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Jan. 19, 1943. R. C. WALKER 2,308,635

COMBAT VEHICLE GUNNERY SIGHT

Filed Nov. 15, 1940 2 Sheets-Sheet 1

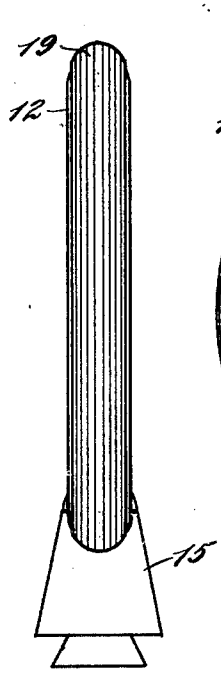


Fig. 2.

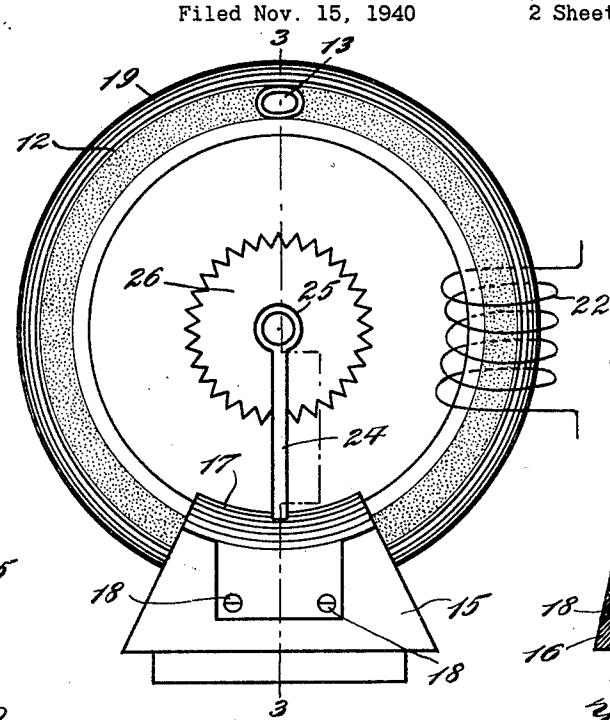


Fig. 1.

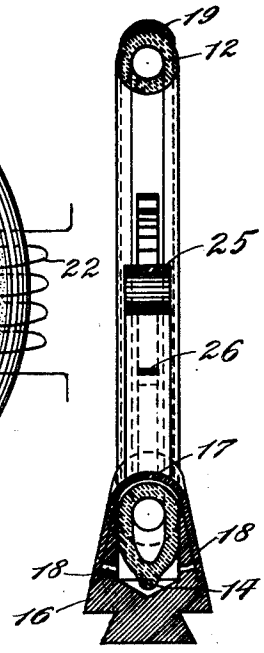


Fig. 3.

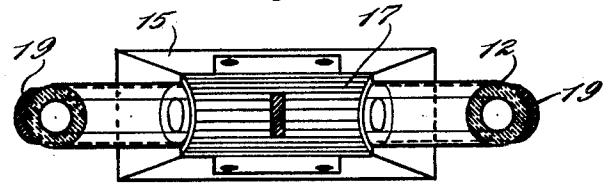


Fig. 4.

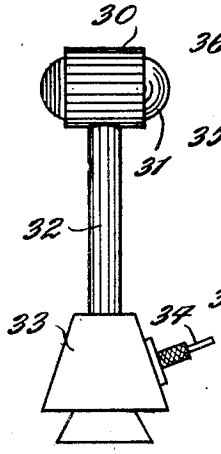


Fig. 5.

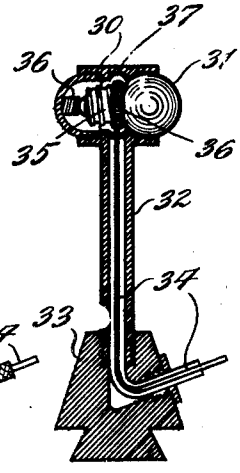


Fig. 6.

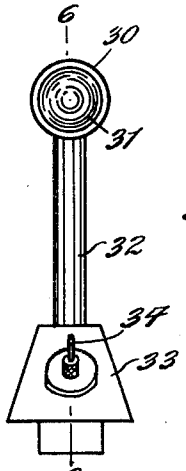


Fig. 7.

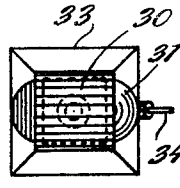


Fig. 8.

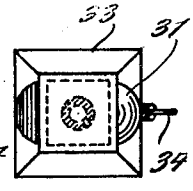


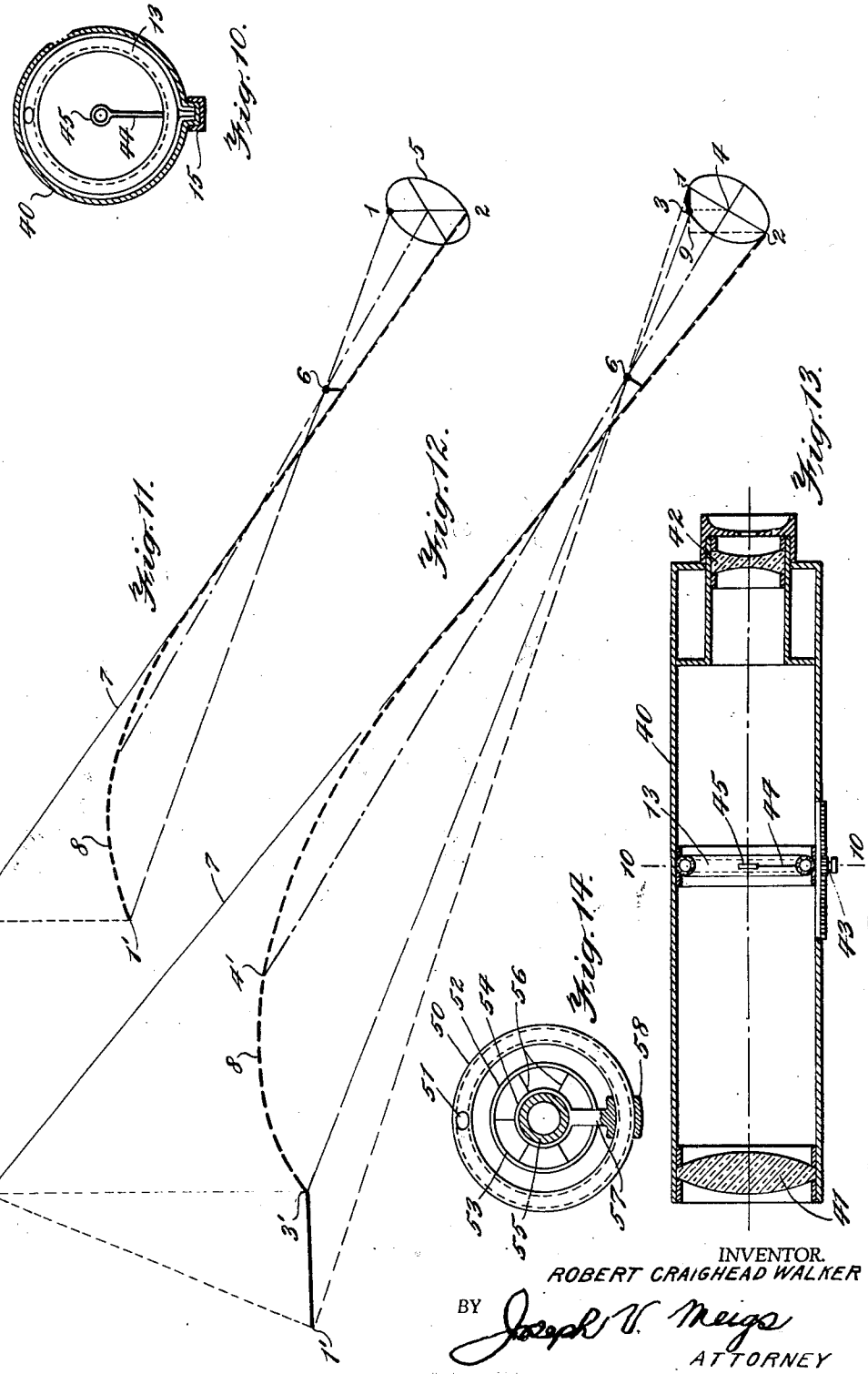
Fig. 9.

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COMBAT VEHICLE GUNNERY SIGHT

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UNITED STATES PATENT OFFICE

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COMBAT VEHICLE GUNNERY SIGHT

Robert Craighead Walker, Scarsdale, N. Y.

Application November 15, 1940, Serial No. 365,781

6 Claims. (Cl. 33—47)

This invention relates to an improved gun sight for a combat vehicle, as for example, a combat aeroplane or mechanized land vehicle.

Such vehicles have, of course, transverse and longitudinal axes normally lying in a horizontal plane with one or more guns mounted at various parts of the vehicle with the axis of the gun barrel commonly parallel to the longitudinal axis and perpendicular to the transverse axis of the vehicle. When such vehicles are on an "even keel," that is, when the axis transverse to the axis of the gun barrel lies in its normal horizontal plane accurate fire can be obtained. When, however, the transverse axis of the vehicle, which axis is in turn transverse to the axis of the gun barrel, rotates in a plane which intersects the normal horizontal plane, or in other words when the longitudinal axis (or axis of translation) of the vehicle parallel to the axis of the gun barrel constitutes an axis about which the vehicle rotates as a whole, serious inaccuracies of fire occur. Such rotation is commonly met with in aerial combat, as for example when firing occurs from a plane undergoing a steep bank. Such rotation may also occur in the case of an armored land vehicle, as for example when firing occurs from a tank which is inclined about its longitudinal axis.

The reason for such inaccuracy will more fully appear by reference to Figs. 11 and 12 of the accompanying drawings. Fig. 11 shows diagrammatically a conventional form of rear sight and front sight on an armored vehicle resting on an "even keel," that is, with the longitudinal and transverse axes of the vehicle lying in their normal horizontal plane. The rear circular sight 5 comprises a reticule or line 1—2 and the front sight a post 6. Line 7 represents the axis of the gun barrel and its projection and the heavy dotted line 8 represents the trajectory of the projectile fired from the gun at the object 1' which is the intersection of the trajectory 8 of the bullet and the line of sight 1—1' passing through the point 1 and the center of the front sight 6. This trajectory always lies in a vertical plane irrespective of the movement of the gun barrel because of the effect of gravity upon the projectile. The plane containing the line 1—2 and the center of the front sight 6 constitutes what may be termed the plane of sight, and in Fig. 11 this plane of sight is vertical and coincides with the plane containing the trajectory of the bullet.

Fig. 12 shows diagrammatically the result of rotation of the gun barrel with its attached rear sight and front sight 6 about an axis parallel to the axis of the gun barrel or bore through an angle subtended between the lines 1—2 and 9—2. The line 1—2 and the plane passing through this line and front sight 6 (which also rotates) do not remain vertical and undergo a rotation and the rotated plane contains the lines 1—1' and 2—2'. The line 8 shows the trajectory of the projectile, the line 7 is an extension of the axis of the bore of the gun and 3' indicates the object aimed at. Since the reticule represented by the line 1—2 in Figs. 11 and 12 is in fixed relation to the gun, rotation of the latter about an axis parallel to the bore causes displacement of the point 1, as shown in Fig. 12. This point corresponds to the position of the rear sight for maximum range, and the line of sight which connects the point 1 and the center of the front sight 6 when projected ends at the point 1'. The triangles 1—3—6 and 1'—3'—6 are similar triangles and it will therefore be seen that as a result of the rotation, the error (for maximum range) is magnified in proportion to the distance of the object from the front sight, which will be readily observed by comparing the respective lengths of the lines 1'—3' and 1—3 in Fig. 12.

In short, as a result of the rotation, the gunner sights at the target in one direction while the trajectory of the projectile takes a different direction.

It has been discovered that if the plane of sight is maintained in a vertical position parallel to or coplanar with the plane of the trajectory, the error can be obviated and it will be noted that the error is caused by the fact that the plane of sight passing through the fixed vertical reticule or line 1—2 and the front sight 6 does not remain vertical and coincidental with or parallel to the vertical plane of the trajectory when the plane rotates, but undergoes an angular movement in relation to the vertical plane of the trajectory in the manner described.

It is an object of the present invention to maintain the plane of sight in a vertical position so that this plane is either parallel to the vertical plane containing the trajectory of the bullet and in predetermined fixed relation thereto or coincident with the plane of said trajectory. Stated otherwise, it is an object of the invention to maintain, when the vehicle undergoes the rotation described, a relation between the plane containing the trajectory of the bullet and the plane of sight, which is substantially or in practical effect the same relation which exists when the vehicle is on an "even keel."

It is a further object to provide means whereby the plane of sight is always in a vertical position and in coplanar relation to the plane of the trajectory irrespective of rotation of the axis of the gun barrel about an axis parallel thereto, that is to say, irrespective of the rotation of the transverse axis of the vehicle in a plane intersecting the horizontal plane in which said axis normally lies.

It is a further object to provide a combination of gun sight and range finder, the said range finder affording means for determining automatically or by simple mental calculation the range of the object.

It is a further object of the invention to provide a telescopic gun sight to magnify the image of the object in addition to overcoming the error due to rotation above described.

Further objects and advantages will hereinafter appear.

In accordance with the invention, the gun sight for a vehicle of the class described comprises a closed, light-transmitting conduit having a circular axis, this conduit being adapted to be rigidly mounted in relation to the gun barrel, the circular axis of the conduit lying in a plane perpendicular to the axis of the gun barrel, together with means within said conduit providing in effect a point establishing a line of sight connecting said point with the object aimed at, said line of sight lying in a vertical plane of sight containing the center of said circular axis, said plane being coincident with the vertical plane containing the trajectory of the projectile fired from the gun when the transverse axis of the vehicle occupies its normal position in a horizontal plane, and means within said conduit to maintain said plane of sight in a substantially vertical position coincident with or parallel to the plane of the trajectory, irrespective of rotation of the vehicle about its longitudinal axis.

The principles of the invention will be set forth in the claims and illustrative embodiments of these principles will be set forth in the following description, taken in conjunction with the drawings, in which:

Fig. 1 shows an elevation of a preferred form of rear gun sight of the present invention;

Fig. 2 shows a side elevation;

Fig. 3 is a section on the line 3—3 of Fig. 1;

Fig. 4 is a top view of Fig. 1 partly in section;

Figs. 5 and 7 are side and front elevational views of a preferred form of front sight;

Fig. 6 is a section on the line 6—6 of Fig. 7;

Figs. 8 and 9 are top views of a tandem assembly of front sights.

Fig. 10 is a section on the line 10—10 of Fig. 13;

Figs. 11 and 12 are diagrammatic views to assist in explaining the advantages and principles of the invention;

Fig. 13 is a sectional elevational view of a telescopic sight; and

Fig. 14 illustrates a construction in which the circular axis of the conduit or hollow ring of the invention is concentric with the axis of the gun bore.

Referring to Fig. 1, the rear sight there shown comprises a hollow ring 12 made of transparent glass or plastic material filled with mercury except for a space of any predetermined and convenient dimensions constituting the bubble 13 which is floated in the mercury. The ring 12 has a circular axis and a circular cross section. The hollow ring may be filled with mercury with the aid of a tubulature, not shown, through which mercury is introduced into the ring, which tubulature is then sealed off leaving a protuberance 14, as shown in Fig. 3. The ring may be mounted in a base 15, said base comprising a lower receiving portion 16 and a cooperating upper portion or saddle 17, screws 18 being provided to clamp the saddle to the lower portion 16 of the base 15. An annular guard 19 is preferably provided and secured in place together with the hollow ring by means of the base 15. The ring and base may be mounted on any part of the vehicle with the circular axis of the ring lying in a plane perpendicular to the axis of the bore of the gun or guns. The facts that the center of the ring is located in spaced relation to the axis or axes of the gun bore or bores introduces an error which varies as the distance from the center of the ring to the axis of the gun. Combat vehicles are frequently provided with a plurality of guns. For example, an aeroplane may have a gun positioned on or closely adjacent to the cockpit and one or more other guns at various other portions of the plane, as for example in the wings. The sight comprising the ring 12 and base 15 may be mounted directly upon one of the guns with the center of the ring only a few inches from the axis of the bore. If the vehicle has another gun or guns located somewhere remote from the rear sight the distance from the center of the ring 12 to the axis of the bore of that gun or those guns will, of course, be greater, but whatever error is occasioned by the distance between the center of the ring and the bore of the gun will always be a constant regardless of the range, and negligible in amount. In other words, the plane of sight containing the center of the bubble 13 and the center of the ring will always be vertical and either coincidental with or parallel to the plane of the trajectory of the bullet as contrasted with the divergence or angular relation of the plane of sight and the plane of the trajectory of the bullet which characterizes a rear sight in a fixed position, this divergence and consequent magnification of error proportional to the range having been already alluded to above in connection with Figs. 11 and 12.

Consequently the rear sight of the present invention may be located on any part of the vehicle and it is not necessary that it be mounted on any particular gun or on any gun. The plane containing the circular axis of the ring 12 should, however, be perpendicular to the axis of the bore of the gun, and the axis of translation of the vehicle.

Mercury has been specifically mentioned as the preferred liquid filling for the hollow ring 12, and while mercury is distinctly preferred on account of its combination of high specific gravity and high surface tension with low viscosity or mobility, other liquids may be employed.

The column or filling of mercury remains in substantially the same position irrespective of the rotation of the hollow ring 12 caused by angular rotation of the vehicle about its longitudinal axis (or axis of translation), and the walls of the ring move in relation to the column of mercury so that there is a relative movement of these walls in relation to the mercury. The coefficient of friction between the mercury and the transparent walls, when these are of glass, is so low that the bubble 13 always remains substantially in a vertical plane passing through the center of this bubble and the center of the ring, and this plane which also contains the center of the front sight is the plane of sight which

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nas already been mentioned. Consequently, the mercury column constitutes and embodies means within the conduit or hollow ring to maintain said plane of sight in a substantially vertical position irrespective of rotation of the vehicle about its longitudinal axis (or axis of translation) parallel to the plane of sight, or otherwise stated, rotation of the transverse axis of the vehicle in a plane intersecting the horizontal plane in which said axis normally lies.

Instead of mercury other liquids possessing the necessary qualities of low viscosity and low coefficient of friction in relation to the walls of the ring, preferably in combination with surface tension and high specific gravity, may be employed, as for example various kinds of organic and inorganic liquids.

The bubble **13** constitutes and embodies a species of body of predetermined dimensions floated by the liquid. Preferably this body is fluid, that is, a liquid immiscible with the mercury or its equivalent, or a gas. In the specific embodiment shown in the drawings the said body **13** is a gaseous bubble and it may be advantageously one of the rare gases, as for example neon, although nitrogen or other inert gas or air will be satisfactory. If desired the gas may be enclosed within a transparent globule or envelope.

A gaseous body or bubble **13** is more advantageous than a liquid or solid because the extremely low specific gravity of the gas in relation to the high specific gravity of the mercury makes it possible for the center of said bubble always to remain in the same vertical plane passing through the center of this bubble and the center of the hollow ring, that is, there is substantially no lag or drag, or tendency of the bubble to follow the walls of the ring in their annular movement caused by rotation of the vehicle about its longitudinal axis. Moreover, it is possible to impart to the gaseous bubble **13** a high degree of luminosity and contrast in relation to its adjacent environment or background. This may be done by discharging through the gaseous bubble a high frequency induced current produced by the coil **22** provided with high frequency current from any suitable source, not shown. The presence of the mercury will cause the gaseous bubble to emit light having the characteristics of the mercury spectrum.

The invention also provides, in combination with the sight, a device for estimating the range of the target. In the specific form shown in Fig. 1 this device includes the post **24** extending from the base **15** and terminating in a hollow ring **25**, the center of which ring is the center of the ring **12**. This post carries a frame **26** having a series of points, as shown, arranged in a circle in concentric and spaced relation to the circular axis of the ring. These points are spaced apart equidistant and the distance between any two points is of course predetermined and known. Consequently, if an object having known dimensions comes into the range of vision, its relation to these points affords a basis for estimating the range of the object. In aerial combat, for example, the dimensions of an enemy plane are generally known from its type and the device described therefore enables the operator to estimate or mentally calculate the range.

Preferred forms of a front sight employed in the present invention are shown in Figs. 5 to 9 inclusive. This preferred form includes a socket **30** carrying an incandescent bulb **31**, a hollow post **32** and a base **33**. An insulated wire **34** contacts with the shank **35** of the incandescent bulb which, of course, constitutes one terminal thereof. The other terminal or base contacts with the socket **30** through the boss **36** and the socket **30** is grounded to the body of the vehicle through the post **32** and base **33**. To provide against movement of the bulb **31** the terminal of the wire **34** is provided with a wire spiral **36** enclosed within a tubular covering of resilient and insulating material such as rubber which engages a recess **37** in the socket **30**.

Current for the illumination of the incandescent bulb **31** as well as for energizing the high frequency coil **22** may be provided by any suitable source which it is not necessary to specifically show in the drawings and describe.

As shown in Figs. 8 and 9, it may be desirable to have a tandem assembly of front sights so that in the event that one is shot away the remaining sight will still be available.

The mode of operation will now be described in the light of the prior description and with further reference to diagrammatic Figs. **11** and **12**:

Assuming that the vehicle is on "even keel" with its longitudinal axis (axis of translation) lying in its normal horizontal plane the operator estimates the range of the enemy object, which may for example be an enemy plane, by means of the range finding device **26** and then sights through any point in the vertical plane passing through the middle of the bubble **13** and the center of the ring **12** (which is also the center of the ring **25**) and the center of the front sight, said point being intermediate between the bubble **13** and the center of the ring **12** for intermediate range, at the center of the bubble **13** for maximum range, and through the center of the ring **25** for point-blank range. This plane of sight is coincident with the plane of the trajectory of the bullet when the vehicle is on "even keel" and it is therefore necessary only to correct for the fall of the bullet or its trajectory. When the vehicle rotates about its axis of translation or longitudinal axis, if the body or point **13** were in fixed relation to the ring the plane of sight would of course undergo a corresponding rotation, as illustrated in Fig. 12 by the line 1—2. The trajectory of the bullet, shown by the line **8** in Fig. 12, still remains in a vertical plane but the plane of sight containing the lines 1—2 and 1'—2', as shown in Fig. 12, is not in a vertical plane but on the contrary in a plane which intersects the vertical plane of the trajectory at an angle. Consequently the plane of trajectory progressively diverges from the plane of sight depending on the degree of rotation of the vehicle and the range of the target, thus introducing a serious and indeterminate error.

In the present invention, however, the center of the body or bubble **13**, shown in Fig. 1, always remains in the same vertical plane containing the center of said bubble **13**, the center of the ring **25**, and the center of the front sight, irrespective of rotation of the ring **12** caused by corresponding rotation of the vehicle about its axis of translation parallel to the bore of the gun and transverse to the plane containing the circular axis of said ring **12**. As the ring **12** rotates, the plane of trajectory which as already stated always remains vertical, progressively moves away from the plane of sight to an extent dependent upon the degree of inclination of the vehicle from the horizontal plane but these two planes, the plane of sight and the plane

of the trajectory always remain in parallel vertical and coplanar relationship so that there is no magnification of the error due to the distance between these parallel planes which is determinate and can be allowed for. When the sight is mounted on the barrel of the gun the maximum possible distance between these two parallel vertical planes is very small, as for example a matter of a few inches. If the sight is mounted on a given portion of the vehicle and the gun being fired is mounted at a remote portion of the vehicle the distance between these two planes, that is, the plane of sight and the plane of trajectory may be a matter of a few feet or a few yards, but again, this distance is constant and determinate, and in the case of aerial combat gunnery, where a number of guns are mounted at various points and their fire controlled by the present invention, the slight dispersion of fire cause by the plurality of guns is a distinct advantage.

This is again illustrated by reference to Fig. 12 in which **3** represents the bubble **13** shown in Fig. 1 and **1**, shown in Figs. 11 and 12, represents a fixed point on the circumference of the ring **12** which, as shown in Figs. 11 and 12, represents a ring sight mounted directly upon a gun in close proximity to the barrel, the bore of which is represented by line **7** in Figs. 11 and 12. In these Figs. 11 and 12 the solid crossed lines of the ring **12** represent the conventional crossed wire reticule. As the ring **12** rotates, the bubble **13** of Fig. 1 (represented as **3** in Fig. 12) remains in the same vertical plane containing the dotted lines **3—4** and **3'—4'** of Fig. 12. This vertical plane is in coplanar parallel relation to the vertical plane of the trajectory of the bullet containing the lines **2—9** and **7**.

Consequently the error caused by the distance between the vertical plane of the trajectory of the bullet and the vertical plane of sight is always constant. When the sight is mounted directly on the gun the distance between these planes is not only constant but is negligible, and where the sight is mounted at a point on the vehicle remote from the gun being fired the error, while greater, is still constant and can be readily allowed for if desired, and in many cases is advantageous, as above explained.

If desired, it is possible to eliminate even the constant and determinate error measured by the distance between the vertical plane of sight and the vertical coplanar plane of the trajectory. This can be done by constructing the hollow circular conduit or ring so that its circular axis is concentric with the bore of the gun on which it is mounted, and in such case the said hollow conduit may wholly surround the barrel of the gun or only partially. However, it is believed to be convenient, usually, not to attempt such concentric relation but to mount the sight on any desired portion of the vehicle and make proper allowance for the constant, determinate error previously described where such error is anything more than negligible.

Fig. 14 shows a structure in which the hollow conduit **50** carrying the bubble **51** floated in a suitable body of liquid, e. g. mercury, is concentrically arranged in relation to the bore of the gun barrel **55**. A hanger having a strap **57** and a clamping portion **58** is suspended from the gun barrel **55** by means of a circular strap **54**. The clamping portion **58** carries the hollow ring so that the latter is concentric with the bore of the gun. There is preferably used in combination with this rear sight comprising the hollow conduit **50**, a front sight comprising an annular ring **53** carrying radial arms **56** joined to a second annular ring (not specifically shown) mounted on the gun barrel, the said annular ring **53** being also concentric with the bore. In using the device shown in Fig. 14 the center of the bubble **51** and the intersection of an arm **56** with the ring **53** may be used as the points respectively determining the line of sight for maximum range, and for intermediate ranges the rear sight will be any point between the center of the bubble **51** and the said intersection of an arm **56** with the ring **53**. The image of the front sight comprising the ring **53** and arms **56** appears to the observer to lie concentrically within the hollow conduit **50**, and the arms **56** provide not only front sights but also radial arms, any point along which (or the projection of which) may be selected as the rear sight. If desired, a second annular ring **52** having a circular axis lying in the same plane as the circular axis of the hollow conduit **50** may be provided and supported on the gun barrel in the same manner as the front sight.

Figs. 10 and 13 show a form of the invention in which the sight described is mounted within the barrel or tube **40** of a telescope having an objective lens **41** and an eye piece **42**, the particular telescope elements shown in Figs. 10 and 13 being substantially those of a Galilean telescope represented diagrammatically. The hollow ring **13** is constructed similarly to that shown in Fig. 1 except that the base **15** cooperates with an adjustment device **43** to permit the sight to be adjusted in proper focused and spaced relation to the objective and eye piece so that both the hollow ring and target may be viewed coincidentally. A post **44** extends from the base **15** and terminates in an annular ring **45** in substantially the same manner as the post **24** and ring **25** shown in Fig. 1.

I claim:

1. A rear gun sight for a combat vehicle, said vehicle having a transverse axis normally lying in a horizontal plane, a gun mounted on said vehicle and a front sight on said gun, said rear gun sight comprising a closed light-transmitting conduit having a circular axis; said conduit being adapted to be rigidly mounted in relation to the gun barrel, the circular axis of said conduit lying in a plane transverse to the axis of the gun barrel; said conduit containing therewithin means providing, in effect, a point establishing with the front sight a line of sight connecting said point with the object aimed at, said line of sight lying in a vertical plane of sight containing the center of said circular axis and the front sight, said plane being coincident with the vertical plane containing the trajectory of the projectile fired from said gun when the transverse axis of the vehicle occupies its normal position in a horizontal plane; and liquid means within said conduit floatingly supporting said first named means to maintain said plane of sight in a vertical position substantially coincident with the plane of the trajectory irrespective of inclination of the transverse axis of the vehicle from its normal horizontal position.

2. A rear gun sight for a combat vehicle, said vehicle having a transverse axis normally lying in a horizontal plane, a gun mounted on said vehicle and a front sight on said gun, said rear gun sight comprising a closed light-transmitting conduit having a circular axis; said conduit being

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adapted to be rigidly mounted in relation to the gun barrel, the circular axis of said conduit lying in a plane transverse to the axis of the gun barrel; said conduit containing therewithin means providing, in effect, a point establishing with the front sight a line of sight connecting said point with the object aimed at, said line of sight lying in a vertical plane of sight containing the center of said circular axis and the front sight, said plane being coincident with the vertical plane containing the trajectory of the projectile fired from said gun when the transverse axis of the vehicle occupies its normal position in a horizontal plane; and means within said conduit to maintain said plane of sight in a vertical position substantially coincident with the plane of the trajectory irrespective of inclination of the transverse axis of the vehicle from its normal horizontal position, said means comprising a column of mobile liquid and a body of predetermined dimensions floated by said liquid.

3. A rear gun sight for a combat vehicle, said vehicle having a transverse axis normally lying in a horizontal plane, a gun mounted on said vehicle and a front sight on said gun, said rear gun sight comprising a closed light-transmitting conduit having a circular axis; said conduit being adapted to be rigidly mounted in relation to the gun barrel, the circular axis of said conduit lying in a plane transverse to the axis of the gun barrel; said conduit containing a floating body providing, in effect, a point establishing with said front sight a line of sight connecting said point with the object aimed at, said line of sight lying in a vertical plane of sight containing the center of said circular axis and the front sight, said plane being coincident with the vertical plane containing the trajectory of the projectile fired from said gun when the transverse axis of the vehicle occupies its normal position in a horizontal plane; and liquid means within said conduit to maintain said plane of sight in a vertical position substantially coincident with the plane of the trajectory irrespective of inclination of the transverse axis of the vehicle from its normal horizontal position, said means comprising a column of mobile liquid on which said first named means is floated; and means to render said floated body clearly visible and in sharp contrast to the column of liquid.

4. A rear gun sight for a combat vehicle, said vehicle having a transverse axis normally lying in a horizontal plane, a gun mounted on said vehicle and a front sight on said gun, said rear sight comprising a closed light-transmitting conduit having a circular axis; said conduit being adapted to be rigidly mounted in relation to the gun barrel, the circular axis of said conduit lying in a plane transverse to the axis of the gun barrel; said front sight comprising a luminous substantially spherical body; said conduit containing a gaseous bubble floated therein providing, in effect, a point establishing with said front sight a line of sight connecting said point with the front sight and the object aimed at, said line of sight lying in a vertical plane of sight containing the center of said circular axis and the front sight, said plane being coincident with the vertical plane containing the trajectory of the projectile fired from said gun when the transverse axis of the vehicle occupies its normal position in a horizontal plane; and liquid means within said conduit to maintain said plane of sight in a vertical position substantially coincident with the plane of the trajectory irrespective of inclination of the transverse axis of the vehicle from its normal horizontal position, said means comprising a column of mercury on which said bubble is floated; and means to render luminous said floated gaseous bubble.

5. A combination of gun sight and range finder for a combat vehicle having a transverse axis normally lying in a horizontal plane, a gun mounted on said vehicle and a front sight on said gun, the axis of the gun barrel being substantially transverse to the said axis of the vehicle, said combination comprising a hollow ring having transparent walls constituting a conduit path having a circular axis and a circular cross section; a base on which said ring is mounted, said base being adapted to mount the ring in rigid and spaced relation to the gun barrel, with the circular axis of the ring lying in a plane transverse to the axis of the gun barrel; a post extending from the base and having a terminus at the center of the ring; said conduit containing a mobile liquid and a gaseous bubble floated in said liquid whereby a plane passing through the center of said bubble, the center of the terminus of said post and the front sight constitutes a plane of sight which remains vertical and substantially coincident with the plane of the trajectory irrespective of the inclination of the transverse axis of the vehicle from its normal horizontal position; said post carrying a frame having a series of points arranged in a circle in concentric and spaced relation to the circular axis of the ring, the distance between any two of said points affording means to determine the range of an object having known dimensions.

6. A telescopic gun sight for a combat vehicle having a transverse axis normally lying in a horizontal plane and a gun mounted on said vehicle, comprising a hollow ring having transparent walls constituting a conduit having a circular axis and a circular cross section; a post extending from the circumference of said ring and having a terminus at the center of the ring; said conduit containing a mobile liquid and a gaseous bubble floated in said liquid whereby a plane passing through the center of said bubble and the center of the terminus of said post constitutes a plane of sight which remains vertical and substantially coincident with the plane of the trajectory irrespective of the inclination of the transverse axis of the vehicle from its normal horizontal position; a telescope having an objective lens and an eye lens; said ring being mounted within said telescope between the objective lens and eye lens with the circular axis of the conduit lying in a plane transverse to the axis of the telescope; and means to translate the ring along the axis of the telescope to adjust the position of the ring in relation to said lenses.

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