Dec. 20, 1949 L. H. BROWN 2,491,476

COLLIMATING SIGHT AND REFLECTING AIMING POST FOR INDIRECT AIMING OF GUNS

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Fig. 1.

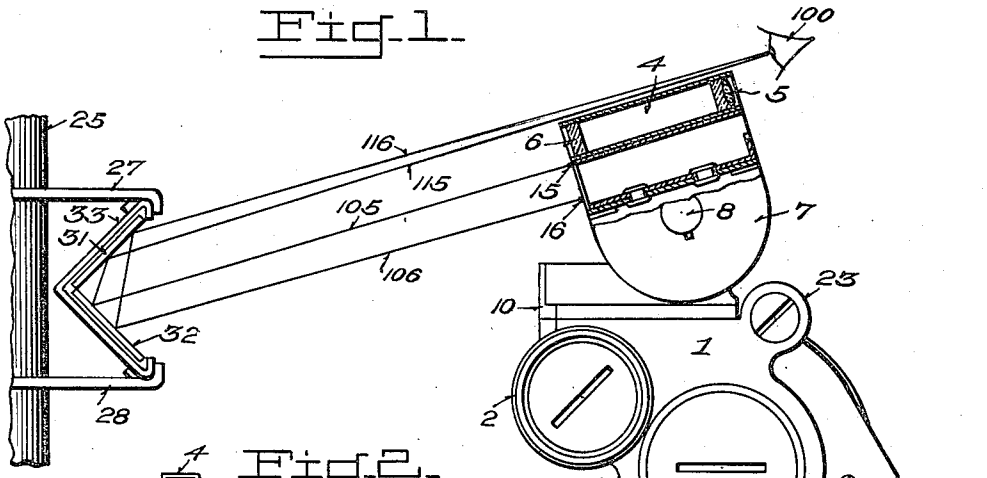


Fig. 2.

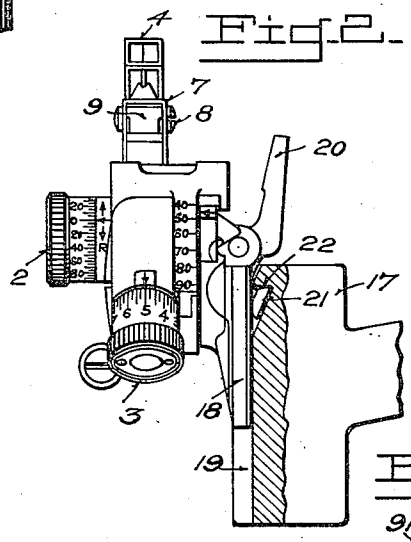


Fig. 4.

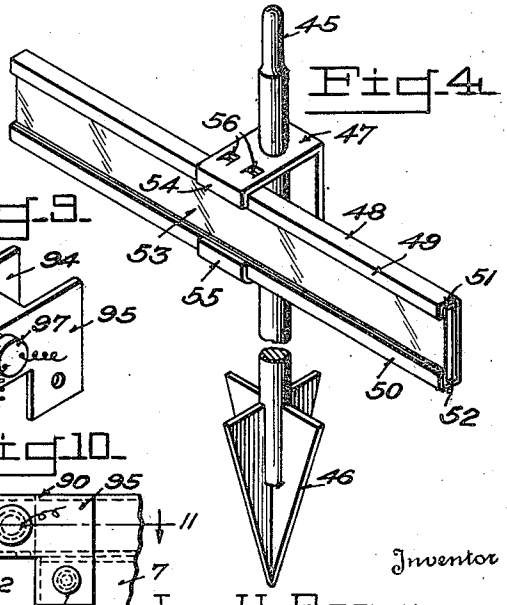


Fig. 3.

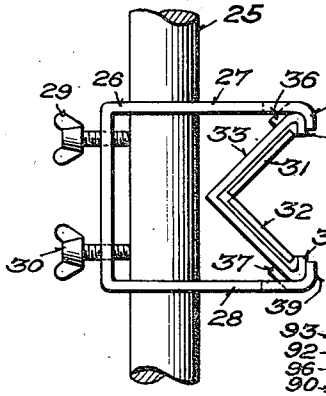


Fig. 9.

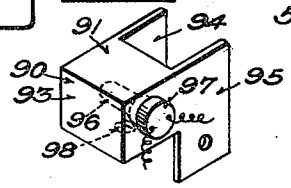


Fig. 10.

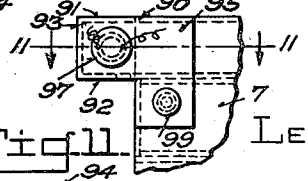
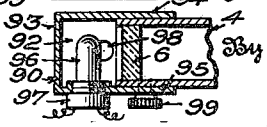


Fig. 11.



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Fig. 6.

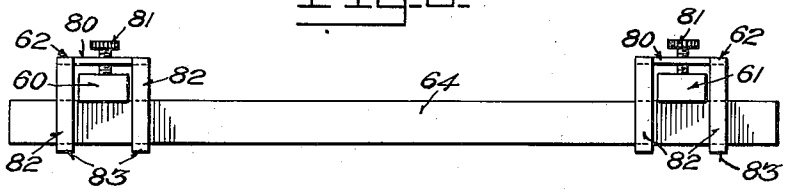


Fig. 5.

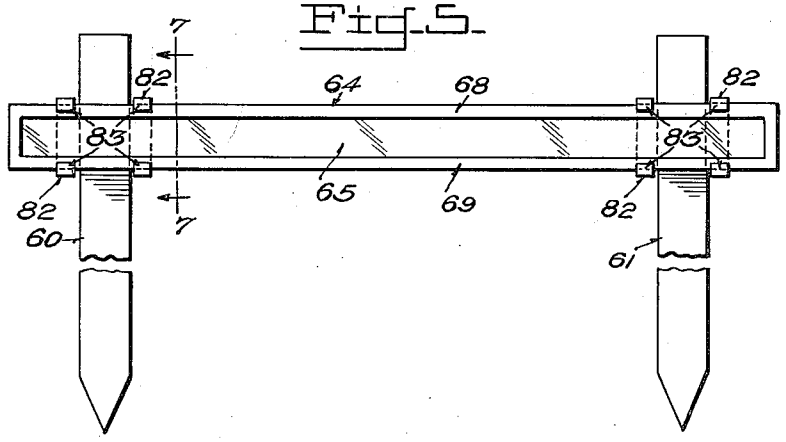


Fig. 7.

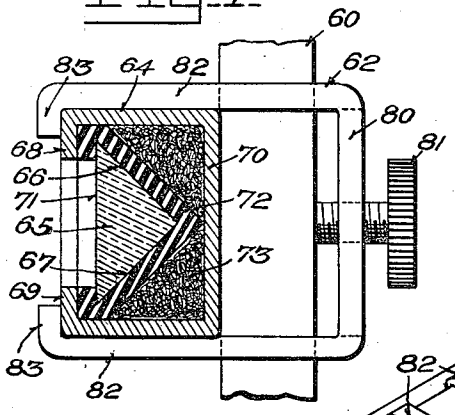
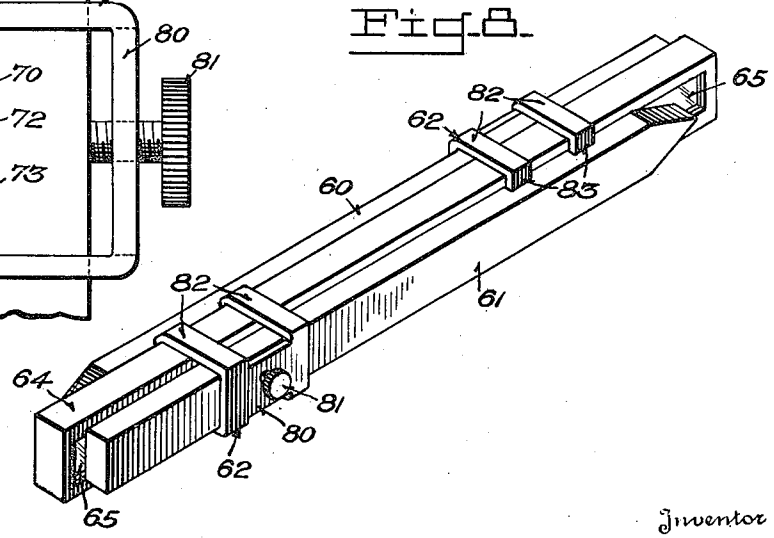


Fig. 8.



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UNITED STATES PATENT OFFICE

2,491,476

COLLIMATING SIGHT AND REFLECTING AIMING POST FOR INDIRECT AIMING OF A GUN

Leo H. Brown, Glenville, Conn.

Application June 9, 1944, Serial No. 539,507

2 Claims. (Cl. 88—2.2)

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

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to fire-control method and apparatus for cannon of all types, particularly mortars, and howitzers.

One form of cannon, namely a mortar, in particular a trench mortar, is referred to hereinafter to explain the application and utility of the invention, although it is to be understood that the invention may be used in indirect firing or indirect laying of other kinds of cannon or means for projecting missiles or projectiles. The invention is particularly useful in connection with controlling the fire of cannon whose projectiles have comparatively low muzzle velocities and which are fired with their bore axes at comparatively large angular elevation above the horizontal, examples of which are mortars of all types and howitzers.

For the purpose of explaining and describing the application and utility of the invention, a particular form of sighting means for sighting on a particular point or on an aiming post has been selected, namely a collimator sight. It is to be understood, however, that any other suitable sighting means for establishing a line of sight may be used instead of a collimator sight, as for example a telescopic sight having a reticle which preferably may be illuminated in any suitable manner.

An object of the invention is to provide improved method and means for setting or adjusting the azimuth of cannon in indirect firing or indirect laying. In indirect firing the target is not visible from the cannon and the regulation or adjustment of the azimuth or traverse and the elevation of the cannon is made in accordance with data or instructions received from an observer who is situated at a point or location from which the effect of the fire, the hits or misses, can be observed. This observer, observing the misses, gives the necessary instructions or data to the gun crew with regard to change of azimuth or change of elevation, or change of both.

The present invention is particularly concerned with method and means for setting the azimuth of the cannon in accordance with data received from the observer mentioned above.

According to the present practice of indirect firing, an aiming post, consisting essentially of a rod planted vertically in the ground, is placed at a distance from a cannon, and a sighting device, e. g., a collimator sight or telescopic sight,

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carried on a part of the cannon which traverses with the barrel is sighted on the post or a mark or light on the post. If now, for example, after a projectile has been fired, the observer reports that the azimuth of the cannon should be changed, let us say, X mils to the right, the sight is moved or rotated X mils in azimuth to the left of the aiming post, while the traversing means of the cannon remains fixed. Then the traversing means of the cannon is operated so as to traverse the cannon with the sight to the right until the aiming post is again in the line of sight of the collimator sight or telescopic sight. It will, therefore, be seen that these operations traverse the mortar or howitzer X mils to the right. In night firing, a small electric light bulb energized by a dry cell or cells, is attached to the aiming post, and serves as the point of the post on which the collimator sight or telescopic sight is sighted.

From the foregoing it will be evident, that two factors may introduce errors. These factors are: (1) the whole cannon may move backward, i. e., further away from the aiming post, under the influence of the recoil in firing, and (2) the whole cannon may also move laterally under the same influence. Either of these movements will cause the line of sight of the collimator to be no longer on the aiming post, except in the case where the line of backward movement of the mortar or howitzer happens to be parallel with the line of sight of the collimator or telescopic sight. Therefore, if a correction of Y mils is now directed or indicated by the observer, and applied to the sight as above explained, the correction applied will be in error by an amount depending upon how much laterally and how far backwardly the cannon has moved. Where the aiming post is located at a large distance from the cannon, these errors are usually ignored, particularly after the cannon has become set in the ground after several firings. However, where the aiming post is at a short distance from the cannon, these errors become material and cannot be ignored when strict accuracy is to be maintained.

Lateral thrust or lateral movement of the cannon also is a material factor in indirect firing, even when the aiming point or aiming post is at a comparatively large distance from the piece, where the cosine of the angle between line of fire and the transverse axis of the whole artillery piece is large since then there would be a large or considerable component of the recoil laterally or parallel with the transverse axis of the piece. This component tends to produce lateral dis-

placement of the cannon, and where large, may introduce errors if the aiming point or aiming post is not sufficiently removed from the cannon. Thus, even with a large distance between the aiming post and the cannon, the error due to lateral displacement of the piece may not be negligible in adjusting or setting the azimuth of the cannon barrel.

From the foregoing it will be seen that in indirect firing or indirect laying of cannon as heretofore practiced, it is essential in the interest of accuracy to place the aiming post or point at a considerable distance from the cannon or sight, e. g., collimator sight, carried thereby. This distance is usually of the order of magnitude of fifty yards. The positioning of the aiming post under conditions of combat may be hazardous, and hence it is desirable to avoid exposure of personnel to this hazard during the time required for personnel to place the post in position and to remove it after firing at the particular location has been completed. The present invention eliminates this hazard, since it permits the aiming post to be placed at a few feet or at a few yards from the cannon without the introduction of errors in sighting due to lateral displacement or backward displacement of the cannon. Thus, according to the present invention, the aiming post may be placed a few feet or a few yards from the cannon in the same pit or trench in which the cannon, e. g., mortar or howitzer, is located or behind the same cover which shields the cannon and the personnel serving it.

The present invention therefore has among its objects the elimination of errors due to backward or lateral movement of the cannon in the azimuthal control or setting in indirect firing thereof.

Still another object of the present invention consists in the provision of an aiming post which can be located at very short distances from cannon, such as mortars and howitzers, while nevertheless permitting accurate control of indirect fire or indirect laying of the piece.

The method of setting the azimuth of a cannon according to the present invention comprises a number of steps or operations.

The first step of the method consists in establishing a fixed plane light reflecting specular surface or mirror having considerable lateral extent or horizontal dimension, at a position removed from the cannon or sighting means carried by it in its traverse. This plane specular light reflecting means may consist of a long narrow mirror, the length or horizontal dimension of which may, for example, be from one foot to three feet in length, depending on the lateral displacement of the cannon, also referred to hereinafter. The plane light reflecting surface may be constituted by two such plane narrow mirrors arranged at a right angle to each other with a longer dimension of each at the vertex of the right angle, or the plane light reflecting surface may be constituted by a long right angle triangular prism, for example, about one foot to eighteen inches in length, and silvered or otherwise coated with a specular material on the faces which intersect to form the right angle. The long dimension of said fixed light reflecting surfaces is horizontally disposed above the surface of the ground in a fixed or stationary position at a distance from the cannon.

The second step of the method consists in establishing a line of sight perpendicular to the lateral extent or direction, i. e., to the horizontal length or dimension, of the said plane light reflecting surfaces. This may be done by placing the line of sight of a collimator in a position to cause the image of the reticle thereof to coincide with or overlap the image produced by said plane light reflecting means of a light emitting or light reflecting fiducial line or point carried in traverse with the collimator sight. This fiducial line or point, generally referred to herein as a fiducial indicium, is preferably placed in the vertical plane containing the line of sight of the collimator sight, although it may be placed near to such plane without introducing appreciable error. The said fiducial indicium is placed in the said vertical plane preferably below the line of sight of the collimator sight. It may be placed immediately below the reticle end of a collimator sight in the vertical plane containing the line of sight, or optical axis, of the collimator sight. It will be understood, therefore, that when the image of the reticle of the collimator sight is superimposed upon the image of the fiducial indicium, the line of sight of the collimator sight is perpendicular to the lateral direction or horizontal dimension of the plane light reflecting surface. Now even though the cannon moves backward in recoil or moves laterally the line of sight of the collimator remains perpendicular to the longitudinal direction of the reflecting surface, regardless whether the direction of recoil is perpendicular to the longitudinal direction of the reflecting surface. Even though the whole cannon may turn in firing about a vertical axis, errors in sighting are not introduced thereby.

The third step of the method consists in applying to the azimuthal reading of the collimator sight the correctional data directed by the observer and then traversing the cannon with the collimator sight until the image of the reticle of the collimator sight and the image of the fiducial indicium are superimposed one upon the other. For example, let it be supposed that the observer instructs that the fire be directed Z mils further to the right. Even if the cannon has moved backward or laterally or both, it is only necessary to change the setting of the collimator sight Z mils to the left, and then traverse the cannon together with the collimator sight until the image of the reticle and the image of the fiducial indicium overlap or coincide. Suppose, however, that the cannon as a whole has rotated about a vertical axis an unknown number of mils (let us say, V mils) to the left, and the correction of Z mils to the right of the previous position is desired. Obviously, traversing the cannon back to the position where the image of the reticle of the collimator sight and the image of the fiducial indicium overlap will traverse the cannon the said V mils to the right, and the azimuth of the cannon will be the same as it was before. Now the correctional data of Z mils to the right may be applied by rotating the sight Z mils to the left and again traversing the cannon to the right until the image of the collimator reticle and the image of the fiducial indicium overlap or come into the desired relative position. From this explanation, it will be clear, that it is even not necessary to traverse the cannon back to its former position before applying the correctional data from the observer, since if the Z mils correction to the right is introduced into the collimator sight azimuth

reading by rotating it Z mils to the left, and then the cannon traversed to the right until the image of the collimator sight reticle and the image of the fiducial indicium overlap, the cannon in one traversing operation is traversed Z mils to the right of its previous firing position.

As was mentioned above, a telescopic or other sighting means for establishing a line of sight may replace the collimator sight referred to above. Where a telescopic sight is used, the reticle in the telescopic sight, whether or not illuminated, serves the same purpose and is used in the same manner as the reticle of the collimator sight.

From the foregoing explanations, it will appear that that dimension of the light reflecting specular surface or surfaces disposed in a horizontal direction is greater than the component of the lateral or sidewise displacement of the cannon along a direction parallel to the plane of the specular light reflecting surfaces or mirrors, since otherwise it would be impossible to dispose the parts of the fire control means so that the line of sight of the collimator sight or other sighting means, after said displacement, meets the said longitudinal dimension perpendicularly. In the absence of said meeting, no image of the fiducial indicium in the vertical plane of the line of sight would be visible.

Referring now in detail to the accompanying drawings illustrating several embodiments of apparatus comprising the invention and suitable for use in practicing the method of the invention,

Fig. 1 is a side elevation, partly in vertical section, of a known collimator sight; and an aiming post constructed according to the present invention, and illustrating how the two co-operate in sighting.

Fig. 2 is a rear elevation, partly in section, of the collimator sight shown in Fig. 1, but on a smaller scale, and also illustrating how the collimator sight may be attached to a part of a mortar that is traversed with the barrel of the mortar.

Fig. 3 is a side elevation of an aiming post, constructed according to the present invention, embodying two long narrow plane mirrors at right angles.

Fig. 4 is a perspective view of another embodiment of the aiming post of the present invention in which a single long plane narrow mirror is employed.

Fig. 5 is a front elevation of another aiming post constructed according to the present invention in which two plane mirror surfaces at right angles, provided by a long triangular prism, silvered on the faces perpendicular to each other, are employed.

Fig. 6 is a top plan of Fig. 5.

Fig. 7 is a cross section on the line 7—7 of Fig. 5, showing the triangular prism in section.

Fig. 8 is a perspective view showing the parts of the aiming post illustrated in Figures 5, 6 and 7 assembled together for transport or storage.

Fig. 9 is a perspective view of an illuminating means which may be placed over the reticle end of the collimator sight, and containing an electric light bulb for illuminating, when necessary, the reticle of the collimator sight and the fiducial indicium on the said sight.

Fig. 10 is a side elevation of part of the collimator sight showing the illuminating means shown in Fig. 9 applied thereto.

Fig. 11 is a cross section on the line 11—11 of Fig. 10.

In Figures 1 and 2 there is shown a known collimator sight 1, which may be transversed and moved in elevation by rotating graduated heads 2 and 3 respectively. Heads 2 and 3 are graduated in mils or degrees as desired. The collimator 4, comprising the usual collimating lens 5 and reticle plate 6, is carried on a head 7. Head 7 is carried on a bolt 8 and fixed for rotation therewith. Bolt 8 passes with a sliding and rotating fit through a hole in the standard 9 of the plate 10 which is traversed by rotating the head 2. This construction enables the collimator 4 to be adjusted in elevation independently of elevating head 3.

According to the present invention fiducial lines or points are placed on the collimator sight, preferably as explained above, below the reticle on reticle plate 6 and in, or substantially in, the vertical plane containing the line of sight of the collimator sight. Such a fiducial line is indicated in Fig. 1 by the numerals 15 and 16, which indicate the extremities of the line. This line may be a narrow white line, or line of other color, and whose image in a plane mirror is easily visible.

The collimator sight 1 is removably mounted on a part 17 of a mortar which traverses with the barrel when the traversing means of the mortar are operated. This mounting is provided by a bracket 18 of the collimator sight which engages within a slot 19 in the traversing part 17. The collimator sight 1 carries a latch 20 having a catch 21 which engages beneath a shoulder 22, for the purpose of releasably holding the collimator sight on the said part 17.

A cross level 23 and a longitudinal level 24 are carried by the collimator sight 1 and are used to place the plane of traverse of the collimator horizontally. When angles of azimuth are referred to herein, it is of course understood that they are measured in a horizontal plane. When, therefore, the sight is adjusted level according to the two levels 23 and 24, the plate 10 carrying the collimator moves in a horizontal plane when the collimator 4 is traversed by rotating the knob or head 2.

Referring now to the modification of the aiming post illustrated in Figs. 1 and 3, there is shown a post 25 which may be planted vertically in the ground at a position removed from the mortar. On the post is mounted a U-shaped bracket 26. The post 25 passes through openings in the two arms 27 and 28 of the bracket, and the bracket may be secured in any desired position along the length of the post by means of butter-fly screws 29 and 30 which fit threaded openings in the bracket. Turning the screws 29 and 30 until they tightly engage the post 25 fixes the bracket 26 in position on the post.

Two long narrow mirrors 31 and 32 are mounted, at right angles to each other, in a long V-shaped trough-like member 33. The edges 34 and 35 of this trough-like member may be turned over the edges of the mirrors, as shown in Figs. 1 and 3, to protect said edges of the mirrors.

The two bracket arms 27 and 28 have tongues 36 and 37 punched from them, and between these tongues and the inwardly bent ends 38 and 39 of the bracket arms 27 and 28 is held the trough-like member carrying the long narrow mirrors 31 and 32.

The aiming post or means illustrated in Fig. 4, and constituting another modification of an aiming means constructed according to the invention,

comprises a post 45 having a four bladed spear head 46 at the bottom end to enable the post to be easily planted vertically in the ground and to hinder or prevent rotation of the post after it is planted in vertical position at a point removed from the mortar. This modification of the aiming post is also provided with a bracket 47 that is in all respects similar to bracket 26 disclosed in Fig. 3. In the bracket 47 is mounted a long narrow channel member 48 with edges 49 and 50 bent inwardly to form grooves 51 and 52 for the reception of the long narrow plane mirror 53. The channel member 48 is held in the bracket 47 between the inwardly bent portions 54 and 55 of the arms of the bracket and tongues punched inwardly from each arm of the bracket, two of which tongues are indicated by the numerals 56.

The modification of the aiming post or aiming surface illustrated in Figs. 5, 6, 7 and 8 comprises two pointed posts 60 and 61, of like construction, two clamps 62 of like construction and a long channel member 64 in which a long right angle triangular glass or plastic prism 65 is mounted lengthwise of the channel member.

The faces 66 and 67 of the prism 65 meet at an angle of ninety degrees, and are silvered, whereby two plane mirrors at an angle of ninety degrees are obtained.

Channel member 64 is provided with inwardly bent marginal portions 68 and 69, between which and the bottom 70 of the channel member the prism 65 is mounted. The face 71 of the prism is so disposed that it is parallel with the bottom 70 of channel member 64. The prism is mounted in channel member 64 on a rubber carrier 72 to which it may be cemented, and resilient packing such as sponge rubber, wool or kapok 73 is packed between the rubber carrier 72 and the bottom 70 of channel member 64.

Each of the clamps 62 comprises a back portion 80 provided with a thumb screw 81 which fits and passes through a correspondingly threaded hole in back portion 80. Four fingers 82 extend from back portion 80 in a manner clearly shown in Figs. 5, 6, 7 and 8. Each of the fingers 82 at its free end is provided with an inwardly bent tip 83.

When the modification of the aiming post or surface illustrated in Figs. 5, 6, 7 and 8 is in use, the various parts are assembled as shown in Figs. 5, 6 and 7. However, when it is desired to transport or store the parts, they are advantageously assembled as shown in Fig. 8.

In using all of the modifications of the aiming posts herein described, the long dimension of the mirrors is disposed substantially horizontal with reference to the earth.

The illuminating means for illuminating, when necessary, the reticle of the collimator sight and the fiducial indicium is shown in Figs. 9, 10 and 11. This illuminating means comprises a substantially cubical box 90 consisting of top portion 91, bottom portion 92, end portion 93 and side portions 94 and 95. The side portions 94 and 95 extend rearwardly of the cubical portion and then downwardly, as shown in Fig. 9, in order to form two spaced wings adapted to fit and slide over the end of collimator 4 and head 7 of the collimator sight, as shown in Figs. 10 and 11. A small electric light bulb 96 is located in the cubical box 90 and is carried in a socket 97 mounted in an opening in the side 95 of the box 90. The bottom 92 of the box 90 is provided with an opening 98 which enables light to pass from the box to illuminate, when necessary, the fiducial line 15, 16 situated below the reticle plate 6 of collimator 4. The illuminating means is held on the sight in the position illustrated in Figs. 10 and 11 by means of a thumb screw 99 threaded in the wing portion of the side 95 of the box 90. Turning this screw into tight engagement with the head 7 of the sight clamps the illuminating means to the sight. The illuminating means is used when ordinary solar light is not sufficient to render the image of the collimator reticle and the image of the fiducial indicium clearly visible.

The use of two plane mirrors at an angle of ninety degrees to each other, as shown in Figs. 1, 3, and 7, has the advantage that any light ray in a plane normal to said plane mirrors and incident at any angle on either of them, and which causes deflection of the ray to the other of said mirror, is reflected from the other of said mirrors in a path which is parallel to the path of the said ray. This condition is clearly illustrated in Fig. 1, which illustrates the use of the invention but with the mirrors 31 and 32 shown much nearer to the collimator sight 1 than they would be in actual use. In this figure the eye of the user in sighting is indicated by the numeral 100. A light ray 105 proceeding from point 15 of the fiducial line is reflected by the two mirrors as ray 115 which is parallel to ray 105. Similarly a light ray 106 proceeding from point 16 of the fiducial line is reflected by the two mirrors as ray 116 which is parallel to ray 106.

Rays 115 and 116 enter the eye 100 of the user who simultaneously seeks to view the image of the fiducial line and the image of the reticle of the collimator 4, and to superimpose them.

The manner of use of the apparatus for practicing is clear from the preceding disclosures. However, in conclusion, an illustrative example of use of the invention is given. Let it be supposed that the aiming post of the invention illustrated in Figs. 1 and 3 is located in the second quadrant about midway between 90° and 180°. The mortar is layed according to the firing data and then the collimator sight is adjusted by turning knob or head 2 until the eye 100 of the user sees the image of the reticle of the collimator sight 1 overlapping or superimposed upon the image of the fiducial line 15, 16 produced by mirrors 31 and 32. The line of sight of the collimator 4, or the vertical plane containing it, is now perpendicular to the horizontal dimension of the mirrors 31 and 32, and in a plane normal to both of the surfaces of the said mirrors.

The mortar is now fired. The observer spots the shot and advises the mortar crew how many mils the azimuth of fire should be changed. Let it be supposed that the observer directs that the azimuth be changed five mils to the right. The knob or head 2 is then turned so as to traverse the collimator 4 five mils to the left, after which the traversing means of the mortar is actuated to traverse the mortar to the right, together with the whole collimator sight 1 attached to part 17 which traverses with the mortar, until the eye 100 of the user again sees the image of the reticle of the collimator 4 superimposed upon the image of the fiducial line 15, 16; and then the traversing of the mortar is discontinued. The mortar then has been traversed five mils to the right in accordance with the directions of the observer.

I claim:

1. For use in the indirect aiming of a gun mounted for elevation about a normally horizontal axis upon a part trainable about a normally vertical axis, the combination with said

gun, of a collimating sight mounted upon said part for movement therewith and angular movement relatively thereto about normally vertical and horizontal axes, a sighting mark on said sight in the same vertical plane as the reticle of said sight, an elongated plane reflector, and means mounting said reflector adjacent and independently of said gun remote from the vertical plane through the bore axis of said gun, said reflector being mounted with its elongated dimension substantially horizontal and all lines of its specular surface parallel to said dimension perpendicular to a line between said mirror and sight, to thereby reflect an image of said sighting mark into alignment with said reticle.

2. For use in the indirect aiming of a gun mounted for elevation about a normally horizontal axis upon a part trainable about a normally vertical axis, the combination with said gun, of a collimating sight mounted upon said part for movement therewith and angular movement relatively thereto about normally vertical and horizontal axes, a sighting mark on said sight in the same vertical plane as the reticle of said sight, an elongated plane mirror, and means mounting said mirror adjacent and independently of said gun remote from the plane of fire, with its longitudinal axis horizontal and its reflecting

surface perpendicular to a line between said mirror and sight, to reflect an image of said sighting mark into alignment with said reticle.

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