuthal and elevational corrections obviously in a practical set-up, the arrow *m* will take a position in space equivalent to the position of the target aircraft, and thus both the elevational and the azimuthal corrections will be combined in determining the correct angular position of the gun relative to the sight line.

In Fig. 4 I have illustrated a specific embodiment of this invention in the form of a simplified sight director, which I have shown mounted on a .50 caliber anti-aircraft machine gun. The gun per se, which forms no part of the present invention, is indicated generally at **10** of Fig. 4, merely for the purpose of showing the mounting and positioning of the sight director relative thereto. The sight director carrier bar **11** is secured to the gun carriage **12** by means of the suitable clamps **13**. The director is, however, spaced from this carrier bar **11**, so as to be laterally offset from the gun, by means of the spacing rods **19**, one end of each of which is secured to the angle bar **14**. This angle bar **14** forms a supporting structure for both the pointer **15** and the sight member **16**.

The angle bar **14** is purposely offset from the gun so that the sights will be placed in the optimum position in reference to the gun blast. Furthermore, the control of the position of both the pointer and the sight bar by the gun crew members may be facilitated without interference with the other members of the crew as a result of this lateral offset.

The angle bar **14** is supported so as to extend

rearwardly of the gun trunnion **17** and has a longitudinal through slot **18** cut therein. A front pivot supporting member, indicated generally at **20**, is secured to the angle bar at the end near the trunnion **17** and extends vertically therefrom, so that its vertical axis preferably intersects the horizontal axis of the gun trunnion **17**. A second vertical member **21** is mounted on the bar **14** in the through slot **18** so as to be adjustable longitudinally therein.

The sight member **16** carries front and rear sights **22** and **23** respectively. This sight member is pivoted at the front pivot supporting member **20** so as to be movable both in elevation and in train.

The details of this pivot support, which is indicated generally at **20** in the drawings, are illustrated in Fig. 6. A hollow cylindrical member **26** is secured to the angle bar **14** by means of the knurled thumb screw **24** and the threaded supporting rod **25**. This rod **25** has a pin **29** extending radially therethrough which preferably engages an opening (not shown) formed in the hollow cylindrical member **26**. The bead sight **22** is suitably secured to the sight member and has a lug **27** extending downwardly from the under side thereof. A horizontal bore **32** is formed in this lug and is adapted to receive the bolt **28** when the lug is inserted into the hollow cylindrical member **26**. The flanged nut **31** holds the bolt and lug in place so as to form a pivotal support for the sight member **16**. The axis of the bore **32** is preferably in the same vertical plane which contains the axis of the vertical bead sight **22**. The lower end of the hollow cylindrical member **26** is provided with a flanged bearing surface **33** which keeps the supporting member normal to the angle bar **14**, irrespective of the azimuthal position of the sight member **16**.

The height of the front and rear pivotal members may be adjusted or accurately machined so that a line drawn through the center of the pivots will parallel the axis of the bore when no other ballistic corrections are introduced into the sight director.

The sight member is preferably formed of a flat lightweight metallic member having a hollow annular middle portion **30**. In the illustrated modification of my invention this ring **30** has a number of transverse elastic strings **34** threaded thereon, each of which is provided with a bead **35**. These strings are threaded transversely across the ring member so that the beads **35** will all fall within the vertical plane of the line of sight established by the front and rear sighting members.

A pointer **15** is mounted on a second vertical member **21**, the details of which are illustrated in Fig. 7. This vertical member **21** is secured to the angle bar **14** by means of the spacing member **36** and the flanged bushings **37** and **38**, which are threaded to the hollow cylindrical member **21**.

The surface of the spacing member **36** is preferably graduated with the graduations being calibrated in units of the projectile velocity, so that the distance between the two vertical members supporting the pivot for the sight member **16** and pointer **15** may be accurately adjusted to represent the average velocity of the projectile.

A rod **40** is rotatably supported in the hollow cylindrical member and is provided at one end with a crank **41**. The other end of the rod carries the support **44** for the pointer **15**. The pointer **15** is provided with a longitudinal

33. GEOMETRICAL INSTRUMENTS.
49

SEARCH ROOM

through slot 42 formed therein and is secured to the support 44 by means of a clamping screw 45 and a thumb nut 43, so that the pointer may be adjusted to any angle of altitude. The length of the pointer may also be adjusted. The pointer is preferably graduated along the surface, with the graduations being calibrated in units of target speed so that the length of the pointer can be easily set to represent the speed of the target. The scale of graduations formed on the pointer are the same as the scale of graduations formed on the carrier bar 11. The crank 41 is provided for the purpose of adjusting the angle of train of the pointer to accommodate for any changes in the course of the target.

The operation of the device is as follows:

The distance between the two vertical pivotal supporting members 20 and 21 is adjusted so as to represent the average speed of the projectile. The position and length of the pointer 15 is also adjusted so that its length is proportional to the speed of the target and its position is parallel to the direction of the target. The first pointer keeps the front and rear sights, 22 and 23 respectively, on the target, thereby establishing the line of sight to the target. The second pointer or the firing pointer, moves the gun so as to keep the end 50 of the pointer 15 in line with the beaded portions 35 of the resilient strings 34. The third pointer keeps the pointer member 15 set at a length proportional to the speed of the target at a selected scale, and in a direction parallel to the target's direction.

The bore of the gun is thus offset from the line of sight, both in a horizontal and a vertical direction, the amount of the offset being determined by considering the vector components of the triangle, one side of which indicates the direction of the bullet and is proportional to its average velocity, another side of which is parallel to the direction of the target and proportional to its speed, and the third side is established along the line of sight from the gun to target.

In the above description I have referred to the second pointer as the firing pointer although it is frequently desirable to have the first pointer do the firing, because in certain instances it may be difficult for the second pointer to observe the end 50 of the pointer member 15 in reference to the sight line. The operating handle 48 could be provided with a suitable firing key when the end 50 of the pointer member 15 contacts the line established by the intersection of the vertical plane of sight and the plane of the sight member, or along the line established by the beads 35.

The elastic members are provided to allow the pointer to pass through the annular portion of the sight bar without disturbing the line of sight established by said member. For example, if the target plane were in a dive, as illustrated in Fig. 3, the point or end 50 of the pointer 15 would be set below the center of the pivot screw 45. To move the gun in elevation an amount necessary to bring the pointer into the plane of the sight member 16 and the vertical plane of the line of sight, the pivot support 44 and a portion of the pointer member 15 would necessarily pass through the plane of the sight member. The elastic members, therefore, permit the pointer and pivot to pass through the plane of the ring when necessary to follow the target in elevation.

This invention is not necessarily limited to the particular means illustrated for adjusting the position and length of the pointer member, since obviously other means may be provided whereby the adjustment in length and altitude may be more readily made.

It is apparent that the principle that I have employed to solve the particular fire control problem is that of the collision course on the maneuvering board, and the only elements which are used are the average speed of the projectile and the speed and direction of the target. However, other various ballistic components such as drift, wind force and direction, own ship's course and speed, etc., may if necessary be incorporated in the instrument by means well known to the art.

It is to be expressly understood that the above description of the embodiment of my invention has been set forth in order to comply with the statutory requirements only, and that the embodiment of the invention as disclosed is to be taken in a descriptive and not in a limiting sense. The invention is set forth in its preferred simplest form, chosen because it clearly indicates my inventive concept. I do, however, anticipate that various modifications will be incorporated into the finished sight director; for example, the director is not limited to the use of a beaded and open front and rear sight; in fact, a telescope sight may be used. Accordingly, various modifications of the invention may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A sight director for an anti-aircraft gun or the like, comprising a graduated support member mounted substantially parallel to the axis of the gun and rigidly secured thereto, the graduation on said member being calibrated in units of velocity, a sight member having front and rear sights pivotally mounted on said support member at one end thereof adjacent the front sight so as to have both lateral and vertical freedom of movement relative to said member, a second pivot on said support member adjustable longitudinally thereof so that the distance between said pivots may be set to represent the average velocity of the projectile, a graduated pointer carried by said second pivot so as to have universal movement with respect to said member, the graduations on said pointer being calibrated in units of speed, means for adjusting the length of said pointer from said pivot to represent the speed of said target and for changing the position of the pointer relative to the sight member so that it may at all times parallel the target's direction, and means for training and elevating the gun to bring one end of the pointer into the vertical plane of the line of sight as well as the plane parallel to the line of sight having a horizontal axis through the first named pivot in order that the gun may be properly pointed and trained to correct for the speed and direction of the target.

2. A device for sighting a gun at a target comprising a sight member, said sight member being pivotally supported on said gun for movement in train and in elevation independently of movement of said gun to establish a line of sight to the target, means to establish a first vector parallel to the line of sight established by said sight member, means to establish a second vector proportional to the velocity and direction of the pro-

jectile fired from the gun, said first and second vectors being joined, means to establish a third vector proportional to the assumed speed and direction of the target, said second and third vector being joined, and means for moving said gun independently of movement of said sight member to close said vectors into a vector triangle whereby said gun will be offset from said line of sight to compensate for speed and direction of said target.

3. In a device for sighting a gun at a target the combination comprising a sight member, pivot means for mounting said sight member on said gun so that it may move in elevation and in train to follow said target independently of movement of said gun, the line of sight established by said sight member constituting a first vector, one end of which is located at said pivot means, means for establishing a second vector fixed to the gun parallel to the bore thereof and proportional to the velocity of the projectile fired from the gun, one end of said second vector also being located at said pivot means, means for establishing a third vector proportional to the speed of the target and having a direction parallel to the course of the target, one end of said third vector being connected to the other end of said second vector, and means for moving said gun to bring the free end of said third vector into contact with said first vector to complete a vector triangle whereby the bore of the gun will be offset relative to the line of sight established by said sight member to compensate for target speed and direction.

4. A device for sighting a gun at a target comprising a support member carried by said gun, means for pivotally supporting a target sight member on said support member, whereby said sight member may be moved pivotally in train and in elevation independent of movement of said gun, the line of sight established by said sight member constituting a first vector, means for establishing a second vector fixed to the gun parallel to the bore thereof, the length of said second vector being proportional to the velocity of the projectile fired from said gun, one end of said second vector being connected to one end of said first vector, means for establishing a third vector, the length of which is proportional to the speed of said target and the direction of which is parallel to the course of said target, one end of said third vector being connected to the other end of said second vector, and means for moving

said gun to bring the free end of said third vector into contact with said first vector to complete a vector triangle whereby the bore of said gun may be offset relative to the line of sight established by said sight member to compensate for target speed and direction.

5. A device for sighting a gun at a target comprising a sight member, first pivot means for pivotally supporting said sight member on said gun whereby said sight member may be moved in train and elevation to follow said target independent of movement of said gun, a pointer member, the length of which is proportional to target speed, second pivot means for supporting said pointer member on said gun whereby said pointer may be kept parallel with the course of said target, said first and second pivot means being arranged in a line parallel with the bore of said gun and spaced apart at a distance proportional to the velocity of a projectile fired from the gun, and means for moving said gun and pointer carried thereby to bring the end of said pointer into a line formed by the intersection of a vertical plane through the sight member with a plane normal to said vertical plane, said latter plane passing through said first pivot means and being parallel to the line established by said sight member whereby said gun will be offset an amount necessary to correct for direction and speed of said target.

6. In a device for sighting a gun at a moving target, the combination comprising a sight member, pivot means for mounting said sight member on said gun for movement thereof in elevation and in train independently of movement of said gun to establish a line of sight from the gun to follow the target, means to establish a first vector, the magnitude of which is proportional to the assumed speed of the target and the sense of which is parallel to the direction of flight of the target, means to establish a second vector the magnitude of which is proportional to the average velocity of the projectile fired from the gun and the sense of which is parallel to the bore of the gun, and means for moving said gun in elevation and in train independently of movement of said sight member an amount determined by the vector relationship between said first and second vectors whereby the gun is offset angularly from said line of sight to compensate for the speed and direction of said target.

JULES JAMES.