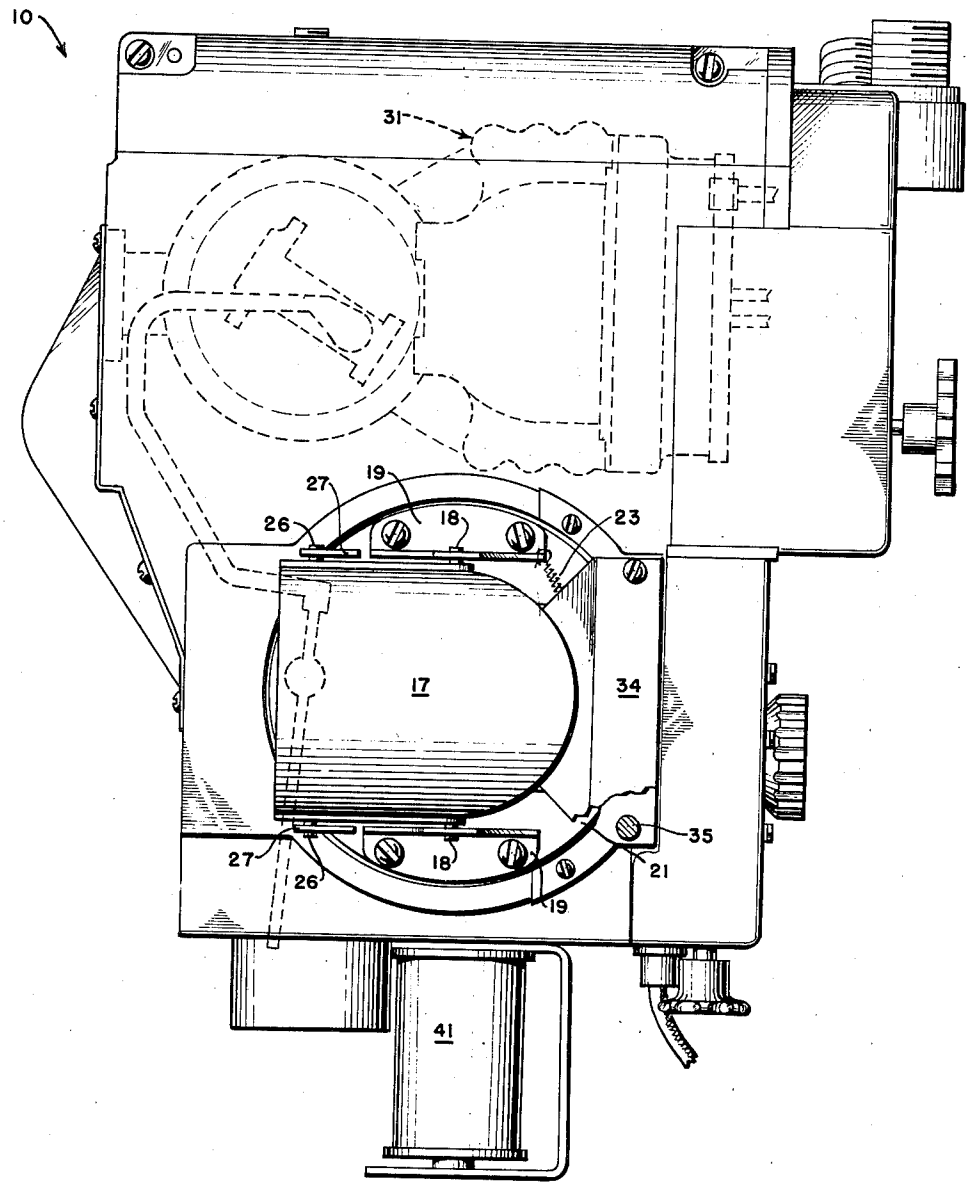
June 21, 1949. D. L. HIBBARD ET AL 2,473,524

LEAD ESTIMATION TRAINING REFLEX GUN SIGHT

Filed June 30, 1945

3 Sheets-Sheet 1

Fig. 1



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LEAD ESTIMATION TRAINING REFLEX GUN SIGHT

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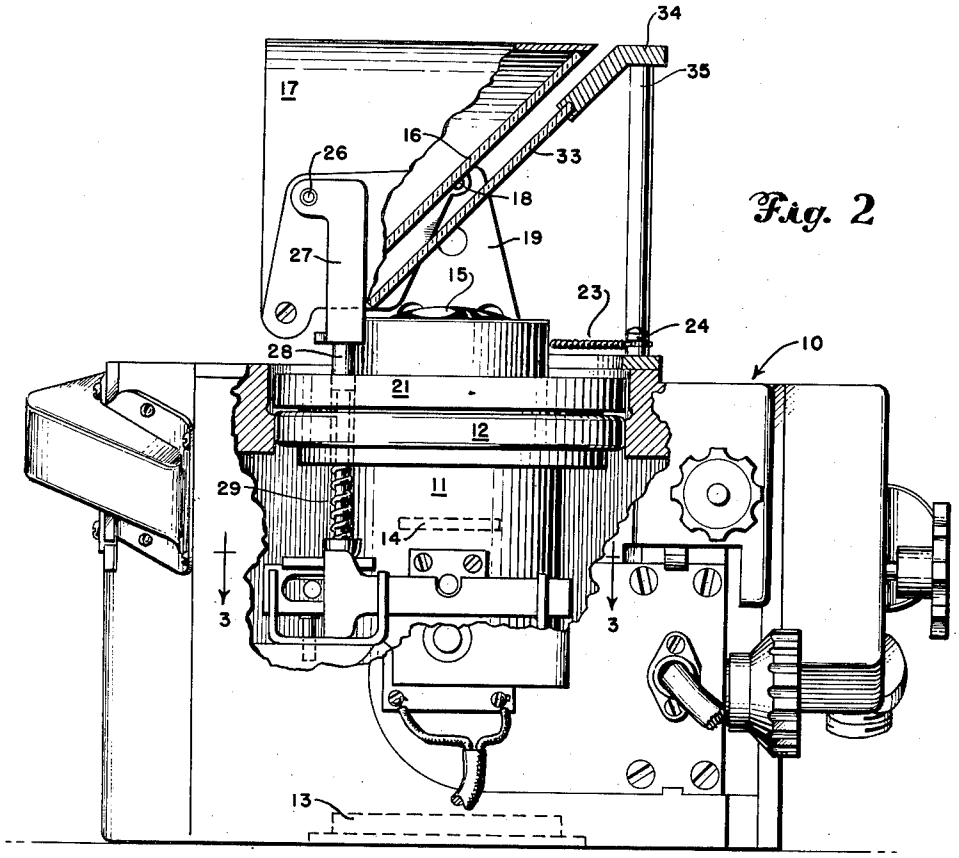


Fig. 2

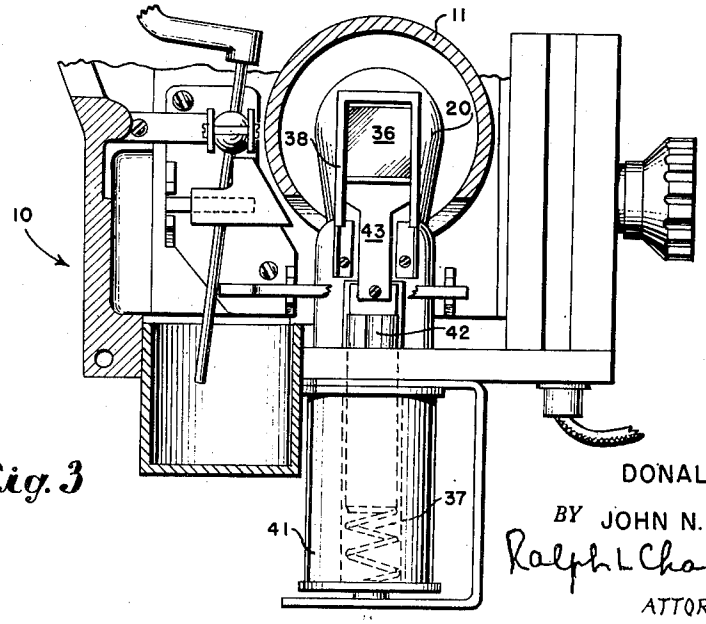


Fig. 3

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LEAD ESTIMATION TRAINING REFLEX GUN SIGHT

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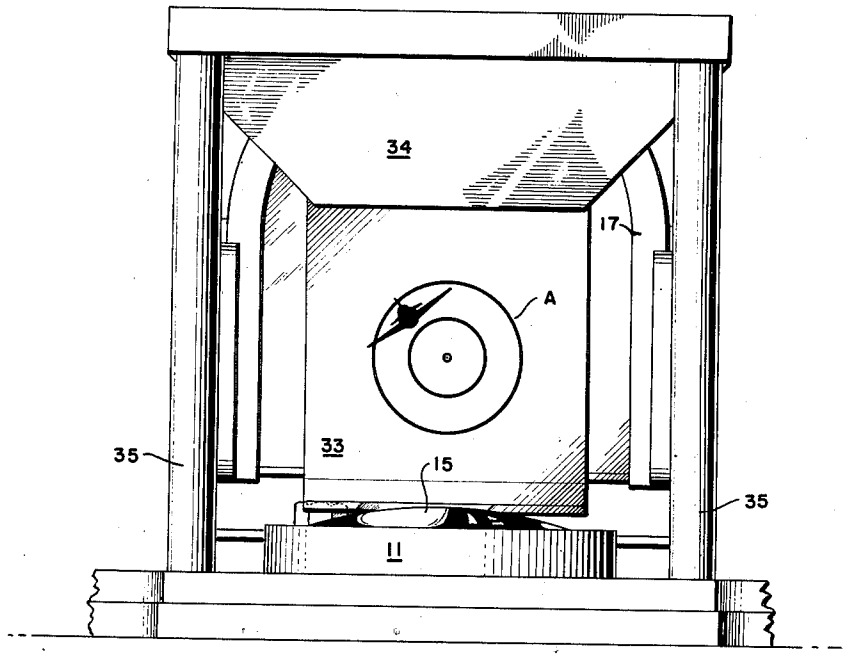


Fig. 4

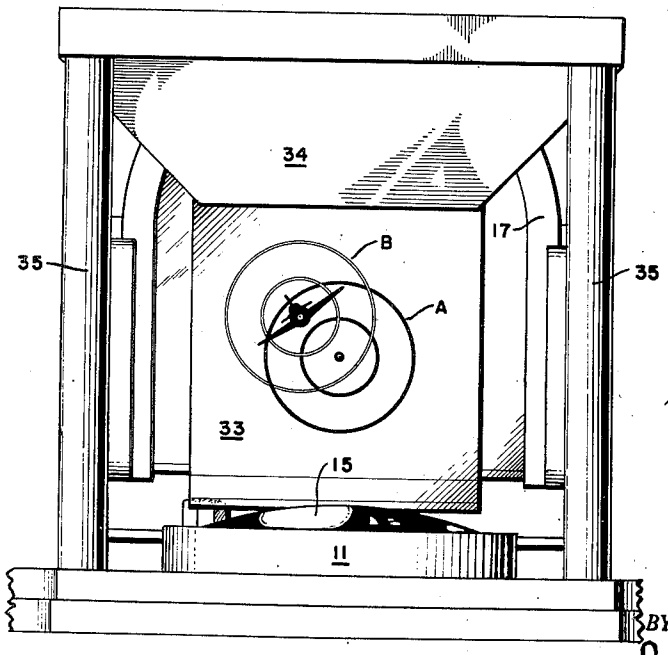


Fig. 5

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UNITED STATES PATENT OFFICE

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LEAD ESTIMATION TRAINING REFLEX GUN SIGHT

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Application June 30, 1945, Serial No. 602,624

8 Claims. (Cl. 88—1)

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

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The present invention relates to training gunsights. More specifically, it relates to a sight structure designed as a training sight, to provide instruction and practice in lead estimation. Although the general principles disclosed here are believed to be of rather general application, the specific device described is in a form particularly adapted for training aircraft gunners of bombing planes the principles of the "position firing" system of defense against attacking aircraft.

In connection with the description of the device, it is believed pertinent to point out that the use of conventional types of fixed sights in free aerial gunnery brings about extremely difficult problems of lead estimation. This stems from the fact that, unless the guns are pointed directly ahead or directly astern, the projectiles from the gun do not follow the line of sight. Instead, they follow a course at an angle to the sight line, and this angle may be on either side of the sight line, depending on the position of the gun with respect to the aircraft. Obviously, since the amount of deflection required between the gun axis and the sight line between the gun and the target is affected by numerous factors, a free gunner cannot make all of the computations that would be required to determine the exact lead mentally. In practice, he must rely to a large degree on certain general rules of position firing that have been developed. Even with the aid of these rules, however, it is necessary normally for the inexperienced gunner to make a conscious mental estimate of the relative positions of the bomber and attacking plane in order to choose the applicable rule and direct his guns accordingly.

In the tension and excitement of aerial combat this is a distinct disadvantage. It is infinitely more desirable that the gunners be so well trained that sighting will be entirely instinctive and can be done properly without hesitation and without conscious thought as to amount and direction of lead required. Moreover, it is essential that a novice gunner be given this thorough degree of training before he ever takes part in actual combat, not only to safeguard his own life, but the lives of the entire crew.

Since the instinctive habits of action can be developed only by repeated practice, it is the general aim of the present invention to provide means whereby practice in lead estimation may be carried out, arranged so that the degree of skill achieved by the student will be demonstrated to him automatically; so that he will be encouraged to practice until he can apply instinctively the lead required by any common situation without conscious reference to the rules of position firing and without any conscious analysis of relative speeds and positions of his own aircraft and the target.

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It is one of the principal objects of the present invention to provide a sight having the general characteristics of a standard optical gun sight; together with means to demonstrate the amount and direction of lead required in any one of the multitudinous possible positions of the gun with respect to the aircraft.

A further object resides in the provision of a training gun sight having means for demonstrating the amount of lead required and capable of use as a test instrument to permit a gunner to practice estimation of various lead problems and to check himself as to the proficiency with which he solves these problems.

A further object resides in the provision of an optical sight including a lead-computing mechanism and two independent images of a reticule, together with means for superimposing both reticule images on the field of vision so that one reticule image represents the bore sight position of the guns and the other reticule image demonstrates the degree and direction of lead required under the particular circumstances of the moment.

A further object is to provide a sight as noted above in which only the bore-sight image of the reticule is visible during the normal aiming of the sight, but in which the lead-indicating image of the reticule appears at the instant the gun is fired. By this arrangement the gunner can determine the degree of accuracy with which he has estimated the required lead.

A further object resides in the provision of a gun sight of the type indicated, characterized by a structure of compact arrangement and simple, rugged mechanical design.

Fig. 1 is a plan view of a training sight showing a preferred embodiment of the invention;

Fig. 2 is a side elevational view thereof with certain parts broken away to show the internal mechanism;

Fig. 3 is a detail plan sectional view taken substantially on the plane of the line 3—3 in Fig. 2;

Fig. 4 is a view through the optical system of the sight showing the appearance of the bore-sight image of the reticule when leading a given target; and

Fig. 5 is a view similar to Fig. 4, showing the

appearance of the optical system of the sight when both images of the reticule are visible.

The form of invention illustrated in the drawings includes a sight consisting of a sight housing 10 in which a rotatable lens barrel 11 is mounted. The lens barrel 11 is carried between an upper bearing 12 and a similar lower bearing 13 (see Fig. 2). The lens barrel 11 includes a plurality of lenses and a sight reticule 14 of a conventional type, illuminated by a light source 20 housed in the lower part of the lens barrel 11. A collimated image of the reticule 14 is projected upwardly through the top lens 15 of the lens barrel to a pair of transparent reflectors. The reflector 16 is carried in the hood 17 of the sight, and the hood 17 is rotatable on a pair of trunnions 18. These trunnions are supported by a pair of brackets 19 secured to a flange 21 on the lens barrel 11. The lens barrel 11 and the flange 21 rotate as a unit so that as the barrel 11 is rotated the brackets 19 swing about the center of the barrel and cause the hood 17 and the reflector 16 to move in azimuth with the movements of the lens barrel. A light spring 23 extends between one of the brackets 19 and a stud 24 on the housing 10 of the sight to provide a light tenstion tending to rotate the hood and lens barrel in a clockwise direction as viewed from above.

The forward end of the hood 17 carries a pair of pivots 26 bridged by the yoke 27. The yoke includes a control spindle 28 extending downwardly through the flange 21 to a point adjacent the side of the lens barrel 11. A light compression spring 29 is telescoped over the spindle between the flange 21 and the head 28. This spring tends to pull the forward end of the hood 17 downwardly, to pivot the reflector 16 in a counter-clockwise direction around the trunnions 18.

From the foregoing, it will be seen that the image of the reticule 14 is projected from the lens barrel 11 and is reflected from the surface of the transparent reflector 16, which acts as a combining glass so that as the gunner looks through the hood 17 the collimated image of the reticule 14 of the sight appears superimposed on the field of vision. Obviously, since the combining glass is mounted for rotation about two axes, it may be shifted in elevation and azimuth to offset the optical axis of the sight from the axis of the guns in desired amount and direction; so that any lead required can be set in by tilting the reflector 16 to deflect the axis of the sight from the bore of the guns. The computation of the direction and amount of deflection is accomplished automatically by a vector computer, indicated generally at 31.

The vector computer 31 and its associated linkages are so designed that they are controlled by the gun turret, so that as the position of the gun changes in azimuth or elevation, the deflection is altered accordingly. Thus the required lead is set into the sight automatically.

Since these computing mechanisms form no part of the present invention except in the general combination, and since the details of their structure are fully disclosed in a co-pending U. S. patent application, filed June 30, 1945, and identified by patent Serial Number 602,625, they are described in this disclosure except to point out that it is their function to determine the lead required by any gun position and to set the transparent reflector 16 so that the optics of the sight are offset from the bore-sight point of the guns the required amount and direction.

The sight housing 10 is provided with a second transparent reflector 33 supported on a bracket 34 extending between a pair of posts 35 mounted on the fixed portion of the sight housing. The transparent reflector 33 consists of a red filter glass and its position is fixed with reference to the sight. The optical system of the sight is also provided with a green optical filter 36, positioned immediately above the light source 20 of the sight. The filter 36 is mounted slidably in a frame 38 so that it is held normally in the position shown in Fig. 3 by a light spring 37. The filter 36 is controlled by the core 42 of a solenoid coil 41. The core 42 is coupled to the filter by a link 43, so that when the coil 41 is energized, the filter is withdrawn from the light source 20.

When the filter 36 is in position over the light source 20, the only rays of light reaching the reflector 33 are green. These green rays do not pass through the filter reflector 33 to the movable reflector 16, so no image will be reflected from the reflector 16, but a green image of the reticule (indicated as reticule image A) is reflected from the lower surface of the filter reflector 33. This reflector is fixed with relationship to the sight housing and the guns. Consequently, the green image of the reticule that is transmitted to the eye of the gunner is immovable and represents the bore-sight point of the guns. When the filter 36 is removed from the optical system, that is, when the solenoid coil 41 is energized to draw the filter away from the light source, rays of white light are projected through the reticule and lens system to the reflectors. Now, a white image of the reticule A is reflected from the lower surface of the filter 33, and since some of the white light passes through the filter 33, a second image of the reticule, red in color and designated as reticule image B is reflected from the movable reflector 16. That is, the reflector 16 and the reflecting filter 33 each project an image of the reticule to the eye of the gunner. One of these is a fixed white image comparable to the reticule used normally on the fixed type of optical gun sight. The other is a red image comparable to the movable reticule disclosed in the co-pending patent application Ser. No. 602,625 previously mentioned.

The electrical leads from the solenoid coil 41 extend to a switch associated with the trigger mechanism of the guns. If the sight is used on a training device, said leads are controlled by a switch representing the trigger.

When the sight is in use, the trainee gunner, viewing the target through the reflectors 16 and 33 sees no indication of the lead required but is required to estimate the target lead in accordance with the rules of position firing and "hold off" from the target in the amount and direction he believes necessary to obtain hits. When he is satisfied that his lead is correct, he squeezes the trigger. The red or "lead-computing" image of the reticule appears instantly on his field of vision, and this red reticule image is centered exactly on the target if his estimated lead is correct. If his lead is incorrect in any respect, that fact is indicated by inexact alignment of the red reticule image on the target. This can be noted by the gunner so that he can improve his lead estimation by continued practice.

From the foregoing, it will be apparent that it is possible by the use of the invention here disclosed to provide a means for self-instruction in lead estimation so that the gunner can estimate repeatedly the lead required by targets at various angles, and check his accuracy by depressing the

gun trigger to bring the lead-computing reticule into vision in the sight system. Moreover, in the very elementary stages of training, the solenoid can be arranged so that both images of the reticule are visible simultaneously. The guns can then be swung from one position to another to demonstrate to novice gunners different degrees of lead required in different situations.

While we have described the principles of the present invention in connection with drawings of one specific adaptation of the device, it is subject to numerous variations and modifications. It is accordingly requested that the scope of the invention be regarded as limited only by the terms of the appended claims.

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

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:

1. In an optical sight, the combination of an optical system including a light source, a single reticule, and an image collimating system, a pair of combining glasses, said glasses being each positioned to project a collimated image of said reticule, one of the combining glasses being in fixed position with respect to said reticule and the other combining glass being rotatable about two axes normal to each other for tilting movement in two degrees of freedom, and means to shift one of said images into or out of the optical system.

2. A training gun sight comprising a semi-transparent mirror forming a field of view of a simulated target, a reticule, means to project an image of said reticule from said mirror to an observation position, means to move said mirror in directions imparting apparent motion of said image relative to said target, a second semi-transparent mirror positioned to project said image after said image has passed through said first mirror and to project said image back through said first mirror to said observation position, and means responsive to actuation of said first-mirror moving means whereby said second mirror has a direction of motion other than the direction of motion of said first mirror.

3. A training gun sight comprising a semi-transparent mirror forming a field of view of a simulated target, a reticule, means to project an image of said reticule from said mirror to an observation position, means to move said mirror in directions imparting apparent motion of said image relative said target, a second semi-transparent mirror positioned to intercept said image after said image has passed through said first mirror and to project said image back through said first mirror to said observation position, means responsive to actuation of said first-mirror moving means whereby said second mirror has a direction of motion other than the direction of motion of said first mirror, means for preventing substantially all light except one color from passing through said first mirror and removable means for preventing substantially all light except another color from reaching said first mirror.

4. An optical sight having an element forming a field of view, comprising a deflection computing mechanism, two separate combining glasses each mounted between a point of observation and said field of view, a light source, a reticule and collimating lens system providing a collimated beam of light projected by each of said two glasses into said field of view, one of said glasses being mounted rotatably about two axes normal to each other, means to rotate said glass about said axes, said means being actuated by said computing mechanism, said combining glasses being positioned in substantially parallel planes so that the collimated beam of light formed by the said lens system passes through one of said glasses, is projected from the other of said glasses, and repasses through said one of said glasses to said point of observation.

5. An optical sight as described in claim 4 in which said two combining glasses have different color characteristics whereby the first image formed by the beam of light projected from the first combining glass and the second image formed by the beam of light transmitted twice through said first combining glass and projected from the second combining glass are distinguishable from each other by being of different colors.

6. In a training gun sight, the combination of an optical system including a light source, a single reticule and an image collimating system, a pair of separate combining glasses, said glasses each being positioned to receive from said collimating system and to project upon the field of vision observable through both said glasses an image of said reticule, and further positioned so that each reflects a separate image on said field of vision, means to rotate one of said glasses about two axes normal to each other to thereby move one only of said images, the other of said glasses being positioned in a plane substantially parallel to the plane of said one of said glasses, said other of said glasses having optical characteristics that impart to said movable image as reflected from said rotatable glass optical qualities different from the optical qualities of the image reflected from said other of said glasses, a filter mounted removably between said light source and said glasses, said filter imparting to all the collimated light optical characteristics so related to the optical characteristics imparted by said other of said glasses that said movable image is concealed from said field of vision, and means to remove and replace said filter from said mount selectively.

7. An optical sight comprising a deflection computing mechanism, two separate combining glasses, means delineating a field of view observable through said glasses from a point of observation, a light source, a single reticule and collimating lens system providing a collimated beam of light projected by each of said two glasses upon said field of view whereby two separate images of said reticule are projected simultaneously upon said field of view, the first of said combining glasses being movable by said computing mechanism so that the image formed by projection from said first combining glass is shiftable relative to the image formed by projection from the second combining glass, the second combining glass being so positioned that the collimated beam of light formed by the collimating lens system passes through said second glass, is projected from said first glass and passes a second time through said second glass before reaching said field of view, a filter covering said light source, said filter and said second combining glass being so related as to the optical characteristics that they impart to the light from said light source that said light, after passing through said filter, cannot pass through said second glass but can be projected thereby, and said light, when said filter

is not so interposed, can pass twice through said second glass and be projected by both said glasses, and remotely controlled means to effect removal and replacement of said filter whereby both of said images are projected to said field of view when said filter is removed and one of said images is not projected to said field of view when said filter is replaced.

8. A training gun sight comprising a sight housing, a lens barrel carried rotatably between upper and lower bearings in said housing, said lens barrel including a plurality of lenses and a sight reticule, a pair of transparent reflectors mounted on said housing, the first of said reflectors being mounted in a hood trunnioned between brackets secured to said lens barrel, said hood being rotatable in azimuth with said lens barrel and in a plane normal to said azimuth plane of rotation, a vector computer having means connected to the hood to thereby rotate said hood in said two degrees of freedom, the second of said reflectors comprising a red filter mounted fixedly on said housing proximate said first reflector, a light source housed in the nether part of said lens barrel and adapted to project a collimated image of said reticule through said lens barrel to said reflectors, a green filter mounted removably between said light source and said reticule, and remotely actuated means to withdraw said green filter from said position.

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