

Dec. 27, 1960

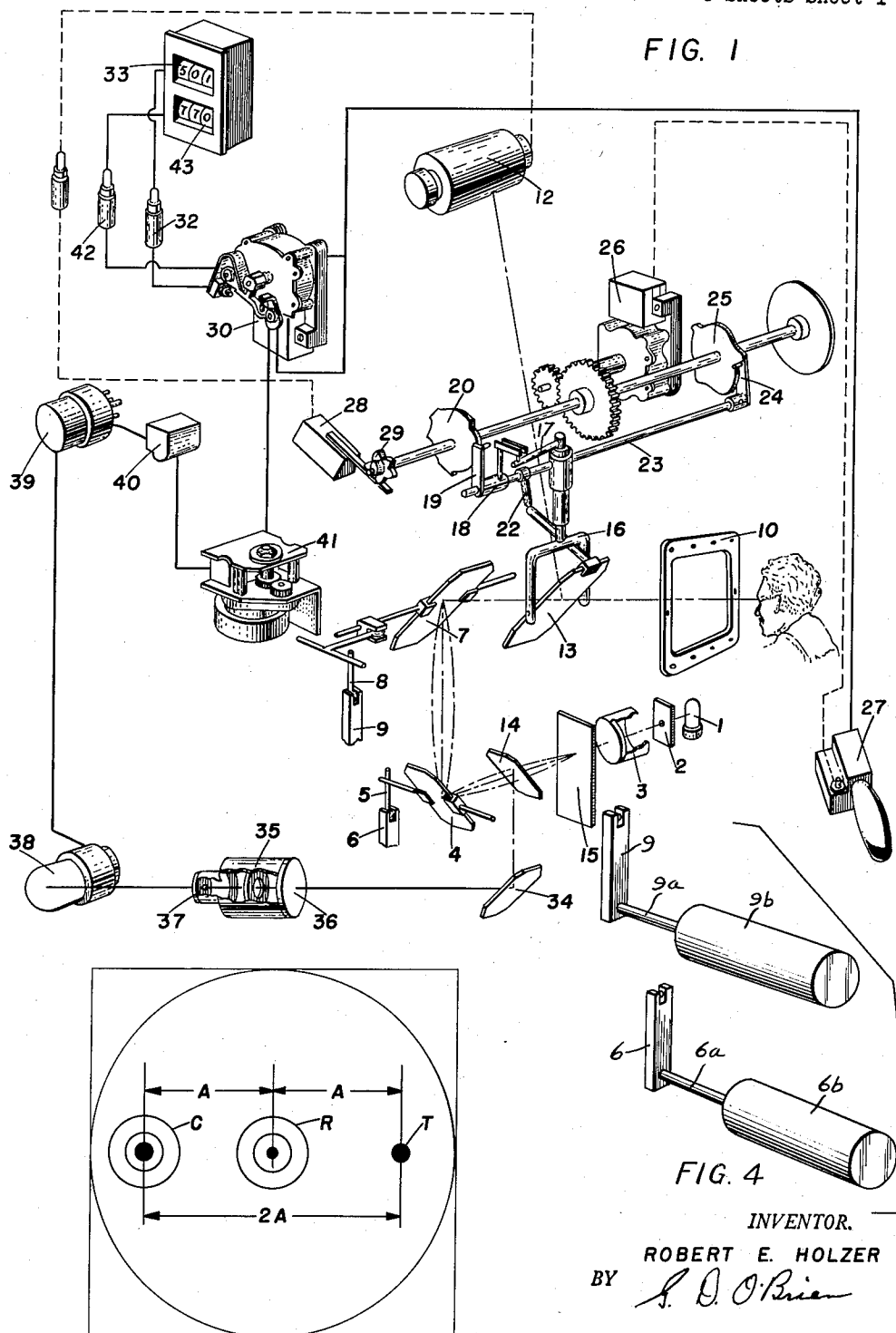
R. E. HOLZER

2,965,979

TRAINING DEVICE FOR MARK 14 GUNSIGHT

Filed Sept. 9, 1949

3 Sheets-Sheet 1



Dec. 27, 1960

R. E. HOLZER

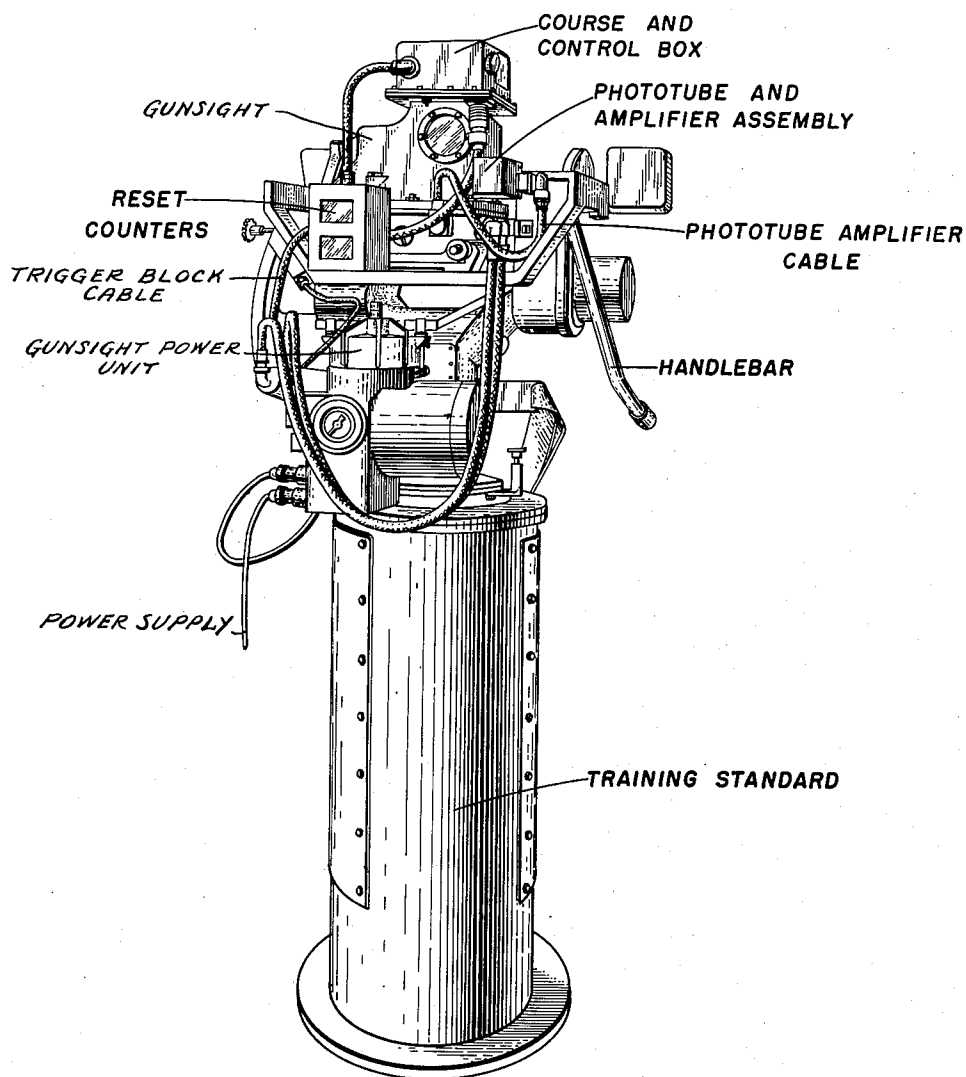
2,965,979

TRAINING DEVICE FOR MARK 14 GUNSIGHT

Filed Sept. 9, 1949

3 Sheets-Sheet 2

FIG. 3



INVENTOR

ROBERT E. HOLZER

S. D. O'Brien

BY

ATTORNEY

Dec. 27, 1960

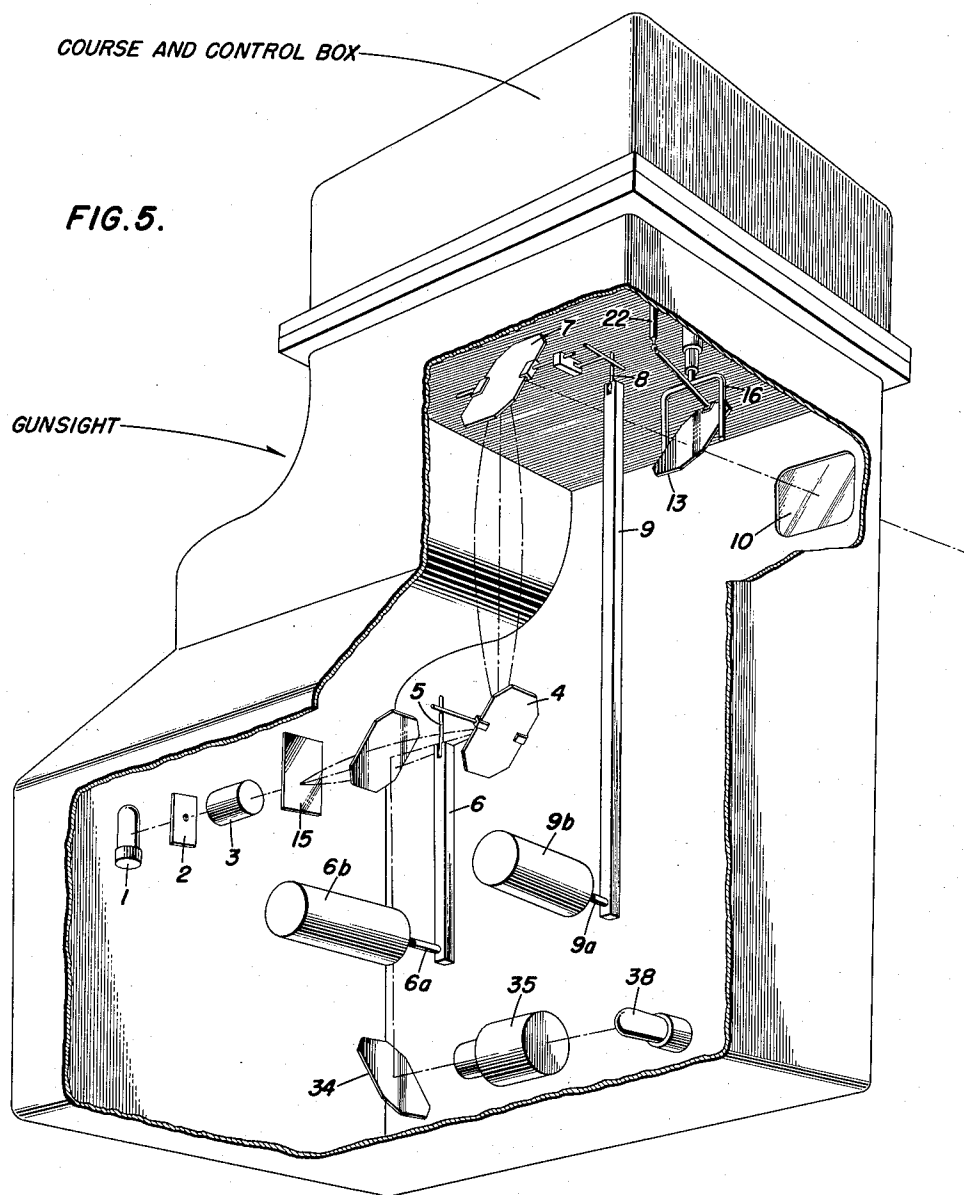
R. E. HOLZER

2,965,979

TRAINING DEVICE FOR MARK 14 GUNSIGHT

Filed Sept. 9, 1949

3 Sheets-Sheet 3



INVENTOR.
ROBERT E. HOLZER
BY *W. O'Brien*

1

2,965,979

TRAINING DEVICE FOR MARK 14 GUNSIGHT

Robert E. Holzer, Los Angeles, Calif., assignor to the United States of America as represented by the Secretary of the Navy

Filed Sept. 9, 1949, Ser. No. 114,720

10 Claims. (Cl. 35—25)

This invention relates to a gunsight trainer for use in training gun crew personnel.

In the past much difficulty has been experienced in training operators in the use of optical, anti-aircraft gunsights of the disturbed, computing type. Such a gunsight comprises a means for automatically inserting a ballistic correction angle and a proper lead angle between the line of sight of the gunsight as it tracks a directly viewed target and the line of fire of the gun upon which the gunsight is mounted. This is achieved by establishing a tracking line which constitutes a reticle image that is focused at infinity and that is offset from the line of fire in azimuth by a swivelly mounted mirror that is controlled by a traverse rate of swing gyroscope, and in elevation by a vertically movable mirror that is controlled by an elevation rate of swing of gyroscope. The amount by which the tracking line is offset by the gyro-controlled mirrors is determined mainly by the motion imparted to the gunsight during the tracking operation and is proportional to the velocity, angle of approach, and range of the target being tracked. Because this amount is dependent upon the motion imparted to the gunsight, it is essential to the successful operation of the gunsight that such motion be as uniform and smooth as possible.

The present invention was designed primarily for the purpose of training gun crew personnel in the art of uniform and smooth tracking with a disturbed, computing, optical gunsight and for this purpose utilizes such a gunsight modified by the addition of an optical system which introduces a synthetic target and controls its movement, and includes a scoring and firing system which indicates the number of rounds fired and hits scored.

It is therefore one object of the present invention to provide a means of training gun crew personnel in the operation of a disturbed, computing, optical gunsight.

Another object of this invention is to provide a gunsight trainer having a controllably, movable synthetic target image for tracking purposes in place of an actual target.

A further object of the invention is to provide a gunsight trainer having a scoring and firing system for more closely simulating combat conditions under which a gunsight would be used and for indicating the proficiency of the trainer operator.

Other objects and many of the attendant advantages of this invention will be appreciated readily as the same becomes understood by reference to the following detailed description, when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a functional, schematic diagram showing the component optical and electrical systems of the trainer and their interrelation.

Fig. 2 is a functional diagram showing the relative positions of the trainer target and reticle images while the trainer is at rest and during the tracking operation; and

Fig. 3 is an elevation view of the trainer shown schematically in Fig. 1 mounted on a training stand.

2

Fig. 4 is a diagrammatic view of the rate gyroscopes and their respective linkages.

Fig. 5 is an enlarged cutaway view of the gunsight portion of the training device showing the arrangement of the sighting components.

Gunsight trainer

Referring now to the drawings more specifically, Fig. 1 shows schematically the gunsight trainer which constitutes the present invention. The trainer consists broadly of two component systems: an optical system, which serves to derive a synthetic controllable movable target image and a reticle image and to impose the two on a viewing window; and a firing and scoring system.

Optical system

The reticle image portion of the optical system is identical to the reticle image system of a Mark 14 gunsight and consists of a reticle image light source 1, a reticle 2, and a reticle image collimating lens 3 which serve to form a reticle image that is focused upon a swivelly mounted traverse mirror 4. Mirror 4 has its lever arm 5 supported in a U-shaped upright 6 that is mounted on the output shaft 6a of the traverse rate of swing gyroscope 6b in such a manner that the output torque developed by the traverse rate of swing gyro causes U-shaped upright 6 to rotate mirror 4 by an amount proportional to the rate of change in azimuth of the target being tracked to thereby offset the reticle image from the line of fire of the gun upon which the gunsight is mounted by a proper lead angle in azimuth. Mirror 4 in turn imposes the reticle image on a gyro-controlled mirror 7 which has its lever arm 8 supported by a U-shaped upright 9 that is mounted on the output shaft 9a of the elevation rate of swing gyroscope 9b and serves to tilt the mirror 7 by an amount proportional to the rate of change in elevation of the target being tracked to thereby offset the reticle image from normal by a proper lead angle in elevation. Mirror 7 is a 50% reflecting mirror and is in alignment with the target viewing window and a sighting window 10 of the gunsight. When used as the reticle image system of a gunsight, an operator looks through sighting window 10, mirror 7, and the target viewing window of the gunsight to view the target being tracked directly with the reticle image superimposed. The present invention provides a controllably, movable synthetic target image in place of an actual target and for this purpose incorporates the synthetic target image system.

The target image system consists of a synthetic target image source 12 that forms a synthetic target image and focuses such image upon a semi-transmissive, gimbal mounted, course control mirror 13 which can be rotated about two different axes. This mirror reflects the synthetic target image away from the pointer's eye to the gunsight elevation mirror 7, downward to the gyro-controlled mirror 4, through a semi-transmissive scoring mirror 14, the purpose of which will be explained later, to a semi-transmissive return mirror 15. From the return mirror the synthetic target image is reflected back through the same train of mirrors, through the semi-transmissive, course control mirror 13 to the pointer's eye. By rotating course control mirror 13 in train or in elevation from its neutral position the apparent position of the synthetic target image can be moved. Rotation of the course control mirror 13 in traverse moves the synthetic target image in a direction opposite to the direction of rotation of the mirror; rotation of the top of the mirror toward the pointer lowers the target image.

When viewed from the trainer window 10 and with the trainer at rest the synthetic target image and the reticle image appear as shown in Fig. 2 of the drawings. Course control mirror 13 is set so that the target image T is

normally displaced to one side of the reticle image R by an amount A. When the trainer is slewed toward the target image, a lead angle is generated by the elevation and traverse rate of swing gyros which results in the reticle image lagging behind its normal position due to the rotation of the gyro-controlled elevation and traverse mirrors. Rotation of these two mirrors also causes the target image to lag behind its normal position; however, since the target image has been reflected twice from each of the gyro-controlled mirrors, its lag is twice that of the reticle image and the two catch up at some predetermined rate of tracking. It is this feature which allows the trainer to be slewed toward the target to align the reticle image with the target image; thus physically simulating the condition of slewing on an actual target. When the correct lead has been developed by establishing the proper angular rate of tracking, the target image will have lagged twice as far as the reticle image and the two will be superimposed as shown at C in Fig. 2.

In order to more effectively simulate slewing upon an actual target a mirror driving assembly is provided for imparting movement to the synthetic target image relative to the center line of the gunsight. This assembly comprises a yoke 16 which supports the course control mirror 13 and which is free to rotate mirror 13 in train. Attached to the shaft of yoke 16 is a lever arm 17 which is linked to a rotatable sleeve 18 by a connecting rod and lever arm mounted on the sleeve. Also mounted upon sleeve 18 is a cam follower arm 19 that is driven by a rotating, train cam 20, so that rotation of the train cam 20 and follower sleeve 18 causes the linkage to move mirror 13 in train. Mirror 13 can also be rotated about about its vertical axes and for this purpose is journaled in yoke 16 in such a manner that it can be rotated in elevation by a connecting rod and lever arm 22 that is secured to a rotatable shaft 23. Mounted on the far end of shaft 23 is a cam follower 24 which serves to rotate shaft 23 and which is driven by a rotating, elevation cam 25. Elevation cam 25 and train cam 20 are cut unevenly so that they, in conjunction with the cam followers and linkage, will rotate course control mirror 13 in elevation and azimuth to provide five different courses and are keyed to a common drive shaft that is geared to a cam drive motor 26 which provides the primary source of movement for the course control mirror 13. Motor 26 is a synchronous motor operating at one r.p.m. and is controlled by a course start button that is located on the trigger block 27 attached to one of the operator's handle bars. Pressing the course start button energizes the cam drive motor which causes the cam drive shaft to rotate until a target course sprocket 29 that is mounted on the end of the cam drive shaft closes microswitch 28. The points of sprocket 29 are aligned with beginning of each of the five courses cut into the course cams and provides a control stop for determining the limits of each course. Upon microswitch 28 being closed a course relay, not shown, is closed which automatically keeps the cam drive motor operating until a particular course is completed at which time the circuit is opened by one of the points of sprocket 29 opening microswitch 28.

Firing and scoring system

The firing system of the trainer comprises a trigger block 27 that is mounted on a handle bar of the trainer and a firing motor and switch assembly 30. Trigger block 27 consists of a button switch, which, when depressed energizes the firing motor and switch assembly 30. The firing motor and switch assembly 30 consists of a small synchronous motor operating at about 60 r.p.m. that drives an eight point firing cam which rotates against the firing switch. Rotation of the firing cam against the switch makes and breaks the firing circuit eight times per second to produce a firing signal of eight pulses per second. These impulses operate a firing pilot light 32 and a rounds fired counter 33 which indicate that

the operator is firing at the target and the number of rounds fired.

The scoring system of the trainer comprises a semi-transmissive scoring mirror 14 that is imposed in the path of the reticle and synthetic target images and which reflects a portion of the target beam hereinafter called the scoring beam, to a second scoring mirror 34 that in turn reflects the scoring beam into scoring lens tube 35. The tube 35 contains a lens 36 which is adjusted to focus the beam on an aperture situated in a scoring aperture plate 37 when the trainer is properly tracking the target. It should be noted that the portion of the target image that goes to make up the scoring beam reaches the scoring mirror 14 on its first travel through the optical system; therefore, it is effected only once by the motion of the gyro-controlled mirrors. Referring again to Fig. 2, it is evident that if the target image T were offset by an amount A after only one pass through the gyro-controlled mirrors, it would be offset by an amount 2A sufficient to be superimposed upon the reticle image R, which is offset an amount A, after the second pass of the target image through the gyro-controlled mirror system. If the angular rate of tracking is correct and the reticle image is centered on the target, the motion of the gyro-controlled mirrors will be such as to focus the scoring beam on the aperture, thereby giving an indication that the reticle and target images are superimposed. Upon the scoring beam being focused on the aperture a portion thereof passes through and falls upon a photo-electric tube 38 of the electron-multiplier type which serves to derive an amplified electrical signal from the scoring beam. The signal derived in photo-tube 38 is utilized to fire a gas filled, trigger tube 39 which in turn actuates a scoring relay 40 that operates either directly, or through a time delay unit 41, to close a scoring circuit. The scoring circuit comprises a pilot light 42 and a scoring counter 43 and which is connected in common with the rounds fired counter; thus, if the firing key is not closed the scoring counter cannot register. In order to more properly simulate the effect of slewing a gunsight on an actual target the time delay unit 41 may be inserted between the scoring relay 40 and the scoring circuit at the operator's option. Its function is to delay application of the scoring signal to the scoring circuit for a two second interval, which is equal to the period of time required for the elevation and traverse gyros of an actual gunsight to generate the correct lead angle after the gunsight is properly tracking a target; therefore by use of the unit the scoring of what would be false hits is prevented during that time.

Operation of the trainer

As shown in Fig. 3 of the drawings the gunsight trainer system illustrated schematically in Fig. 1 is swivelly mounted upon a training standard in such a manner that it may be freely rotated about either its vertical or horizontal axes. A trainee operator stands between the handle-bars of the trainer and causes it to move in traverse and in elevation while tracking the movement of the synthetic target image. By pressing the course start button on trigger block 27, the operator causes cam motor 26 to rotate the cam drive shaft and therefore train and elevation cams 20, 25 and the sprocket 29. Rotation of the sprocket 29 closes micro-switch 28 which in turn closes a course control relay. The relay closes the field of cam drive motor 26 to cause it to continue to rotate until sprocket 29 again opens micro-switch 28 at which time the motor is de-energized. The points on the sprocket 29 define the limit of the five courses cut into the elevation and train cams; therefore in order to continually operate the trainer over all the available courses, the course start button must be depressed at the commencement of each course. During the time that micro-switch 28 is closed, cams 20 and 25 cause mirror 13 to move the synthetic target image along a predetermined course which the

5

trainee tracks by holding the target in the smaller of two concentric circles of the reticle. This will score hits when the firing key is closed; however, if the time delay unit has been inserted in the scoring circuit, the trainee must hold the reticle steadily on the target for two seconds before hits can be scored and if the target is lost even momentarily, he must again track smoothly and accurately for two seconds before hits can be scored.

The trainer may also be operated with a constant target velocity if desired. Operation of the trainer in this manner requires a constant rate of tracking to hold the reticle on the target since the target spot remains at a fixed position; otherwise the operation of the trainer is similar to operation with a constantly changing target velocity as described above.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A gunsight trainer comprising an optical gunsight having a reticle image source, a pair of gyro-controlled mirrors for off-setting said reticle image a predetermined amount in elevation and in azimuth, and a viewing window upon which said offset reticle image is imposed; and means mounted on said gunsight for providing a movable simulated target image for use in training gunsight operators, said means comprising a simulated target image source, a movable semi-transmissive, target course control mirror that is rotatable about two of its axes and a second semi-transmissive return mirror, said simulated target image being imposed on and reflected from said movable mirror to said gyro-controlled mirrors, to said second semi-transmissive return mirror from whence it is reflected back to said gyro-controlled mirrors, through said movable semi-transmissive course control mirror to said viewing window upon which it is imposed along with said reticle image.

2. A gunsight trainer as set forth in claim 1 wherein said target image providing means includes means for moving said movable target course control mirror in accordance with a predetermined course.

3. A gunsight trainer comprising a disturbed, computing, optical, anti-aircraft gunsight having a target viewing window upon which a tracking reticle image is imposed; means for deriving a simulated target image, said means comprising a target image source, and means for imposing said synthetic target image upon said target viewing window for use in place of an actual target, said second means comprising a gimbal mounted, semi-transmissive course control mirror upon which said synthetic target image is imposed and means for imparting movement to said simulated target image, said last mentioned means comprising a pair of rotating cams, one of said cams being linked to said gimbal mounted mirror for rotating said mirror in elevation, the other of said cams being linked to said mirror for rotating said mirror in azimuth.

4. A gunsight trainer as set forth in claim 3 wherein said target image deriving means includes a photo-cell scoring means for indicating proper tracking of the target image.

5. A gunsight trainer for training gunsight operators comprising an optical gunsight having a reticle image source, a pair of gyro-controlled mirrors for off-setting said reticle image a predetermined amount in elevation and in train, and a viewing window upon which said offset reticle image is imposed; means mounted on said gunsight for providing a simulated, optical target image for use in place of an actual target, said means comprising a simulated target image source, a gimbal mounted, semi-transmissive, target course control mirror and a second semi-transmissive return mirror, said simulated target image being imposed on and reflected from said course control mirror, to said gyro-controlled mirrors, to said re-

6

turn mirror, whereupon it is reflected back to said gyro-controlled mirrors, through said semi-transmissive, course control mirror to said viewing window upon which it is imposed along with said reticle image; means for imparting movement to said simulated target image relative to said reticle image comprising a pair of rotating cams that are linked to said gimbal mounted, course control mirror for rotating said mirror in elevation and in azimuth; and a photocell scoring means for indicating proper tracking of the synthetic target image.

6. In a gunsight having a target viewing window and means including a pair of gyro controlled mirrors, responsive respectively to rate of change in elevation and azimuth, projecting a position corrected image of a sighting reticle on said viewing window, an operator training device comprising a simulated target, a semi-transmissive mirror interposed in the line of sight through said viewing window introducing an image of said simulated target into the reticle image projecting system of the gunsight, a semi-transmissive return mirror interposed between the reticle image correcting system and the reticle image source returning said target image through said image correcting system to impress the target image on said viewing window, means actuating said first mentioned semi-transmissive mirror for simulating movement of said target, operating means for slewing said gunsight to follow said movement, a semi-transmissive scoring mirror interposed between the reticle image source and the gyro controlled mirrors reflecting a portion of the target image into a scoring system, a photo sensitive system energized by the reflected portion of the target image when the gunsight is properly trained with respect to the simulated motion of the target, a simulated gun firing trigger, a relay energized by said trigger and said photo sensitive system and a scoring recorder actuated by simultaneous energization of said relay.

7. A gunsight trainer device as set forth in claim 6, characterized by a time delay device connected in series with said photo sensitive system.

8. In a gunsight having a target viewing window and means including a pair of gyro-controlled mirrors, responsive respectively to rate of change in elevation and azimuth, projecting a position corrected image of a sighting reticle on said viewing window, an operator training device comprising a simulated target, a semi-transmissive mirror interposed in the line of sight through said viewing window projecting an image of said simulated target into the reticle image projecting system of the gunsight, a semi-transmissive return mirror interposed between the reticle image correcting system and the reticle image source returning said target image through said image correcting system to impress the target image on said viewing window, means actuating said first mentioned semi-transmissive mirror for simulating movement of said target, operating means for slewing said gunsight to follow said movement, a scoring system, and a semi-transmissive scoring mirror interposed between the reticle image source and the gyro controlled mirrors reflecting a portion of the target image into said scoring system.

9. In a gunsight having a target viewing window and means including a pair of gyro-controlled mirrors, responsive respectively to rate of change in elevation and azimuth, projecting a position corrected image of a sighting reticle on said viewing window, an operator training device comprising a simulated target, a semi-transmissive mirror interposed in the line of sight through said viewing window introducing an image of said simulated target into the reticle image projecting system of the gunsight, a semi-transmissive return mirror interposed between the reticle image correcting system and the reticle image source returning said target image through said image correcting system to impress the target image on said viewing window, means actuating said first mentioned semi-transmissive mirror for simulating movement

7

of said target, and means for slewing said gunsight to follow said movement.

10. In a gunsight having a target viewing window and means including a pair of gyro-controlled mirrors, responsive respectively to rate of change in elevation and azimuth, projecting a position corrected image of a sighting reticle on said viewing window, an operator training device comprising a simulated target, a semi-transmissive mirror interposed in the line of sight through said viewing window projecting an image of said simulated target into the reticle image projecting system of the gunsight, a semi-transmissive return mirror interposed between the reticle image correcting system and the reticle image source returning said target image through said image correcting system to impress the target image on said viewing window, means actuating said first mentioned semi-transmissive mirror for simulating movement

8

of said target, operating means for slewing said gunsight to follow said movement, a semi-transmissive scoring mirror interposed between the reticle image source and the gyro-controlled mirrors reflecting a portion of the target image into a scoring system, and a photo sensitive system energized by the reflected portion of the target image when the gunsight is properly trained with respect to the simulated motion of the target.

References Cited in the file of this patent

UNITED STATES PATENTS

2,420,633	Wittel et al. -----	May 13, 1947
2,424,088	Furman et al. -----	July 15, 1947
2,442,240	Hooker et al. -----	May 25, 1948
2,471,368	Ekstrom et al. -----	May 24, 1949
2,473,524	Hubbard et al. -----	June 21, 1949