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United States Patent [19]

Hodges

[11] **3,749,494**

[45] **July 31, 1973**

[54] **GUN SIGHTING AND RANGING MECHANISM**

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[73] Assignee: **Ranging, Inc.**, Rochester, N.Y.

[22] Filed: **Oct. 26, 1970**

[21] Appl. No.: **83,724**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 755,192, Aug. 26, 1968, abandoned.

[52] **U.S. Cl.** **356/16**, 33/245, 33/276, 356/17

[51] **Int. Cl.** **F41g 1/52**, G01c 3/04

[58] **Field of Search** ..... 356/7, 16, 17, 19; 33/53 R, 64 R; 350/33, 10

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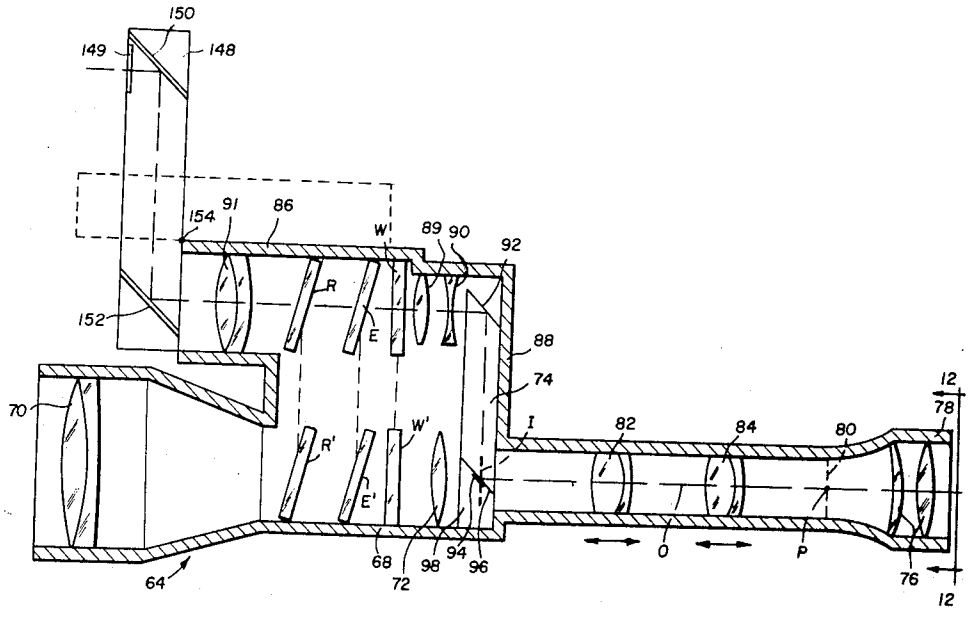
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Primary Examiner—Ronald L. Wibert
Assistant Examiner—F. L. Evans
Attorney—Steve W. Gremban

[57] **ABSTRACT**

A gun sighting and ranging mechanism in which the operation of ranging the mechanism on the target by the operator automatically adjusts the sights of the gun for precise trajectory compensation at any shooting distance for any bullet. The sighting and ranging mechanism has two separate objective lens systems for focusing two separate images of the target at a common image plane which are viewed through a single eyepiece.

13 Claims, 22 Drawing Figures

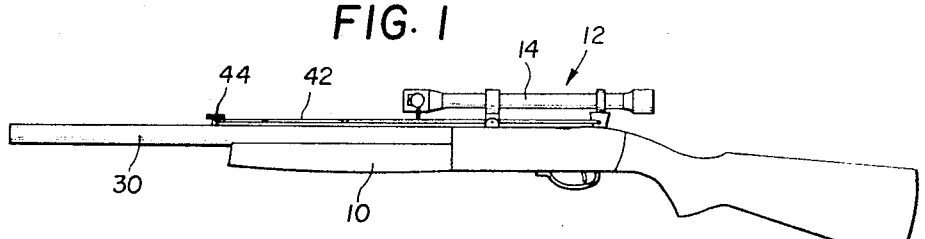


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FIG. 1



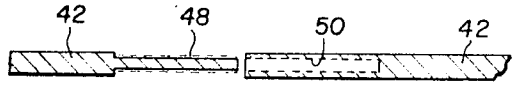


FIG. 4

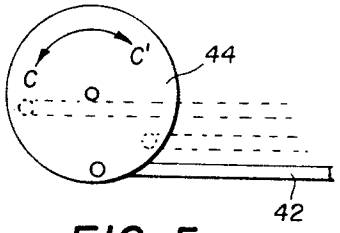


FIG. 5

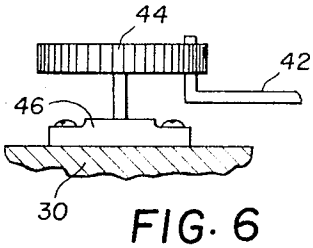


FIG. 6

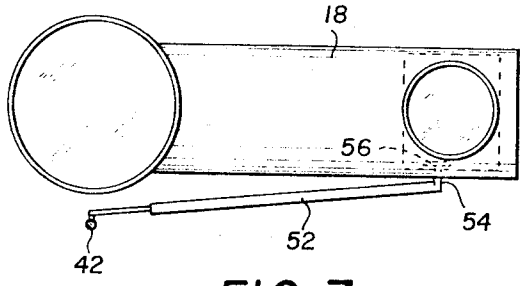


FIG. 7

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ATTORNEY

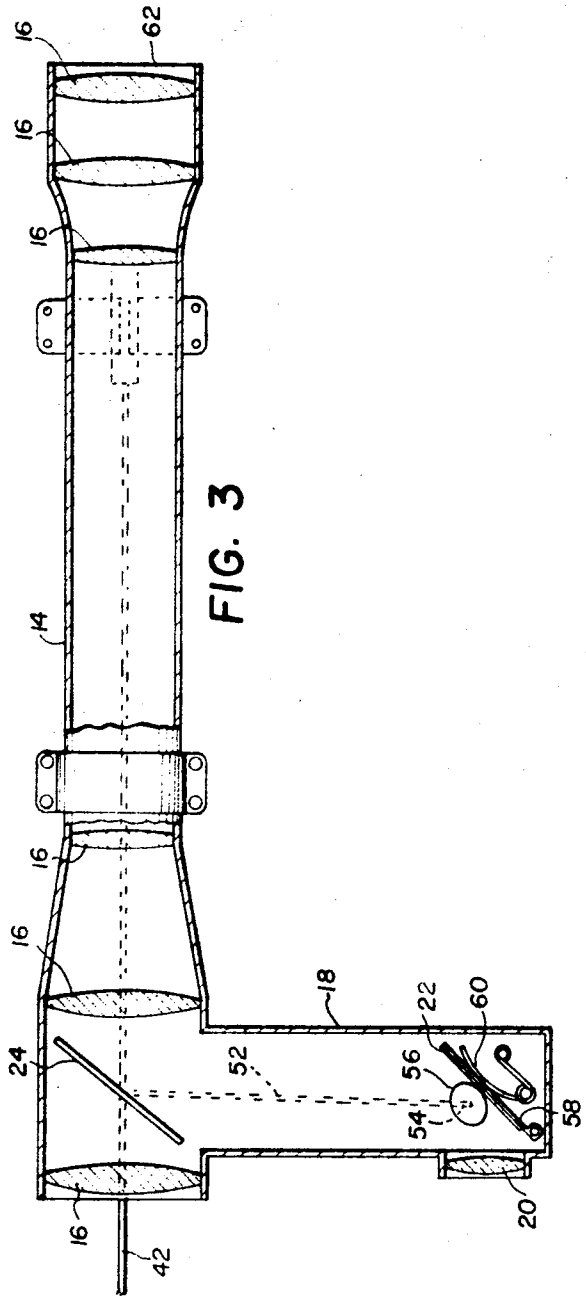


FIG. 3

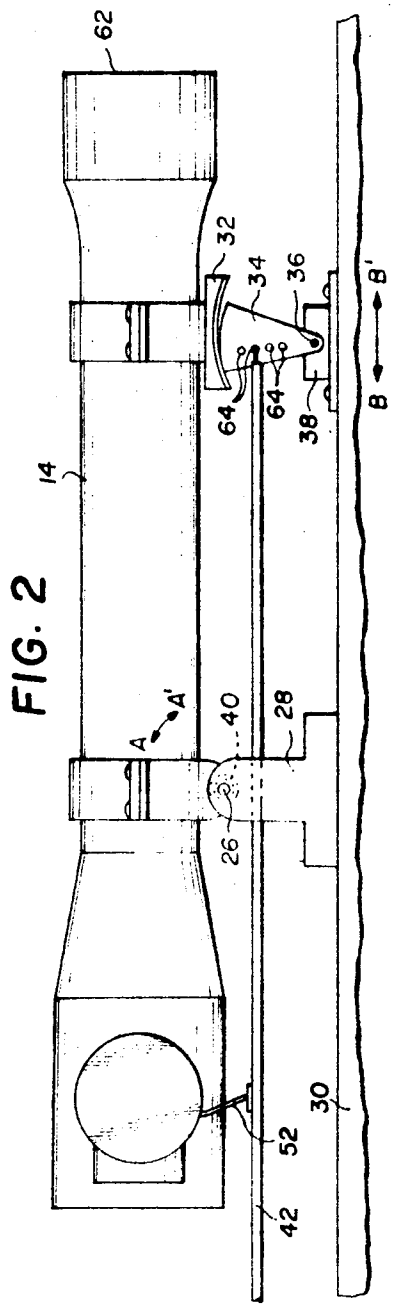


FIG. 2

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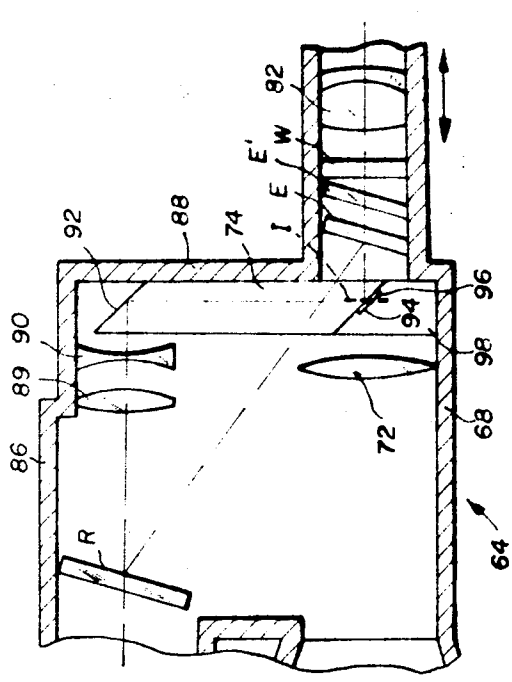


FIG. 8A

FIG. 8

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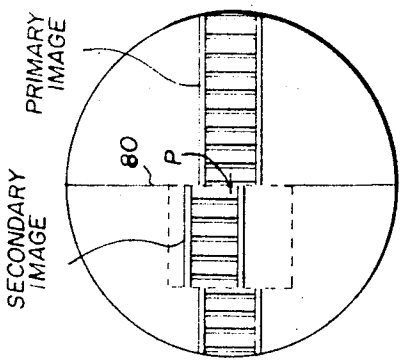


FIG. 12

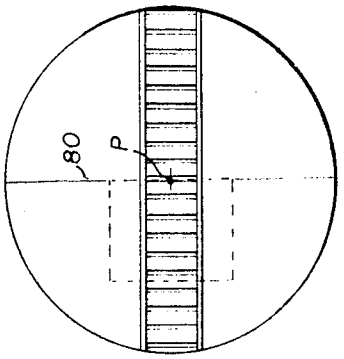


FIG. 13

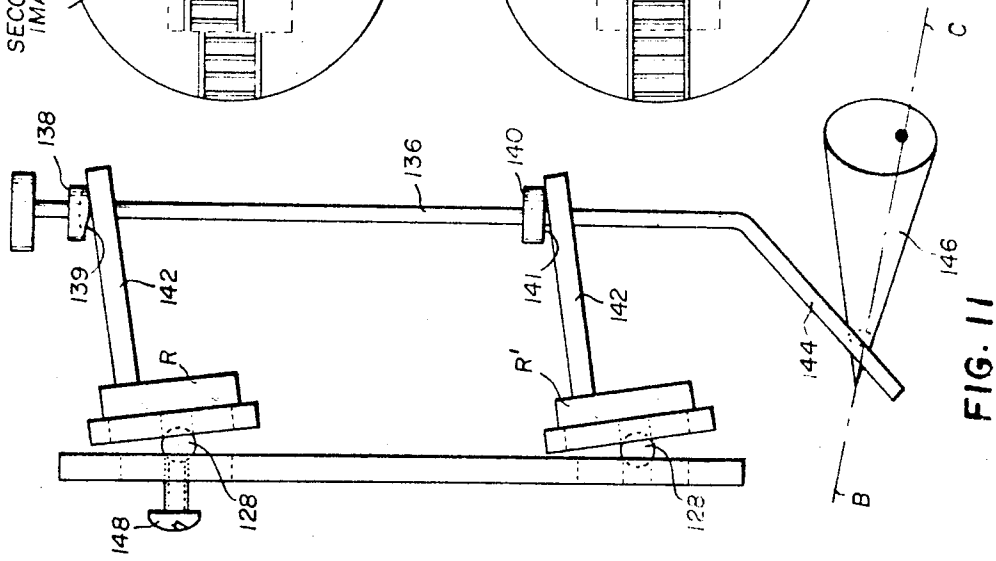


FIG. 11

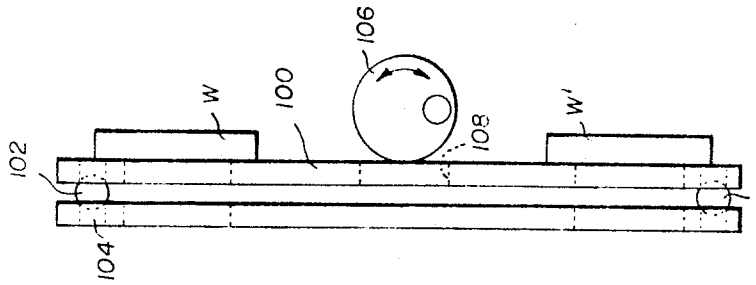


FIG. 9

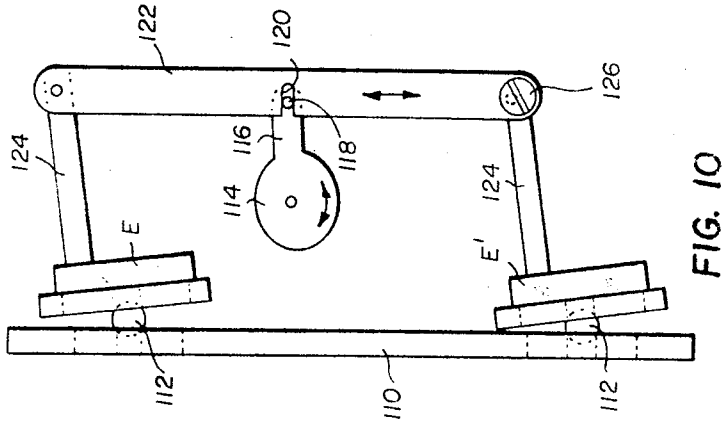


FIG. 10

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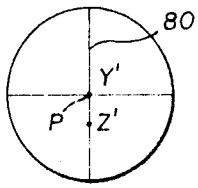


FIG. 14A

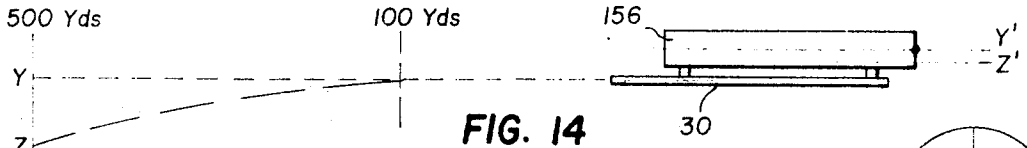


FIG. 14

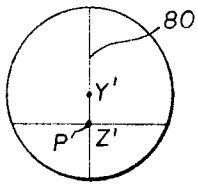


FIG. 15A

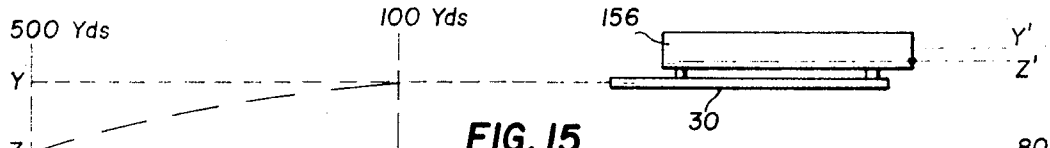


FIG. 15

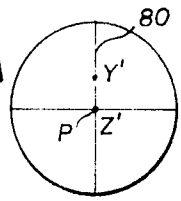


FIG. 16A

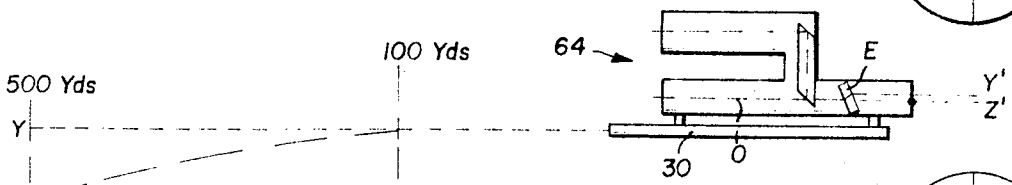


FIG. 16

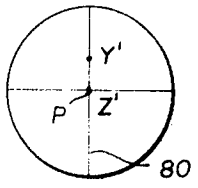


FIG. 17A

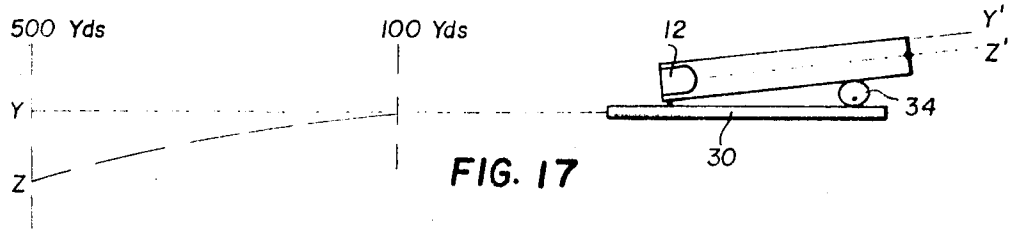


FIG. 17

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GUN SIGHTING AND RANGING MECHANISM

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of U. S. patent application Ser. No. 755,192, now abandoned entitled Gun Sighting and Ranging Mechanism, filed on Aug. 26, 1968 in the name of Marvin P. Hodges.

BACKGROUND OF THE INVENTION

This invention relates generally to sighting mechanisms, and more specifically, to an improved sighting and ranging mechanism for a gun or the like.

Optical sighting mechanisms for guns or the like utilizing a telescopic lens system and cross-hairs are well known in the art. One of such mechanisms requires the operator to make an estimate of the range or distance of the target from the operator, and in response thereto to adjust the sighting mechanism to compensate for the bullet's trajectory. Another such mechanism utilizes a rangefinder comprising a beam splitter and mirror for producing two images of a target which are focused by a single objective lens system on an image plane. The images produced by such a system are superimposed, split field images being unattainable, and the image produced by the beam splitter cannot be separately adjusted or focused relative to the other image except for ranging. In this mechanism, the manipulation required to superimpose the images also adjusts the position of the cross-hairs to automatically require tilting of the gun to compensate for the range and trajectory of the bullet. Another prior art mechanism requires an estimate of the size or height of the target. Applicant's invention is believed to remove the estimating or guess work involved in the use of such sighting mechanisms by providing a sighting and ranging mechanism which in response to manipulation by the gun operator to superimpose or align in an image plane images of the target viewed through the eyepiece of the mechanism, automatically compensates for the range and trajectory of the bullet used by adjusting the position of the cross-hairs relative to the gun barrel in one embodiment, and by displacing the superimposed images a required amount relative to the primary optical axis of the sight scope in another embodiment.

SUMMARY OF THE INVENTION

This invention includes within its scope a sighting and ranging mechanism for a gun or the like comprising means such as two separate objective lens systems for focusing two separate images of a target on a common image plane, in which the ranging system of the sighting mechanism is manipulated by the gun operator to superimpose or align the images of the target visible through an eyepiece of the mechanism, such manipulation automatically sighting the gun for the range and predetermined trajectory of the bullet used.

One object of the present invention is to provide a sighting mechanism for a gun or the like having means for producing two separate images of a target on an image plane, each of which may be adjusted or moved relative to the other.

Another object of the invention is to provide a sighting mechanism for a gun for producing an image of the target on an image plane that is displaced relative to a reference line of sight of the sighting mechanism.

Another object of the invention is to provide an improved sighting and ranging mechanism for a gun or the like having two separate objective lens systems which in response to the manipulation of the ranging mechanism for superimposing or aligning images of the target visible through the eyepiece of the mechanism, automatically compensates for the target range and trajectory of the bullet used.

Another object of the invention is to provide an improved sighting and ranging mechanism for a gun or the like that is of simple design and construction, thoroughly reliable and efficient in operation, and economical to manufacture.

Objects and advantages other than those set forth above will be apparent from the following description when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a front elevational view of a gun on which one embodiment of the sighting and ranging mechanism of this invention is mounted;

FIG. **2** is an enlarged side elevational view of the sighting and ranging mechanism of FIG. **1**;

FIG. **3** is a top plan view in section of the sighting and ranging mechanism of FIG. **2**;

FIG. **4** is an enlarged segmental view of a portion of the linkage rod disclosed in FIG. **2** and showing an adjustable feature therein;

FIG. **5** is an enlarged top plan view of a control knob of FIG. **1**;

FIG. **6** is a side elevational view of the control knob of FIG. **5**;

FIG. **7** is a front elevational view of the sighting and ranging mechanism of FIG. **3**;

FIG. **8** is a side elevational view in section of another embodiment of the sighting and ranging mechanism of this invention;

FIG. **8A** is a segmental view similar to FIG. **8** showing still another embodiment of the invention;

FIG. **9** is an enlarged segmental view in side elevation of the windage plate mounting of the embodiment shown in FIG. **8**;

FIG. **10** is an enlarged segmental view in side elevation of the elevation plate mounting of the embodiment shown in FIG. **8**;

FIG. **11** is an enlarged segmental view in side elevation of the ranging plate mounting of the embodiment shown in FIG. **8**;

FIG. **12** is an enlarged side elevational view of the field of view seen through the eyepiece of FIG. **8** looking at it from line **12—12** and showing two images of a fence out of alignment with one another;

FIG. **13** is a view similar to FIG. **12** showing the images in register or alignment;

FIG. **14** is a schematic side elevational view of a prior art type of sighting scope for a gun;

FIG. **14A** is an enlarged view of the field of view of the scope of FIG. **14** showing where the cross-hairs were aimed and where the bullet struck the target;

FIG. **15** is a view similar to FIG. **14** in which the cross-hairs have been shifted downwardly relative to its central position of FIG. **14A**;

FIG. **15A** is a view similar to FIG. **14A** of the field of view of the scope of FIG. **15**;

FIG. 16 is a view similar to FIG. 14 in which the image formed by the biscope is shifted or displaced upwardly relative to the cross-hairs;

FIG. 16A is a view similar to FIG. 14A of the field of view of the scope of FIG. 16;

FIG. 17 is a view similar to FIG. 14 in which the biscope is tilted relative to the gun barrel to compensate for range and bullet trajectory; and

FIG. 17A is a view similar to FIG. 14A of the field of view of the scope of FIG. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, one embodiment of this invention is shown in connection with a gun **10** as seen in FIG. **1**. In this embodiment, the sighting and ranging mechanism **12**, seen in enlarged form in FIGS. **2** and **3**, comprises a lens barrel **14** having a telescopic lens system of any known type comprising a plurality of lens elements **16**, a cross-hair, not shown, and a transversely extending housing **18**. Housing **18** has a combination mirror-lens system comprising a lens **20** and light reflecting mediums such as mirrors **22**, **24** mounted therein to provide, in cooperation with lens barrel **14**, a ranging system operating on the well known triangulation principle normally used for determining the range or distance of a target from the operator or mechanism in a manner that is well known in the art. Although housing **18** is shown integrally formed with barrel **14**, it may with slight modification be rotatably mounted on barrel **14** for movement between the position shown in FIGS. **2** and **3** for a person who sights with his right eye, to a position 180° removed therefrom (seen dotted in FIG. **3**) for the person who sights with his left eye.

The lens barrel **14** is pivotally mounted for movement in the direction of the arrows designated A–A^1 in FIG. **2** on a pivot pin **26** carried by a support **28** secured to the gun barrel **30**. The rear of lens barrel **14** has a cam follower plate **32** rigidly secured thereto engageable with a cam member **34**. Cam member **34** is pivotally mounted on a pin **36** carried by a support **38** which is adjustably secured to gun barrel **30** for axial movement in the directions designated by the arrows B–B^1 (see FIG. **2**). A relatively strong spring **40** encircling pin **26** is interposed between lens barrel **14** and support **28** for strongly urging lens barrel **14** and cam follower plate **32** in a clockwise direction denoted by the arrow A^1 into firm engagement with cam member **34**.

A control mechanism is provided for controlling the position of cam member **34** and hence the rotational or elevational position of lens barrel **14** in the direction of the arrows A–A^1. The control mechanism comprises a rod **42** having one end secured by any suitable means to cam member **34**, and its opposite end secured by any suitable means to a rotatable knob **44** as best seen in FIGS. **5** and **6**. The knob **44** is rotatably supported by a support member **46** secured to barrel **30** for rotation in the directions designated by the arrows C–C^1 (See FIG. **5**) for movement of cam member **34**. To provide proper adjustment of rod **42** between cam member **34** and knob **44**, rod **42** may be provided in two parts with one of the parts having a threaded portion **48** engageable with a threaded bore **50** in the other part as best seen in FIG. **4**. A telescopic linkage **52** transverse to rod **42** has one end connected by any suitable means such as a ball joint to rod **42**, and its opposite end secured to a stub shaft **54** extending into and rotatably supported by the offset housing **18** of the sighting mechanism. A mirror control cam **56** (see FIG. **3**) is secured to stub shaft **54** and engages a mirror support member **58** which is urged by a spring **60** into engagement with cam **56**. Axial movement of rod **42** by means of knob **44** results in pivotal movement of linkage **52**, mirror control cam **56**, and mirror **22** to permit relative movement of images of the target visible through an eyepiece **62** of telescopic lens barrel **14** for bringing the two images of the target into superimposition. When the images are superimposed, gun barrel **30** will be properly sighted on the target taking into account the target range and trajectory of a predetermined bullet. In order to compensate for bullet trajectory for cartridges of different velocity and weight, cam member **34** is provided with a plurality of openings **54**, each of which will permit a slightly different position of cam member **34** for the same position of rod **42** resulting in a slightly different elevational setting in the directions A–A^1 between the sighting and ranging mechanism **12** and gun barrel **30**. As indicated earlier, cam member support **38** is also adjustable in the direction of the arrows B–B^1 to permit acceleration of the cam action of cam **34** to compensate for bullet trajectory values of all commercial and military cartridges.

In the embodiment of the invention shown in FIGS. **8–13**, optical means are provided for positioning the gun so that it can be accurately sighted on any object or target. In this embodiment, a biscope sighting and ranging mechanism **64** is shown mountable on a gun by any suitable rigid mounting, not shown. A main sight barrel **68** (See FIG. **8**) has a primary objective lens system at one end comprising a pair of objective lenses **70**, **72** of an effective focal length for forming a focused primary image of a distant object on an image plane I, shown dotted in FIG. **8**, within a parallelogram shaped glass prism block **74**. The primary image formed at the image plane I by the primary lens system is viewed through an ocular lens **76** secured in an eyepiece **78** at the opposite end of the sight barrel **68**. The lenses in the sight barrel **68** have a primary optical axis "O". A reticle **80** such as cross-hairs which provides a point sight "P" at their intersection is mounted in sight barrel **68** in the focal plane of the ocular lens **76** with the point "P" on optical axis "O" which serves as a reference line of sight. A pair of erector lenses **82**, **84** are mounted in sight barrel **68** between the reticle **80** and prism block **74** and are movable axially along the optical axis "O" by any suitable linkage, not shown, at different rates to change the power of the scope while maintaining proper focus of an image, as is done in conventional "zoom" lenses.

A plurality of secondary objective lenses **89**, **90** and **91** are mounted in a secondary lens tube **86** integral with a laterally extending housing **88** for forming a secondary image of an object which is reflected from a beveled surface **92** of prism block **74** onto a small rectangular spot of aluminum **94** located on a parallel beveled surface **96** of the prism block **74** at its lower end, which beveled surface **96** is located along the optical axis "O" of the primary objective lenses **70**, **72**. The prism block **74** is initially ground to make the beveled surfaces **92**, **96** parallel to one another, the aluminum spot **94** added, and an end portion **98** of the prism block **74** cemented to the block. The objective lenses

90 have an effective focal length that is substantially equal to the effective focal length of the primary objective lenses **70, 72** for forming a secondary focused image on the image plane I. The secondary image may be only a portion of the primary image to form a split field image as seen in FIGS. **12** and **13**, or superimposed image may be achieved by taking the reflective surface **94** out of image plane I. By proper selection of size and position of reflective surface **94**, the secondary image can merge into the primary image at the image plane I at any position and at any percentage of the overall field of view. Although a solid glass prism block **74** is used to deflect the secondary image beam to the image plane I and again to the eyepiece **78**, any other suitable means such as mirrors or the like may be used. In addition, although two objective lens systems are provided for forming two independent images of a target, other means such as mirror optics involving concave mirrors may be used to form two independent images on a common image plane.

To adjust the biscope **64** for windage any suitable glass plates or lenses W, W¹ (See FIGS. **8** and **9**) are adjustably mounted in the objective lens systems for lateral pivotal movement to produce a corresponding lateral shift in the objective lens axis which causes the image to shift laterally with respect to the optical axis of the objective lenses. The plates W, W¹ may be mounted on an apertured support plate **100** pivotal about spherical balls **102** interposed between the plate **100** and a fixed plate **104.** The pivoting of the windage plate **100** may be accomplished by any suitable mechanism such as an eccentric cam **106** engageable with an arm **108** on the support plate **100.**

Similar elevation plates or lenses E, E¹ are mounted in each of the primary and secondary objective lens systems for properly vertically shifting the optical axis. The windage plates W, W¹ and elevation plates E, E¹ (See FIGS. **8** and **10**) are adjusted for accurate firing when the biscope is initially mounted, and once properly adjusted will not require change except to correct subsequent misalignment. The elevation plates E, E¹ are coupled together by any suitable linkage mechanism such as cams, gears or screws for synchronous pivotal movement of the plates for vertically shifting the primary and secondary images with respect to the optical axes of the objective systems. A mechanism for accomplishing this comprises an apertured fixed plate **110** to which the elevation plates E, E¹ are pivotally mounted on spherical balls **112.** The plates E, E¹ are moved synchronously by a knob **114** having an arm **116** secured thereto with a pin **118** at one end movable in a slot **120** in plate **122.** The ends of plate **122** are pivotally secured to arms **124** secured to plates E, E¹. The plates E, E¹ may be adjusted relative to one another by adjusting eccentric screw **126** if necessary to correct any vertical misalignment between the two axes.

In addition, ranging plates or lenses R, R¹ (See FIGS. **8** and **11**) are adjustably mounted in each of the primary and secondary objective lens systems and actuated by a cam system so that when the two images of a target at any predetermined range are aligned or superimposed at image plane I (See FIG. **13**) the point sight of the cross-hair **80** accurately predicts the point of impact of the bullet at that range, accounting for the trajectory drop, provided eccentric cam **146** has been rotated on axis B–C to present to cam follower **144** the cam face which is appropriate for the particular gun-/ammunition combination in use.

To accomplish this, the ranging plates R, R¹ as best seen in FIG. **11,** are pivotally mounted on spherical balls **128** in a similar manner to the elevation plates E, E¹ and differentially pivoted. Fixed arms **142** on plates R, R¹ are biased by any suitable means, not shown, against discs **138, 140** on shaft **136,** and because surface **141** has a different rise than surface **139** (or no rise), plates R, R¹ are moved different amounts as shaft **136** is rotated by knob **143.** Shaft **136** is caused to move axially as it is rotated by cam follower arm **144** riding along the surface of cam **146.** As cam **146** is rotated about its axis B–C, different cam surfaces are presented to cam follower **144** to compensate for various trajectories which result from different gun/ammunition combinations.

The limiting accuracy of the instrument is a function of the magnification and the separation between optical axes, or ranging base length. It is convenient to make the base length short, and then to optically extend it with a "periscope box **148**" into which light enters through opening **149.** If the parallelism of the mirrors **150, 152** (or lack of it) only remains constant, the position and orientation of the box relative to the rest of the instrument is very much less critical than the parts of the main instrument. Thus it may be conveniently demountable, or folded down about pivotal shaft **154** as shown dotted in FIG. **8.** Further, boxes of different length may be mounted interchangeably, enabling the ranging operation to be performed at greater or lesser distances, provided only that a range scale appropriate for the base length used be attached to the range knob or the instrument body.

In the embodiment of the invention shown in FIG. **8,** the elevation, windage and ranging plates are all positioned between image plane I and lens **70.** Accordingly, when the ranging plates R, R¹ are adjusted to range in on a target, the two images formed at the image plane I are automatically shifted or displaced upwardly from optical axis "O" to automatically compensate for the range and trajectory of the bullet. Consequently, when the point "P" of the cross-hairs is sighted on a point on the target visible in the image plane, the bullet will accurately strike that point of the target. In the embodiment of the invention shown in FIG. **8A,** only one ranging plate "R" is positioned in the secondary lens system, and elevation and windage plates E, E¹, W are positioned between the image plane I and the eyepiece **78.** Elevation plate E¹ is adjusted for accurate firing when the scope is initially mounted, and once properly adjusted is fixed in that position. During ranging, the two plates R, E are cammed together for simultaneous differential movement, and the images at image plane I are not displaced from optical axis "O", such displacement occurring between image plane I and the cross-hairs due to the action of the elevation plate E.

With reference to FIGS. **14 – 17,** FIG. **14** schematically illustrates a prior art telescopic rifle sight **156** mounted on a gun barrel **30.** With such a sight, if the point P of the cross-hairs **80** of the scope is sighted on a target Y (barrel **30** pointing directly at Y), a bullet fired will, depending upon its trajectory, strike the target at Z. Assuming the scope were powerful enough, the field of view would appear as seen in FIG. **14A** with point P in register with target image Y¹ and Z¹ indicating the impact point Z of the bullet. With this

type of scope, to hit the target Y, it is necessary to place the point P of the cross-hairs on an imaginary target an estimated distance above target Y to compensate for the bullet drop. The same result may be achieved as seen in FIGS. **15** and **15A** by changing the cross-hairs **80** so that the intersection point P is in register with the image Z^1 of the impact point Z. With this arrangement, the point P is centered on impact point Z, and since barrel **30** is still pointing at target Y, the bullet will drop and strike impact point Z. In FIGS. **16** and **16A**, a biscope **64** of the type shown in FIG. **8A** is mounted on gun barrel **30** having the deflection plate E for shifting or displacing registered images of the target relative to the primary optical axis O. When the point P of the cross-hairs is aligned with impact point image Z^1, the barrel **30** is pointing at target Y and the bullet will accurately strike impact point Z. FIGS. **17** and **17A** show a scope arrangement similar to the embodiment of the invention shown in FIGS. **1 – 7** in which the cam **34** is interposed between the scope **12** and gun barrel **30.** With this arrangement, scope **12** has been ranged on target Y, and since the ranging function is coupled to cam **34,** the cam is moved the required amount tilting the scope relative to the barrel. Now if the scope is aimed at impact point Z by centering point P of the cross-hairs on impact point image Z^1 as seen in FIG. **17A**, the barrel **30** will be pointing at target Y and the bullet fired will drop and strike the impact point Z.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove, and as defined in the appended claims.

I claim:

1. In a sighting and ranging mechanism for a gun, the combination comprising:

a sight scope mountable on a barrel of a gun, said scope having optical means defining an optical axis forming a substantially fixed reference line of sight, an image plane transverse to said optical axis onto which an image of the target is formed, and a point sight adapted to be visually aligned with any part of said image for sighting the gun on the target; and

image moving means for substantially simultaneously determining the range of the target and vertically displacing the target image from said reference line of sight an amount sufficient to compensate for the range of the target and the trajectory of the bullet.

2. The invention according to claim **1** wherein said image moving means comprises an image displacing means interposed between said image plane and said point sight.

3. The invention according to claim **2** wherein said image displacing means comprises a pivotally mounted elevation plate.

4. In a sighting and ranging mechanism for a gun having a primary objective lens defining an optical axis, an image plane transverse to said optical axis and a point sight which when aligned with a reference point on said image plane at said optical axis forms a substantially fixed reference line of sight along which a target is sighted, the combination comprising:

means for forming a pair of independent images of a target on said image plane; and

image moving means for substantially simultaneously moving said pair of images into register and vertically displacing said registered images from said reference line of sight a predetermined amount to compensate for the range of the target and the trajectory of a bullet.

5. The invention according to claim **4** wherein said image moving means comprises an image displacement means interposed between said image plane and said point sight for displacing the registered images.

6. The invention according to claim **5** wherein said image displacement means comprises a pivotally mounted elevation plate.

7. In a biscope sighting and ranging mechanism for a gun, the combination comprising:

sighting means mountable on to a barrel of the gun and having optical means having a primary optical axis, an image plane transverse to said optical axis and a point sight which when aligned with a reference point on said image plane at said optical axis forms a substantially fixed reference line of sight;

first optical means for forming a first image of a target on said image plane;

second optical means optically coupled to said first optical means for forming a second image of the target independent of said first image on said image plane; and

image moving means coupling said first and second optical means for substantially simultaneously moving said first and second images on said image plane into register and vertically displacing said registered images from said reference line of sight an amount dependent upon the distance to the target and the trajectory of the bullet such that when said point sight is sighted on a spot on said registered images, the gun barrel is pointed at a place on the target above said spot on said registered images so that a bullet fired from the gun will strike a corresponding spot on the target.

8. The invention according to claim **7** wherein said second optical means has an image deflecting element optically connecting said second optical means to said first optical means.

9. The invention according to claim **7** wherein said second optical means has an image deflecting element comprising a parallelogram shaped prism optically connecting said second optical means to said first optical means.

10. The invention according to claim **7** wherein said second optical means has an image deflecting element comprising a parallelogram shaped glass prism optically connecting said second optical means to said first optical means, said image plane being formed in said prism along the optical axis of said first optical means.

11. The invention according to claim **7** wherein said second optical means has an image deflecting element optically connecting said second optical means to said first optical means, and a third portion extending transversely from said second optical means for collecting light from the subject and introducing the light into said second optical means.

12. The invention according to claim **11** wherein said third portion is pivotally mounted on said second optical means.

13. The invention according to claim **7** in which said image moving means comprises at least one image deflecting plate responsive to said image moving means for displacing said images from said reference line of sight.

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