

Improved "moving red dot" sighting device.

The invention concerns a "moving red dot" sighting device.

5 One of the most frequently used types of sighting devices for firing arms applies what is called the red dot technique, which consists in projecting, through the sighting optics, a light point, or more generally a light reticle, in such a manner that the shooter only has to
10 align this point visually with the target so as to fire precisely without any parallax error.

Traditionally, we talk of a "red dot" to indicate the light reticle used in this type of sighting device.

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The actual color of the reticle may vary, provided it is visible.

Moreover, the red dot is not necessarily a dot.

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In what follows, the term "red dot" will thus be used in the broad sense to indicate the light reticle, whereby the sighting device can use any visible light source whatsoever and any form of reticle.

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Applying the so-called red dot technique to the firing of ammunitions that have a non-flat ballistic trajectory, as is the case when firing grenades, requires the realization of a moving red dot whose height must be adjusted as a
30 function of the distance of the target, such that the

shooter obtains the correct elevation of his fire arm by aligning the displaced dot with the target.

What makes it difficult to realize a sighting device with a
5 moving red dot is that the range and angular resolution required for firing grenades up to several hundred meters require expensive and sizeable devices.

The so-called "moving red dot" sights with which have been
10 introduced so far for firing ammunitions with a curved trajectory are usually based on the use of an LCD screen or a series of LEDs placed in the focal plane of a lens, whose moving image is superimposed in the sighting field of the shooter by a system of fixed mirror or prism and a
15 beamsplitter.

Given the elevation angle to be covered, for example of more than 30° in the case of a low-velocity grenade, and the required angular resolution, such a system takes up
20 tens of millimeters in width and in height, which is quite bulky.

A disadvantage of such a bulky sighting device is that it is not very appropriate to be used on an individual light
25 fire arm.

Another disadvantage of such a sighting device is that, when it is placed on the upper rail of a gun, it is usually not compatible with the use of an external scope and it
30 cannot be used when aiming with two eyes open.

Yet another disadvantage is that the existing sighting devices of this type are usually not fully ambidextrous.

The invention aims to remedy one or several of the above-mentioned disadvantages and to provide an improved sighting device with a moving red dot which is compact and which can be used on an individual fire arm.

This aim is reached according to the invention by an improved "moving red dot" sighting device, comprising a fixed light source and a reflecting blade, whereby the light source produces a collimated light beam which is projected onto the reflecting blade so as to obtain a red dot or reticle visible to the shooter thanks to the reflection on the reflecting blade, whereby the beam is projected onto the reflecting blade by means of a rotating mirror whose inclination angle in relation to the light beam can be adjusted.

In order to aim at a target, the shooter observes the target while searching the right elevation for his fire arm at which the red dot is aligned with the target, which is a sign that the fire arm is situated in the right firing position.

The shooter can aim with two eyes open by observing directly the target with the non-aiming eye and the red dot projected onto the blade with the aiming eye.

However, the reflecting blade is preferably a semi-transparent beamsplitter plate, which enables the shooter

to observe the target as well as the red dot through the beamsplitter with the aiming eye, while the shooter can also aim with two eyes open, whatever he prefers.

- 5 The sighting device preferably comprises a device to adjust the inclination angle of the rotating mirror in relation to the light beam, which makes it possible to adjust the sighting device by adjusting the angle of the mirror as a function of the distance of the target and the type of
10 ammunition.

For clarity's sake, a few embodiments of an improved "moving red dot" sighting device according to the invention are described hereafter as an example only without being
15 limitative in any way, with reference to the accompanying drawings, in which:

- figure 1 is a schematic side view of an improved sighting device according to the invention;
20 figure 2 is a section according to line II-II in figure 1;
figure 3 represents the sighting device from figure 1, but in a firing position;
figure 4 represents a variant of a sighting device
25 according to the invention;
figures 5 and 6 represent views in the respective directions of the arrows F5 and F6 in figure 4;
figure 6 corresponds to figure 5, but for another position of the fire arm;

figures 7 and 8 are two views similar to those in figures 1 and 2, but for a variant of a sighting device according to the invention;

5 figure 9 is a view similar to that in figure 5, but for a sighting device according to figures 7 and 8;

figure 10 is another variant of figure 1;

figure 11 is a view according to arrow F11 in figure 10;

10 figures 12 and 13 are figures similar to figure 11, but for targets at a larger distance;

figure 14 is a variant of figure 11.

Figures 1 and 2 represent an improved "moving red dot" sighting device 1 which comprises a case 2 to be mounted on
15 a fire arm 3, whereby the case 2 extends longitudinally, mainly parallel to the axis of the barrel of the fire arm 2.

Inside the case 2 is situated a fixed light source 4,
20 producing a collimated light beam 5 whose optical axis X-X' is in this case parallel to the axis of the barrel of the fire arm 3.

In the given example, the light source 4 is a collimator
25 composed of a converging lens 6 and of a lamp or another luminous source 7 of quasi punctual shape with reduced dimensions, for example in the order of one tenth of a millimeter, situated in the focal point 8 of the lens 6 and producing the red dot.

The collimated light beam 5 has a diameter A in the order of 15 to 20 millimeters, which offers the advantage that the cross dimensions of the width and the height of the sighting device 1 are reduced in relation to the known
5 sighting devices.

A mirror 9 is placed in the collimated beam 5 at an angle B in relation to the optical axis X-X' of the produced light beam 5.

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The mirror 9 is mounted in a rotating manner in the case 2 and it is fixed to that end on a transversal shaft 10 mounted in a rotating manner between the side walls 11 of the case 2.

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One far end 12 of the shaft 10 of the mirror 9 goes through one of the lateral walls 11 of the case 2 and is provided with an adjusting device 13 for the inclination angle B of the rotating mirror 9 in relation to the produced light
20 beam 5, for example in the form of a turning knob with which the shooter can position the mirror 9 as a function of the distance of the target.

The above-mentioned control button 14 will be provided with
25 a scale 15 to that end, representing the distance of the target.

In order to make the adjustment more precise, one can add a mechanical demultiplication to the device, such that a
30 rotation of the button 14 results in a smaller rotation of the mirror 9.

Different adjusting buttons comprising scales that are appropriate to different types of ammunition can be realized so as to take the ballistic characteristics thereof into account.

The light beam 5 is projected through a window 16 in the case 2 onto a reflecting blade 17 so as to produce a red dot or reticle, visible to the shooter in the reflecting blade 17 which is mounted on a far end 18 of the case 2 at a fixed angle C of for example 45° , in relation to the optical axis X-X' of the produced light beam 5.

In the given example, the reflecting blade 17 is mounted on the case 2 by means of a rotary hinge 19 which makes it possible to flip down the reflecting blade 17 on the case 2 of the sighting device 1 when the latter is not operational, such that the whole becomes more compact.

The reflecting blade 17 is preferably a beamsplitter that is semi-transparent.

The use and working of the sighting device 1 are as follows.

When in rest, i.e. when aiming along the axis of the fire arm 3 with an elevation E that is zero, as represented in figure 1, the initial angle B of the mirror 9 is preferably 45° . The angle D is at that time 0° .

The shooter 18 estimates the distance of the target and sets the appropriate inclination B of the mirror 9 by means of the graded control button 14.

5 The light beam 5 is projected onto the reflecting blade 17 and is reflected as illustrated in figure 3 towards the shooter so as to produce a red dot or reticle that the shooter can observe to infinity when the eye of the shooter is situated in the light beam 5 reflected by the reflecting
10 blade 17.

As the mirror 9 turns, the deviation of the angle D of the beam amounts to two times that of the angle B of the mirror 9. In other words, when the mirror 9 turns for example 15°
15 in relation to the position of rest of 45°, the angle D increases from 0° to 30°.

The inclination B of the mirror, which is a function of the distance of the target, thus determines the angle D at
20 which the red dot can be seen by the shooter, and thus the elevation angle E that is provided to the fire arm 3, as represented in figure 3, when the shooter aligns the red dot or the reticle with the target 21 which, in the case where the reflecting blade 17 is a semi-transparent
25 beamsplitter, is visible through said blade 17.

If the reflecting blade is not semi-transparent, the shooter will have to aim with both eyes open in order to observe the target with one eye and the red dot with the
30 other.

Also, if the back of the semi-transparent reflecting blade is dirty and cannot be aimed through, the shooter can always aim with both eyes open.

- 5 An advantage of the sighting device 1 according to the invention is that, since quasi punctual luminous source 7 is always situated in the focal point 8 of the lens 6 of the collimator, geometrical aberrations are minimized, and the lens 6 may have a small opening and thus a relatively
10 small diameter and focal distance.

The cross dimensions of the sighting device 1, determined by the diameter A of the collimated beam, may thus be small.

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In another embodiment of the sighting device 1, the adjusting device 13 for positioning the mirror 9 consists of a motor controlled by a ballistic calculator, not represented in the figures, for an automatic adjustment.

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This calculator, when the distance of the target 21 is transmitted thereto, calculates the angle B to provide to the mirror 9 and activates the positioning motor.

- 25 The calculator can perform the ballistic calculation to determine the elevation angle E, taking into account the properties of the ammunitions that are being fired.

Moreover, the calculator can be combined with a range
30 finder that automatically measures the distance of the target 21 when it is activated by the shooter.

The sighting device 1 as represented is disadvantageous in that the collimator, and thus the collimated beam, has a small diameter, which has for a result that it may be
5 difficult for the shooter to find the angle E which guides the eye 20 into the beam 5, in other words to find the red dot.

To remedy this problem, the sighting device 1 can be
10 adapted in the following manner.

A first adaptation consists in placing a fore-sight 22 in the point of convergence 23 of the axes of the reflected beams on the reflecting blade 17, as indicated in figure 4.
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When the inclination angle B of the mirror 9 changes, the axis 24 of the light beam reflected on the reflecting blade 17 will still go through said point of convergence 23, irrespective of the inclination B of the mirror 9.

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The point of convergence 23 actually corresponds to the symmetrical position of the axis of rotation 10 in relation to the reflecting blade.

25 A second adaptation is illustrated by means of figure 5 and consists in providing a narrow reflecting blade 17, placed in a matt, diffusing frame with two lateral strips 25', in such a manner that the incident part of the light beam on the reflecting blade 17 which overflows the reflecting
30 blade 17 will be diffused by the frame 25 and will appear as a reference 26 in the form of a red spot that can be

seen by the shooter, irrespective of the position of the latter's eye 20.

Thanks to both adaptations, the shooter will only have to
5 align the reference formed by the spot 26 with the fore-sight 22 to find the red dot or reticle, which enables him to aim at the target 21 without any parallax or azimuth errors occurring, as represented in figure 6 in the case of a semi-transparent beamsplitter.

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Figures 7 and 8 show a variant of a sighting device 1 according to the invention, in which the point of reference 26 is made brighter by concentrating or condensing the lateral edges of the collimated beam 5 in the frame 25, for
15 example by making the beam 5 go through two cylindrical lenses 27 positioned on either side of the optical axis X-X' of the beam 5, or through any other optical device.

By concentrating lateral edges of the produced beam, the
20 point of reference 26 is also made narrower, as illustrated in figure 9, which makes it easier to align it with the fore-sight 22.

An alternative solution to concentrate the luminous point
25 of reference 26 is provided by the beam of a laser diode or laser pointer, situated in the same horizontal plane as the luminous source 7 of the red dot, and projected parallel to the optical axis X-X' of the collimator onto the frame of diffusion 25 of the sighting device 1.

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This laser beam can be laterally expanded by an appropriate optical device, so as to form a linear spot or a line which constitutes the luminous reference (26).

- 5 This alternative is interesting in that the size of the reference 26 stays constant, irrespective of the angle of the mirror 9.

Figure 10 represents another variant in which the luminous
10 source 7 of the collimator for producing the red dot or reticle consists of a LED 28 with an appropriate intensity and emission angle, placed behind a mask 29 situated in the focal point 8 of the collimator and in which is formed a circular hole 30 or a hole of any other shape at the
15 optical axis X-X'.

This variant makes it possible to realize a luminous source 7 with limited dimensions, which is important in view of the precision of the sighting device 1.

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Indeed, the angle at which the red dot is projected to infinity and thus its apparent size at a given distance, is in proportion to the size of the luminous source 7 of the collimator and inversely proportional to the focal distance
25 of the latter.

For example, in the case of a focal length of 40 mm, a circular luminous source 7 having a radius of 0.5 mm will produce a red dot whose apparent radius is:

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$$0.5 \times 100 / 40 = 1.25 \text{ m at } 100 \text{ m}$$
$$0.5 \times 300 / 40 = 3.75 \text{ m at } 300 \text{ m}$$

Thus, the luminous source 7 must have limited dimensions, in order to provide a red dot with an apparent size which is compatible with the aimed target 21, which means that it
5 must have a radius in the range of 0.1 to 0.2 mm.

It should be noted, however, that the dimensions of the luminous source 7 determine the quantity of light gathered by the lens 6 of the collimator, and consequently, the
10 brightness of the luminous points of reference 26 projected onto the diffusing frame 25 of the sighting device 1. Hence, there is a conflict between the requirement of a small red dot and the necessity to obtain references 26 that are sufficiently bright for the preliminary alignment
15 of the aiming axis with the fore-sight 22.

In order to reconcile both restrictions, it is advantageous to use, instead of a circular dot to be positioned on the target, a mark or reticle with a larger surface, inside of
20 which the shooter has to visually place the target 21. It may be formed, for example, of two pointers 31 framing the target 21, as illustrated in figures 11 to 12, which figures represent the perception of the reticle and the target 21 by a shooter who is aiming at a target at
25 different distances, for example at 100, 200 and 300 meters respectively.

According to yet another variant, as represented in figure 14, also additional scales or marks 32, 33 can be included
30 in the reticle, which enable the shooter to shift his firing axis so as to correct, when firing at long range,

the trajectory error due to the rotation of the ammunition around its axis, better known as the Magnus effect.

Figure 14 shows an example of a reticle which comprises an additional scale 33 on a horizontal axis 34, to be used when firing over more than 300 meters in the case of low-velocity grenades.

Instead of providing an additional scale 33 on the fixed reticle, one can also make sure that a simple reticle such as the one of figure 11 is automatically moved in the lateral direction by a device controlled by the ballistic calculator as a function of the type of ammunition used and the distance of the target, such that the deviation of the trajectory of the ammunition due to the Magnus effect is corrected.

The position of the reticle can also be moved perpendicularly to the optical axis by an adjusting device, so as to harmonize the sighting device with the launcher.

The use of a reticle with a marked horizontal axis 34 offers an additional advantage in that it forms a line of reference that helps the shooter, when aiming, to maintain his fire arm in a strictly vertical position, thus avoiding what are called "cant" errors which occur when the fire arm is laterally inclined.

This effect can be multiplied by making use of a mask which is free to pivot round the optical axis $X-X'$ of the collimator, and which is ballasted with an unbalanced mass,

which has for an effect that the reticle is kept at level, "in the manner of a plumb-line".

5 The inclination of the reticle in relation to the vertical axis of the frame of diffusion will make a possible error in the vertical position of the fire arm more noticeable to the shooter while aiming.

10 Moreover, if the sighting device 1 is controlled by a ballistic calculator equipped with an inclinometer which instantly measures the vertical deflection of the fire arm, this calculator may provoke, by means of an appropriate mechanism or device, an inclination of the reticle or of a horizontal line of reference round the optical axis of the
15 collimator in proportion to the vertical deflection of the fire arm, possibly amplified with regard to the latter, such that it will be better perceived by the shooter while aiming.

20 The masks 29 which correspond to these various reticles can be realized by means of photolithography, which makes it possible to obtain dimensions in the order of one tenth of a millimeter, with resolutions of one hundredth of a millimeter.

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It is clear that the reticles must not necessarily be red, but that reticles having another color, for example yellow-green, may also give a good contrast.

30 A non-monochromatic light source or "white" light can also be used.

It is also clear that the case 2 may have any shape whatsoever.

- 5 Instead of mounting the reflecting blade 17 in a matt frame 25, the frame 25 can also be replaced by one or two lateral diffusion strips 25'.

10 It is clear that the invention is by no means limited to the examples described above, but that many modifications can be made to the above-described "moving red dot" sighting devices while still remaining within the scope of the invention as defined in the following claims.

Claims.

- 5 1.- Improved "moving red dot" sighting device, characterized in that it comprises a fixed light source (4) and a reflecting blade (17), whereby the light source (4) produces a collimated light beam (5) which is projected onto the reflecting blade (17) so as to obtain a red dot or
10 reticle which is visible to the shooter thanks to the reflection on the reflecting blade (17), whereby the beam (5) is projected onto the reflecting blade (17) by means of a rotating mirror (9) whose inclination angle (B) in relation to the light beam (5) can be adjusted.
- 15 2.- Sighting device according to claim 1, characterized in that the reflecting blade (17) is a semi-transparent beamsplitter plate.
- 20 3.- Sighting device according to claim 1 or 2, characterized in that it comprises an adjusting device (13) to adjust the inclination angle (B) of the rotating mirror (9) in relation to the light beam (5), making it possible to adjust the angle (B) of the mirror (9) as a function of
25 the distance of the target (21) and of the type of ammunition.
- 30 4.- Sighting device according to claim 3, characterized in that the adjusting device (13) is provided with a scale (15) representing the distance of the target (21).

- 5.- Sighting device according to claim 4, characterized in that the adjusting device (13) is provided with several scales (15) for different types of ammunition.
- 5 6.- Sighting device according to any one of claims 3 to 5, characterized in that the adjusting device (13) comprises a motor for adjusting the angle (B) of the mirror (9) and a ballistic calculator which controls said motor and which makes it possible to calculate and to set the required
10 angle of the mirror (9) as a function of the distance of the target (21) and of the type of ammunition used.
- 7.- Sighting device according to claim 6, characterized in that the ballistic calculator is equipped with a range
15 finder which automatically communicates the distance of the target (21) to the latter as soon as the shooter triggers the measurement.
- 8.- Sighting device according to any one of the preceding
20 claims, characterized in that the light source (4) comprises a collimator with a convergent lens (6) and a luminous source (7) placed in the focal point (8) of the lens (6) of the collimator.
- 25 9.- Sighting device according to any one of the preceding claims, characterized in that the diameter (A) of the produced light beam (5) is small, preferably in the order of 15 mm or less.
- 30 10.- Sighting device according to claim 8, characterized in that the luminous source (7) of the collimator is quasi

punctual, preferably with a diameter in the order of some tenths of a millimeter.

11.- Sighting device according to claim 8 or 10,
5 characterized in that the luminous source (7) is formed of a LED (28) placed behind a mask (29) situated in the focal point (8) of the lens (6) of the collimator and in which is provided a hole (30) at the optical axis X-X' of the produced light beam (5).

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12.- Sighting device according to any one of the preceding claims, characterized in that it comprises a fore-sight (22) placed in the point of convergence (23) of the axes (24) of the beams reflected on the reflecting blade (17).

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13.- Sighting device according to any one of the preceding claims, characterized in that it comprises a lateral diffusion strip (25') at one or either side of the reflecting blade (17) onto which a luminous reference (26)
20 is projected parallel to the axis (X-X') of the collimated beam (5) on said lateral strips (25').

14.- Sighting device according to claim 13, characterized in that the luminous reference (26) is formed by the
25 collimated beam (5) itself.

15.- Sighting device according to claim 13 or 14, characterized in that the luminous point of reference (26) is formed by condensing the exterior parts of the produced
30 collimated beam (5) by means of an optical device.

16.- Sighting device according to claim 13, characterized in that the luminous reference (26) is formed of the beam coming from a laser pointer whose axis is mainly parallel to the axis (X-X') of the collimated beam (5).

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17.- Sighting device according to claim 16, characterized in that the beam of the laser pointer is laterally expanded by an appropriate optical device so as to form a line which constitutes the luminous reference (26).

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18.- Sighting device according to any one of the preceding claims, characterized in that the reticle comprises several marks (32-33) which correspond, each for a determined distance of the target (21), to the required sighting correction so as to take into account the deviation of the trajectory of the ammunition due to the Magnus effect.

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19.- Sighting device according to any one of the preceding claims, characterized in that the position of the reticle (26) is automatically moved in the lateral direction by a device controlled by the ballistic calculator as a function of the type of ammunition used and the distance of the target (21), so as to correct the deviation of the trajectory of the ammunition due to the Magnus effect.

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20.- Sighting device according to any one of the preceding claims, characterized in that the reticle (26) comprises at least a horizontal reference (33) and in that the ballistic calculator is equipped with an inclinometer which measures the vertical deflection of the fire arm, whereby this calculator provokes, by means of an appropriate device, an

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inclination of the reference or of the reticle round the optical axis (X-X') of the collimator in proportion to the vertical deflection of the fire arm, such that it will be better perceived by the shooter while aiming.

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21.- Sighting device according to any one of the preceding claims, characterized in that the reflecting blade (17) is collapsible.