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H. OMMUNDSEN.
SIGHTING OF SMALL ARMS AND ORDNANCE.
APPLICATION FILED NOV. 22, 1911.

1,055,551.

Patented Mar. 11, 1913.

3 SHEETS—SHEET 1.

Fig. 7

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Fig. 2

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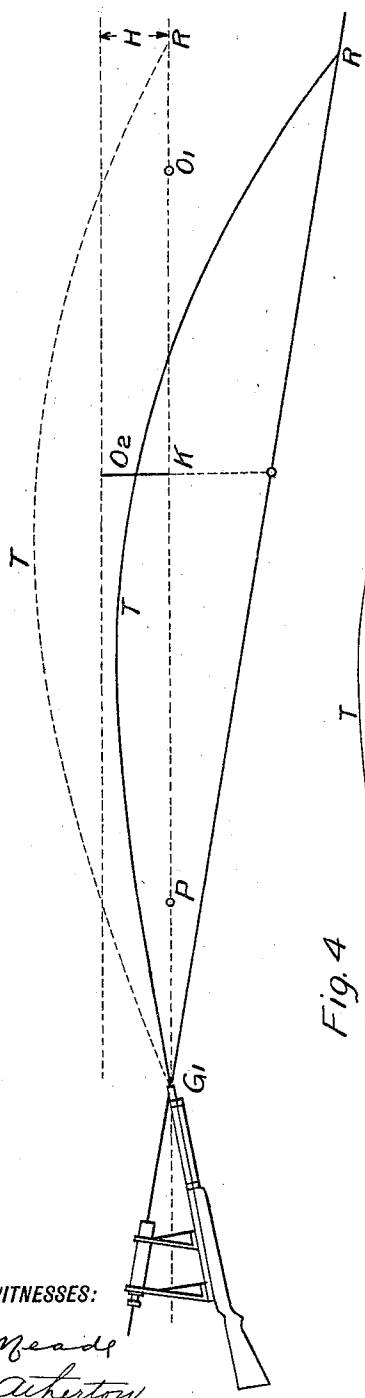
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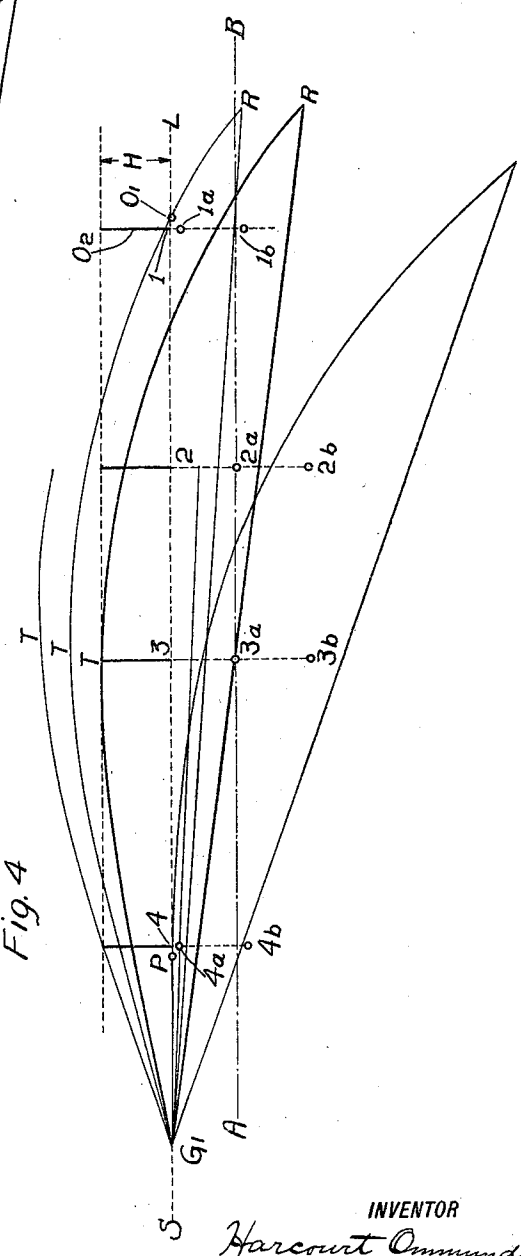
Patented Mar. 11, 1913.
3 SHEETS-SHEET 2.

Fig. 3



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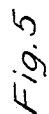
Fig. 4



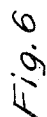
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Specification of Letters Patent. Patented Mar. 11, 1913.

To all whom it may concern:

In the application of sights to a gun it has heretofore been the practice to arrange the sighting devices in such relation to the weapon that the intersection of the sight line by the calculated trajectory shall occur at the assumed distance from the gun of the object aimed at. Thus in the accompanying diagram, Fig. 1, for a gun the muzzle of which is at G_1 , the trajectory T intersects the sight line SL at R , the latter indicating the assumed location of the object O aimed at, that is to say, its location for an estimated "range" G_1R . If the range had been under-estimated and the object were actually at the place X just beyond R the projectile would fall short of it. If on the other hand, the object—assumed throughout the description of Fig. 1 as always projecting up from the sight line to a height a little less than the dimension H —were to be situated at O the projectile would pass over it, as it would, also, were the object to be situated anywhere on the sight line between the points O_1 and P . The object will be vulnerable only when it is at one end of the sight line between the points O_1 and R or at the other end between the points P and G_1 and it is to be noted that the distances O_1R and PG_1 are only the extremes of the total range G_1R . Thus it will

In the example illustrated in Fig. 1 the scale to which the rifle is drawn is magnified and vertical heights are exaggerated considerably, relatively to horizontal distances. This example is typical of similar circumstances which will be found to exist in relation to various guns for the various ranges of each, in cases wherein, as in the example, the trajectory rises to a point much higher above the sight line than is the top of the object.

The present invention consists mainly in the combination with a gun of a sighting device or sighting appliances hereinafter fully described which are adapted to be used in connection with a system of aiming which, being so far as I am aware also new, is also hereinafter fully described. Of the sighting appliances hereinafter described that which I have termed (where a distinction appears desirable) the principal sighting device is of any convenient kind, say, for instance, the sights in a service rifle having a back-sight carrying a notch or aperture and having also a barleycorn fore-sight, and according to this invention is so adjusted relatively to the weapon that the intersection of the sight line of this principal sighting device by the corresponding calculated trajectory shall always occur at a distance from the gun greater than the greatest range for which said device is intended to be employed in actual use. The

diagram Fig. 2 illustrates such a combination; in it the gun muzzle is at G_1 , its sighting device whatever it may be, is indicated at S_1 and is in this instance assumed to be fixed to the weapon at such an angle to the barrel axis that the intersection of its sight line SL with the trajectory T shall occur at R. The trajectory T is the same and its relation to the sight line SL is the same as in Fig. 1, and the object O_2 is the same as the object O in Fig. 1. But the weapon of Fig. 2 and its sighting device, situated as described in relation to it, are in the following description assumed to be intended for use not upon an object situated at R, nor upon objects situated within the extreme portions such as G_1P or O_1R of the range. The sighting device here shown is intended for use against an object situated anywhere on the line SL within the portion O_1P of the maximum range G_1R for which said device is constructed; that is to say it is so constructed and so adjusted in relation to the weapon that when it is used in the manner hereinafter described it will enable the user of the weapon to obtain a correct aim at an object of the height H if situated anywhere along the sight line SL between the two points P and O_1 . Thus my new gun sight is available for use over a very large proportion of the range covered by the weapon when employed in accordance with the system of taking aim hereinafter described.

I will now explain the geometrical principle upon which the said system of taking aim is based. Let the closed figure $G_1 T R O_1 P G_1$ receive an angular shift in its own plane out of its present position about an axis which is perpendicular to the paper and passes through the point of intersection of the sight line and the gun-barrel axis. (Such an angular shift is indicated in Fig. 3.) Simultaneously let the object O_2 be prevented from partaking in that motion but let it be moved upright toward G_1 along a stationary line occupying the present position of the sight line SL. For various positions of the object O_2 during such movement, say its positions at K in diagram Fig. 3 and 1, 2, 3 and 4 in Fig. 4 (which Figs. 3 and 4 are respectively the diagram Fig. 2 modified to illustrate the assumption by the closed figure of various positions in its angular shift) there can be found by trial (see now Fig. 4) two extreme positions of the closed figure $G_1 T R O_1 P G_1$ for each position 1 or 2 or 3 or 4, in which extreme positions respectively the shifted trajectory will be just within the upper and lower limits of the object. Take position 1 of the object for example; directly below the object when it is in position 1 two points $1a$ $1b$ may be found such that when the line G_1R passes through the point $1a$ the trajectory will intersect the top of the object O_2 and when the

line G_1R passes through the point $1b$ the trajectory will intersect the bottom of the object.

For all angular positions of the line of aim G_1R which are intermediate between the two positions so defined the trajectory will intersect the object at some corresponding point. If, therefore, the line of aim G_1R be directed to any point lying between $1a$ and $1b$ the gun will be thereby laid upon an object having the height H and situated at a point 1. A similar pair of positions $2a$ $2b$ and so on for other shifted lines G_1R will be found beneath each of the other positions 2, 3 and 4 of the object, the general rule for finding these points being that the point Nb will be situated a distance below the sight line SL approximately equal to the height above that line of the point in the trajectory (before it is shifted) which is vertically above the point Nb and that the point Na will stand above the point Nb by a distance equal to H. It will be understood that the terms Na and Nb in this connection are generalized forms of $1a$ $1b$, $2a$ $2b$, etc., shown upon the diagram Fig. 4. I have chosen such a position for the sight line SL that the greatest vertical height of the trajectory above that line shall not exceed $2H$ that is to say, shall not exceed twice the height of the object on which the gun is to be laid and it is clear from the diagram Fig. 4 that a straight line A B can be drawn which will pass between the points $1a$ and $1b$ and between the points $2a$ and $2b$ and between the points Na and Nb wherever these are set out within the range between P and O_1 . This line A B will therefore indicate below each of the positions 1 or 2 or 3 or 4, a point to which the line of aim can be swung with the certainty that when said line of aim intersects A B at the point immediately underneath the object, the trajectory will be within the object. Between the points G_1P and below all the points to the right of O_1 the intersections of the shifted line of aim with A B will occur at positions above which the trajectory will not be within the object. But the shifted trajectories will intersect the object at all points of that portion of the range which lies between P and O_1 , and I have discovered that with modern weapons having very flat trajectories, the range thus given to a sight, adjusted once for all and for instance fixed in its adjusted position, is so extended as to constitute the sight so made and used a great improvement upon the adjustable sights in present use, which require separate and precise adjustment for every alteration of point in the range occupied by the object O_2 . It will be observed that I have suggested for the line A B a position in which it is parallel to the sight line SL. The reason for this choice is that in that position the

line A B is the geometrical expression of a very simple rule which may be laid down for the guidance of the marksman. His purpose being, as has been above explained, to direct his line of aim G_1R through some selected point in the line A B, the marksman need only consider that he has to move his weapon so as, for each position of the object, to bring his line of aim which is in fixed relation to the weapon, down to a certain settled distance below the object, wherever the object may be within the limits such as $P O_1$ for which the sighting device under consideration is set. That settled distance is, of course, the distance, settled by the design of the sighting appliance, between the sight line SL and the A B line, and that distance will of course be made known as for instance to marksmen by the maker of the sighting appliance; it may, for instance, be marked upon the sight. I may take, for example, the case of a military rifle to illustrate this point. I will assume that in designing the sighting appliance the maker has first laid out the trajectory given by the rifle to which the sight is to be applied. Next that he has laid down a principal sight line SL so that the greatest vertical height between the trajectory and that sight line will be 11 ft. 6 in. He will then adjust the back-sight permanently to this sight line SL so defined and will tell the marksman that his A B line lies 5 ft. 9 in. below the line joining the foresight of the rifle to the horizon. Then the marksman will know that he may for all practical purposes identify the object point on this line at any distance within the range for which the sighting appliance is certified as being a man's height below the level of the surface of the ground.

I may give another illustration of the application of my principle by discussing the case of a sporting rifle adapted, I will say, for the purpose of deer stalking and I will assume that the sighting appliance is to be so designed as to direct the marksman's aim to an object having a diameter of 1 foot and situated with its lowest part 3 feet above the ground. For such a case the designer when laying out the diagram of Fig. 4 will so place the new SL line (as in one of the positions G_1R) that the trajectory preferably shall have a maximum height above the ordinary sight line greater by 1 foot than the elevation above that line of the bottom of the object proper. He may, for example, choose to place his SL line in such a position in relation to the chosen trajectory that this maximum distance between the trajectory and the ordinary sight line shall amount to 4 feet. He will next lay out a series of points Na by the method of computation hereinbefore explained and beneath them he will set off a corresponding number of points Nc each one foot below its correspond-

ing a point. He will then determine his A B line by selecting the longest straight line parallel to SL which lies wholly between the pairs of a and c points. It will be found upon constructing this diagram that the A B line so determined will lie upon the surface of the ground. The direction given to the marksman in such a case would therefore be to aim at the foot of the deer which he desired to hit in a vulnerable point. It is to be observed however that such a sighting appliance would be certified for use only within a more limited range than if the object were of the full height of the deer and presented a correspondingly extended vulnerable surface. The rule by which the extent and position of this available range may be ascertained will now be explained. With this object I now proceed to give a convenient rule by which a sighting appliance may be adapted according to my invention to use under an arbitrarily selected system of indirect aiming.

In the diagram Fig. 5 let E E be a horizontal line representing the level on which the object aimed at stands and let $Hd Hd$ be a line parallel to E E which passes through the top of the object. Also let the line A B be drawn at any given level below E E at which it is convenient to the marksman to direct his aim and in reference to which therefore he desires his weapon to be sighted. I proceed to construct such a sighting appliance as he requires by the following rule. I first, lay down upon the diagram my principal sight line SL parallel to A B and at a height above the same equal to the height of $Hd Hd$ above E E, equal, that is to say, to the height of the object upon which the gun is to be laid. Next upon this principal sight line I place a line $G_1 T R$ representing the trajectory of the given weapon drawing the same to scale and selecting such a segment of the trajectory that its culminating point T shall have a height above the line $Hd Hd$ equal to the height of the object (*i. e.* equal to the distance between E E and $Hd Hd$). From the points p and o in which the trajectory intersects the line $Hd Hd$ I draw perpendiculars which meet the sight line SL in the points P and O_1 . The sight line SL so divided gives all the data required for the construction of the desired sighting appliance for if the sighting appliance be correctly set and adjusted for direct aiming with the range represented by the distance G_1R measured along the principal sight line it may be certified for use upon the method of indirect aiming at the object line A B within the range defined by the section $P O_1$ of the said sight line. It will be seen that the directions above given for the sighting in the cases chosen for illustration of a military rifle and a sporting gun are particular applications of this rule.

On the same weapon as that to which Fig. 4 applies there may be a second sighting device similarly set to that already described in relation to the said figure but for ranges greater than $G_1 O_1$, and yet another for ranges which may be considerably less than $G_1 O_1$. The A B line for a greater range in which of course the trajectory rises higher from the sight line than in the former instance would be at a lower level relatively to the line $G_1 L$ of Fig. 4 than is the line A B shown in that drawing.

It will, of course, be obvious from the foregoing description that there is a certain range indicated by the point R in my diagrams for which my improved sighting appliance can be employed as an ordinary sight for direct aiming at the object. Though in Fig. 5 the trajectory keeps within the object when the latter is between the limits $P O_1$ if dropped vertically, whereas in Figs. 3 and 4 it has angular shift, yet there is no disagreement between the essential considerations underlying all those figures. Let it be assumed that in Fig. 3, for example, the trajectory has been displaced by the depression of the line of aim through an angle α . Then it is obvious that the point of intersection of the displaced trajectory with the vertical plane approximately normal to the direction of the projectile's flight in which the object stands will have been depressed by a vertical distance very nearly equal to $\tan. \alpha$ multiplied by the distance $G_1 O_2$. It is also obvious that the trajectory would pass through the same point in the object plane if it were depressed not by angular displacement but by bodily displacement parallel to itself through a vertical distance equal to this given vertical distance $\tan. \alpha \times (G_1 O_2)$. Therefore Fig. 5 may be taken to be the equivalent of Fig. 3 for the purpose of the calculations here in question and Figs. 3 and 4 may be taken to be equivalent to Fig. 5 for illustrating the practical application of my invention.

The trajectory, shifted as above described, will alter its position relatively to the earth, and may slightly alter its form; but within practical limits the alterations in the form of the trajectory are negligible and no material error will result from assuming, as in the foregoing demonstration, that the form of the given trajectory suffers no alteration by being shifted nearer to or farther from the earth's surface.

In the foregoing examples it is proposed that the line of aim should be directed, for all objects within appropriate range to a predetermined distance below the object; a sighting device adjusted for use on this principle is herein distinguished as a "principal" sighting device. It will of course be understood that the marksman may be as-

sisted in taking aim with such a principal sighting device by a mirror or other optical appliance adapted to project an image of his object to a position in which it will offer a visible mark upon which he may lay his line of aim instead of having to lay it by estimation on the position of an imaginary A B line.

It is within this invention to employ what will herein be termed a "supplemental" sighting device in order that the gunner may not need to estimate the position below the object of the point toward which the principal sight-line *i. e.* the line of the principal sight, must be directed, that is to say, for instance, in order that he need not estimate the position of the imaginary line A B of the preceding examples. This supplemental sight would be so disposed and so kept in relation to the weapon that when the line of aim, see Fig. 4, intersected the point on the line A B immediately below the object O_2 in any position of the latter on SL, the line of the supplemental sight would cut the bottom of the object or some other point in fixed relation thereto identified by the supplemental sighting device.

The diagram, Fig. 6, illustrates a principal sighting device PS with a line of sight SL. The principal sighting device is trunnioned at t upon a standard S_t to the upper end of which a supplemental sight S_u is similarly trunnioned. The principal sight and supplemental sight are connected by a coupling rod CR parallel with and of a length equal to that of the line connecting the two trunnions so that for any angular motion given to the principal sight PS the supplemental sighting device S_u originally set parallel with it will be maintained in parallelism. The vertical distance between the trunnion t of the principal sight and the trunnion t_s of the supplemental sight is equal to the vertical distance of the A B line below the sight line SL. If this distance has to be altered then the vertical distance between the principal sight and the supplemental sight must be altered to correspond. When the supplemental sight is present there need be no principal sight, but the supplemental sight is laid out and operated with regard to a principal sight line, which latter is in fixed relation to the weapon; the position of the principal sight in relation to the gun need not however be indicated by an actual sight.

If when the old system of sighting has been used a range has been wrongly estimated, use of the sights erroneously set by that wrong estimate is misleading and accurate shooting cannot be had. But with a gun to which is applied a sight set in such relation to it as is exemplified by the foregoing description, exact estimation or even approximate estimation of the range by the

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gunner is unnecessary, and the gunner has not any adjustment of the sight to make. All that is required of him is that he should not use the sight for ranges greater than the particular maximum range or less than the particular minimum range for which its relation to the weapon has been fixed; it will serve him for all ranges (none of which he need know) intermediate between these, so long as he aims at the predetermined distance below the object with his principal sight, or at the base of it if he is using the supplemental sight.

What I claim as my invention and desire to secure by Letters Patent is:—

1. The herein described improvement in the art of sighting guns, which consists in fixing the angle of adjustment between the barrel axis and the sight line to produce a trajectory curve having a vertex whose height above the sight line is greater than the height of the objective and in depressing the sight line below the objective a distance equal to the height of the vertex minus the height of the objective, whereby the trajec-

tory is caused to intersect an objective anywhere within the length of a chord intersecting the trajectory at a distance below the vertex equal to the height of the objective.

2. The herein described improvement in the art of sighting guns which consists in fixing the angle of adjustment between the barrel axis and the sight line to produce a trajectory curve having a vertex equal to double the height of an objective and in depressing the sight line below the objective a distance equal to the height of the objective, whereby the trajectory is caused to intersect an objective anywhere within the length of a chord intersecting the trajectory at distances above the sight line equal to the height of the objective.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARCOURT OMMUNDSEN.

Witnesses:

H. D. JAMESON,
O. J. WORTH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."