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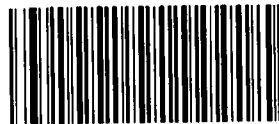
PUBLICATION PARTICULARS AND ABSTRACT

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TITLE OF INVENTION	
54	IMPROVED MOVING RED DOT SIGHTING DEVICE

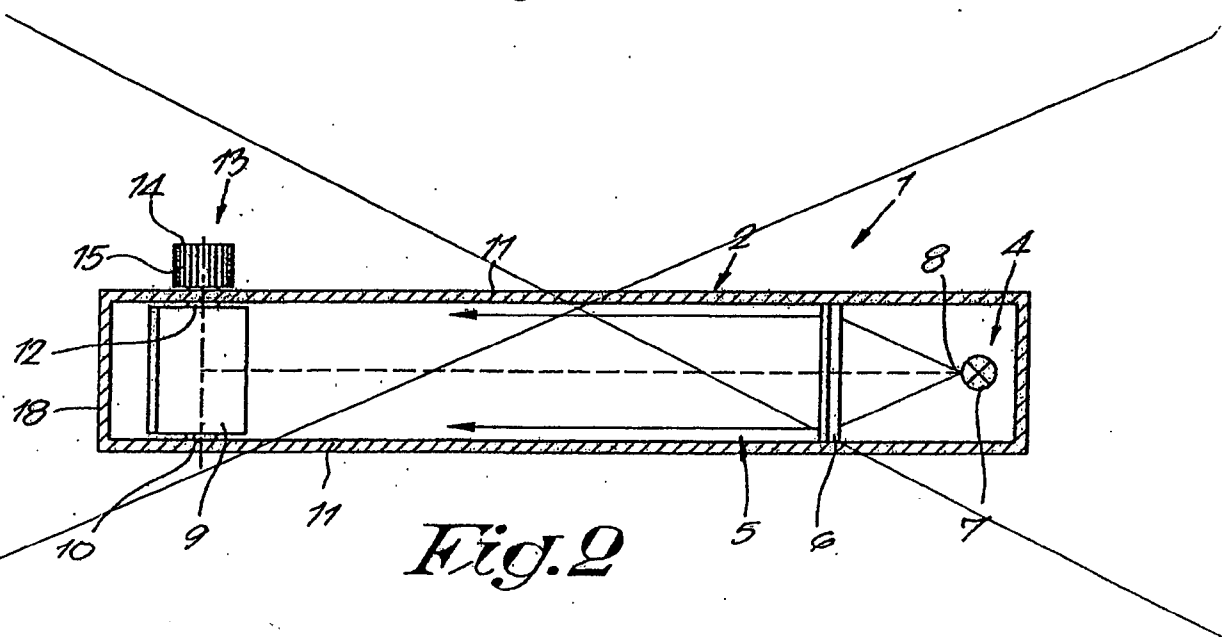
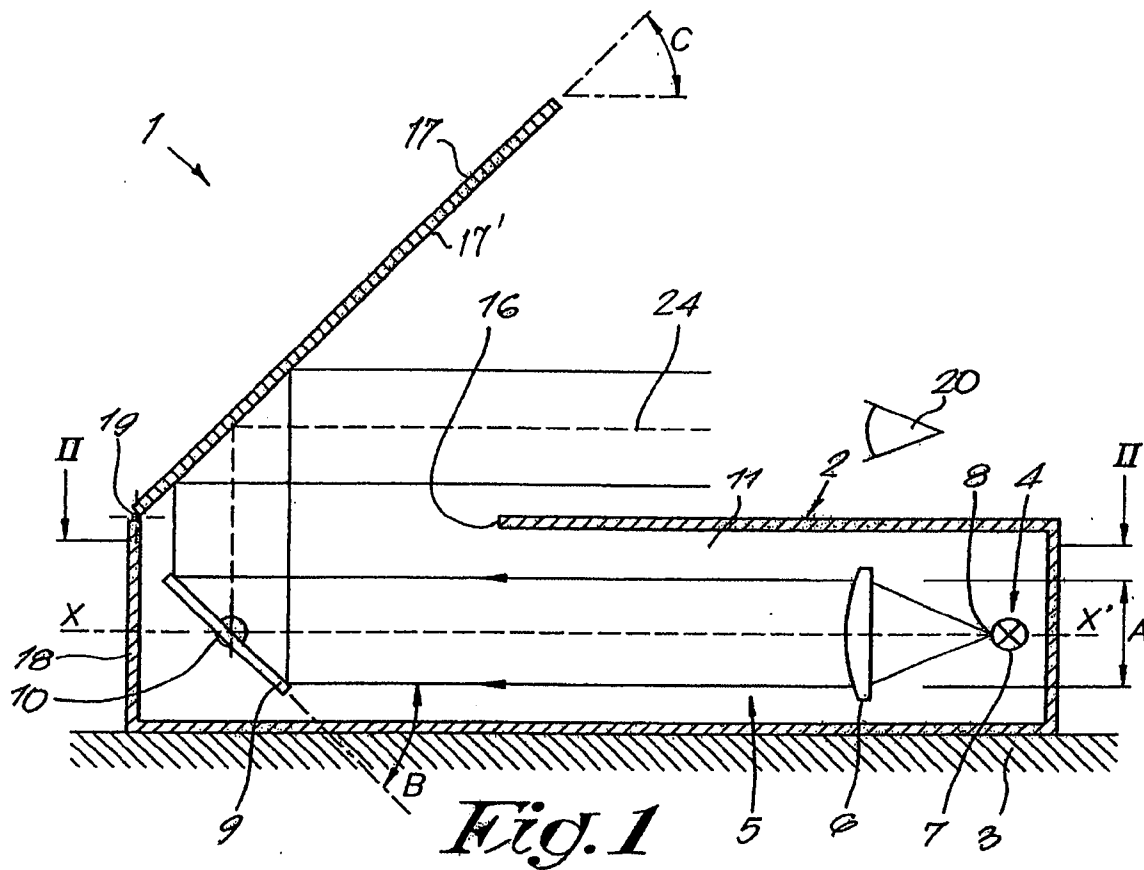
57	ABSTRACT (NOT MORE THAN 150 WORDS)	NUMBER OF PAGES	27
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FOR ABSTRACT SEE THE NEXT SHEET



ABSTRACT OF THE DISCLOSURE

Improved "moving red dot" sighting device, including a fixed light source (4) and a reflecting element (17),
5 whereby the light source (4) produces a collimated light beam (5) which is projected onto the reflecting element (17) so as to obtain a red dot or reticle which is visible to the shooter thanks to the reflection on the reflecting element (17), and whereby the beam (5) is projected onto
10 the reflecting element (17) by means of a rotating mirror (9) whose inclination angle (B) in relation to the light beam (5) can be adjusted.





Improved "moving red dot" sighting device.

BACKGROUND OF THE INVENTION

5

Field of the Invention

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

10 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
15 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.

20

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

Moreover, the red dot is not necessarily a dot.

25

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.

30

2. Discussion of the Related Art

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
5 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
10 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
15 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
20 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
25 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
30 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 cannot be used when aiming with two eyes open.

5

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

10

SUMMARY OF THE INVENTION

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.

15

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

20

25

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.

30

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 reflecting element with the aiming eye.

5

However, the reflecting element is preferably a semi-transparent beamsplitter plate or beamsplitter cube, which enables the shooter to observe the target as well as the red dot through the beamsplitter with the aiming eye, while
10 the shooter can also aim with two eyes open, whatever he prefers.

The sighting device preferably comprises a device to adjust the inclination angle of the rotating mirror in relation to
15 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 ammunition.

20

BRIEF DESCRIPTION OF THE DRAWINGS

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
25 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;
30 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 according to the invention;

5 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;

10 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;

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;

15 figure 11 is a view according to arrow F11 in figure 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; and

20 figure 15 is another variant of the invention.

DESCRIPTION OF THE PREFERED EMBODIMENT

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

30

Inside the case 2 is situated a fixed light source 4, 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
5 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.

10

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
15 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.

20

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.

25

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
30 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.

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

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

15 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.

20 The light beam 5 is projected through a window 16 in the case 2 onto a reflecting element 17 having reflecting surface 17' so as to produce a red dot or reticle, visible to the shooter in the reflecting element 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.

25

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

The reflecting surface 17' preferably comprises a beamsplitter that is semi-transparent.

5 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
10 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
15 of the graded control button 14.

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

As the mirror 9 turns, the deviation of the angle D of the
25 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° in relation to the position of rest of 45° , the angle D increases from 0° to 30° .

30 The inclination B of the mirror, which is a function of the distance of the target, thus determines the angle D at

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
5 where the reflecting surface 17' is a semi-transparent beamsplitter, is visible through said reflecting element 17.

If the reflecting surface 17' is not semi-transparent, the
10 shooter will have to aim with both eyes open in order to observe the target with one eye and the red dot with the other.

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

An advantage of the sighting device 1 according to the invention is that, since quasi punctual luminous source 7
20 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 small diameter and focal distance.

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

In another embodiment of the sighting device 1, the
30 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.

5 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.

10 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 finder that automatically measures the distance of the target 21 when it is activated by the shooter.

15

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 difficult for the shooter to find the angle E which guides
20 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 adapted in the following manner.

25

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 surface 17', as indicated in figure
4.

30

When the inclination angle B of the mirror 9 changes, the axis 24 of the light beam reflected on the reflecting surface 17' will still go through said point of convergence 23, irrespective of the inclination B of the mirror 9.

5

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

10 A second adaptation is illustrated by means of figure 5 and consists in providing a narrow reflecting element 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 surface of the reflecting element 17
15 which overflows the reflecting element 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.

20 Thanks to both adaptations, the shooter will only have to align the reference formed by the spot 26 with the foresight 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
25 a semi-transparent beamsplitter.

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
30 lateral edges of the collimated beam 5 in the frame 25, for 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 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 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.

15

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).

20 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 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 optical axis X-X'.

30

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.

5 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 of the latter.

10

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:

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

15

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

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
20 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
25 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
30 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 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 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 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.

5

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.

10

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".

15

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.

20

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 collimator in proportion to the vertical deflection of the fire arm, possibly amplified with regard to the latter,

25

30

such that it will be better perceived by the shooter while aiming.

The masks 29 which correspond to these various reticles can
5 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.

10 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.

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

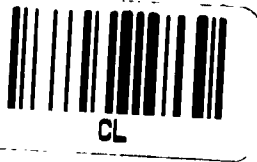
It is also clear that the case 2 may have any shape whatsoever.

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

As shown in figure 15, the reflecting element 17 may also
25 comprise a single prism 36 or, optionally, a beamsplitter cube 40 which provides the advantage of reducing the overall height H_2 of the reflecting element 17. In this embodiment, the reflecting surface is realized by the hypotenuse 38 of the prismatic system. The deviation of
30 the reticle beam rays entering and exiting the prism at the air-prism interface reduces the height H_2 required to

reflect the reticle beam for the maximum elevation aiming angle B, thereby providing a more compact sighting device. A commercial BK7 glass prism with a refraction index around 1.5, with a hypotenuse length in the range of 28mm, for example, will enable the sight to provide elevation aiming angles up to 35°. When a single prism is used, its hypotenuse surface is fully reflective, and the shooter cannot see the target through the prism with the aiming eye, which means that he has to aim with both eyes open. If a beamsplitter cube 40 is used, the beamsplitter surface is transparent relatively to the target, and thereby accommodates sighting by a single eye. In the case of a beamsplitter cube, a commercial BK7 beamsplitter cube with dimensions in the range of 20 mm x 20 mm x 20 mm can advantageously be used. Beamsplitter cubes are well-known and generally comprise two right angle prisms bonded together along their hypotenuse with appropriate interference coatings on the hypotenuse surfaces. While the prism 36 has been illustrated in conjunction with the embodiment of the invention according to figure 10, it will be understood that the prismatic reflecting reticle, including the beamsplitter cube, may be used with any embodiment of the invention.

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. A "moving red dot" sighting device, comprising a fixed light source and a reflecting surface, wherein the light source produces a collimated light beam which is projected onto the reflecting surface so as to obtain a red dot or reticle which is visible to the shooter due to the
- 10 reflection on the reflecting surface, and wherein the beam is projected onto the reflecting surface by means of a rotating mirror whose inclination angle B in relation to the light beam can be adjusted.
- 15 2. The sighting device according to claim 1, wherein the reflecting surface is a semi-transparent beamsplitter plate.
- 20 3. The sighting device according to claim 1, comprising an adjusting device arranged to enable adjustment of the inclination angle B of the rotating mirror in relation to the light beam, making it possible to adjust the angle B of the mirror as a function of the distance of the target and of the type of ammunition.
- 25 4. The sighting device according to claim 3, wherein the adjusting device is provided with a scale representing the distance of the target.

5. The sighting device according to claim 4, wherein the adjusting device is provided with several scales for different types of ammunition.

5 6. The sighting device according to claim 3, wherein the adjusting device comprises a motor for adjusting the angle B of the mirror and a ballistic calculator which controls said motor and which makes it possible to calculate and to set the required angle of the mirror as a function of the
10 distance of the target and of the type of ammunition used.

7. The sighting device according to claim 6, wherein the ballistic calculator is equipped with a range finder which automatically communicates the distance of the target to
15 the latter as soon as the shooter triggers the measurement.

8. The sighting device according to claim 1, wherein the light source comprises a collimator with a convergent lens and a luminous source placed in the focal point of the lens
20 of the collimator.

9. The sighting device according to claim 1, wherein the diameter A of the produced light beam is small, preferably in the order of 15 mm or less.

25

10. The sighting device according to claim 8, wherein the luminous source of the collimator is quasi punctual, preferably with a diameter in the order of some tenths of a millimeter.

30

11. The sighting device according to claim 8, wherein the luminous source is formed of a LED placed behind a mask situated in the focal point of the lens of the collimator and in which is provided a hole at the optical axis X-X' of the produced light beam.

12. The sighting device according to claim 1, comprising a fore-sight placed in the point of convergence of the axes of the beams reflected on the reflecting surface.

13. The sighting device according to claim 1, comprising a lateral diffusion strip at one or either side of the reflecting surface onto which a luminous reference is projected parallel to the axis X-X' of the collimated beam on said lateral strips.

14. The sighting device according to claim 13, wherein the luminous reference is formed by the collimated beam itself.

15. The sighting device according to claim 13, including an optical device arranged to condense the exterior parts of the produced collimated beam to produce the luminous point of reference.

16. Sighting device according to claim 13, wherein the luminous reference is formed of the beam coming from a laser pointer whose axis is mainly parallel to the axis X-X' of the collimated beam.

17. The sighting device according to claim 16, including an optical arrangement whereby the beam of the laser pointer

is laterally expanded so as to form a line which constitutes the luminous reference.

18. The sighting device according to claim 1, wherein the
5 reticle comprises several marks which correspond, each for a determined distance of the target, to the required sighting correction so as to take into account the deviation of the trajectory of the ammunition due to the Magnus effect.

10

19. The sighting device according to claim 6, including a reticle moving device controlled by the ballistic calculator as a function of the type of ammunition used and the distance of the target, whereby the position of the
15 reticle is automatically moved in the lateral direction by a device so as to correct the deviation of the trajectory of the ammunition due to the Magnus effect.

20. The sighting device according to claim 6, wherein the
20 reticle comprises at least a horizontal reference and in that the ballistic calculator is equipped with an inclinometer which measures the vertical deflection of the fire arm, wherein the calculator is arranged to provide, by means of an appropriate device, an inclination of the
25 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.

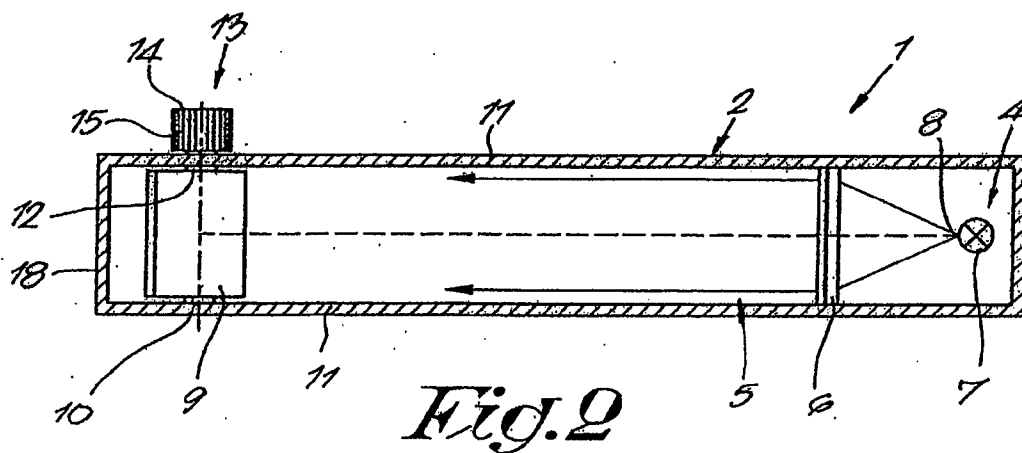
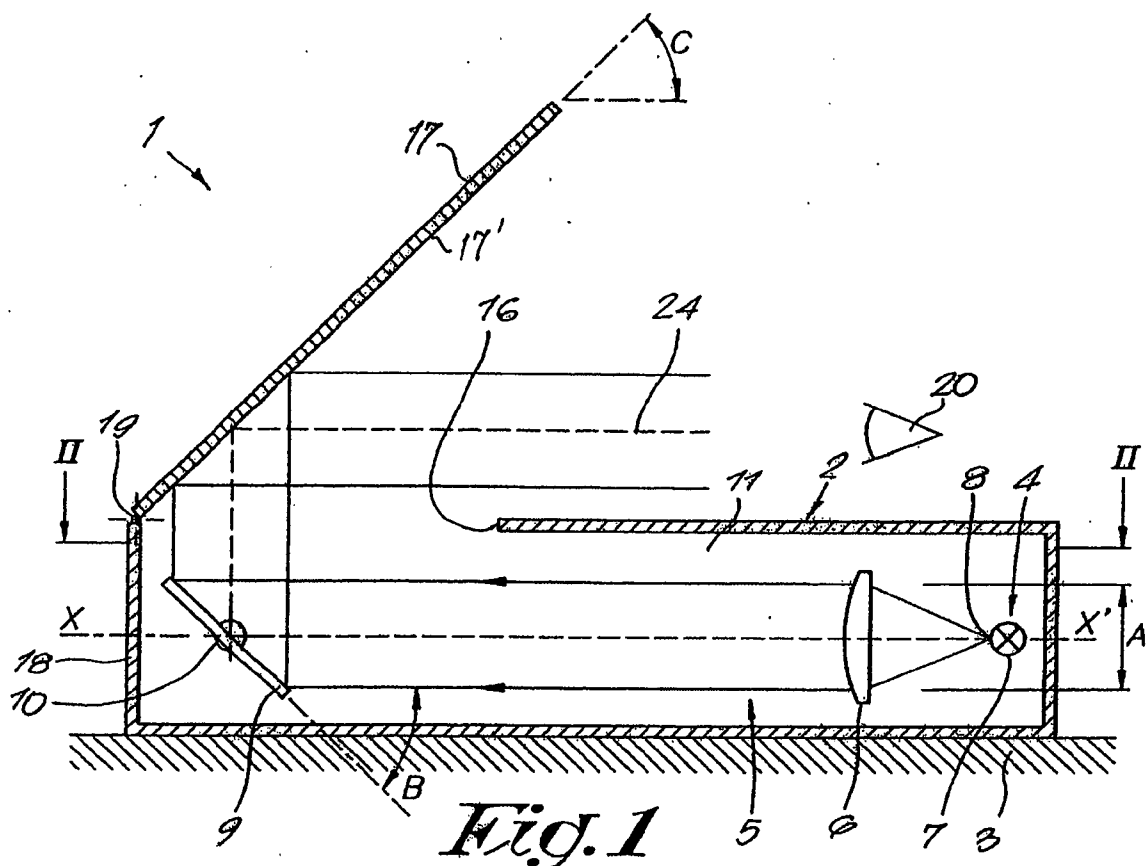
21. The sighting device according to claim 1, wherein the reflecting surface comprises a flat plate that is foldable relative to a support housing of the sighting device.

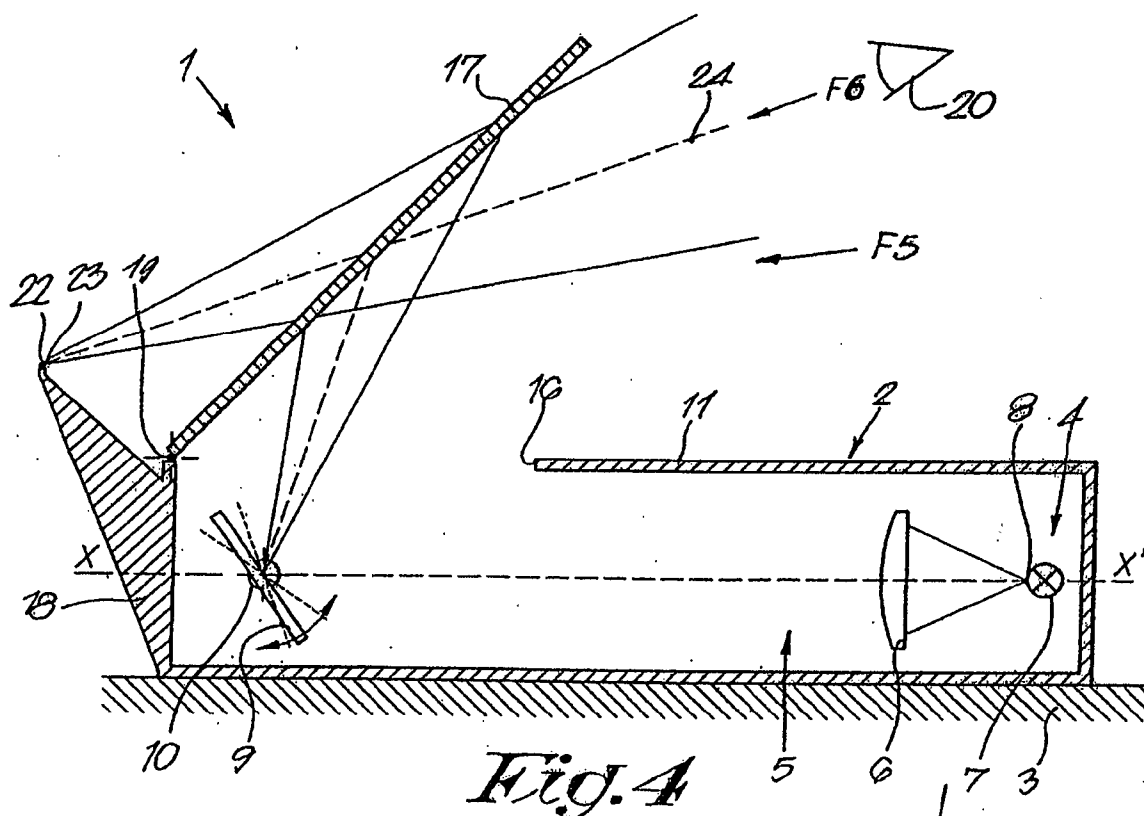
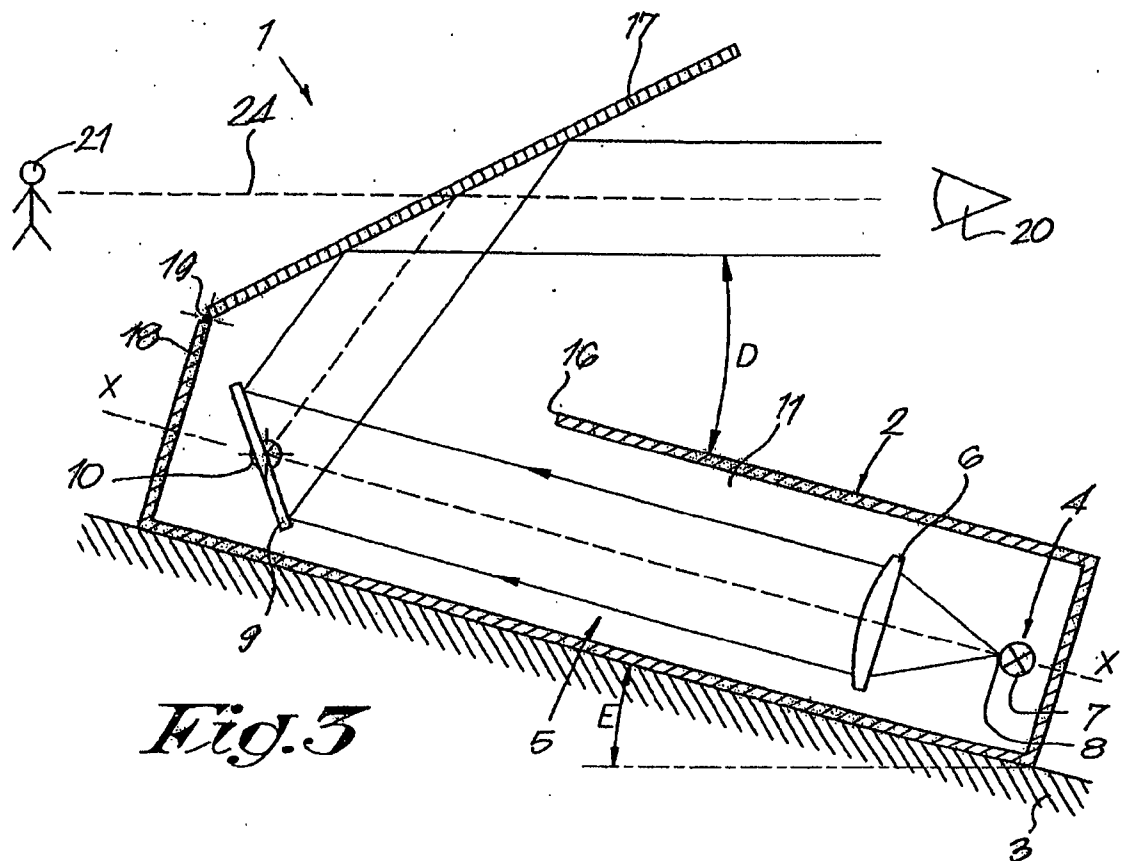
5 22. The sighting device according to claim 1 wherein the reflecting surface is the hypotenuse of a right angle prism.

10 23. The sighting system according to claim 22, wherein the prism is a beamsplitter cube comprising two right angle prisms joined together along their respective hypotenuses.

Dated this 09th day of March 2009


Patent Attorney / Agent for the Applicant





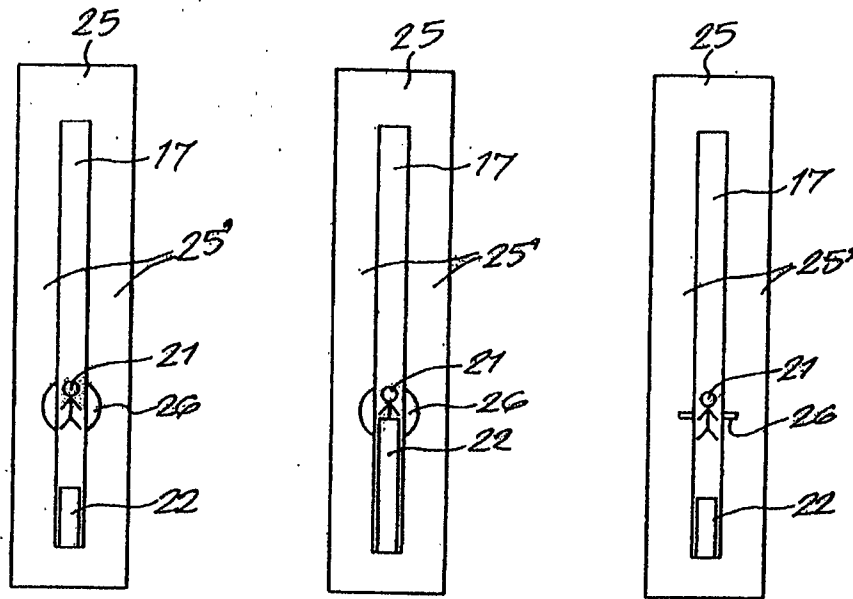


Fig. 5 Fig. 6 Fig. 9

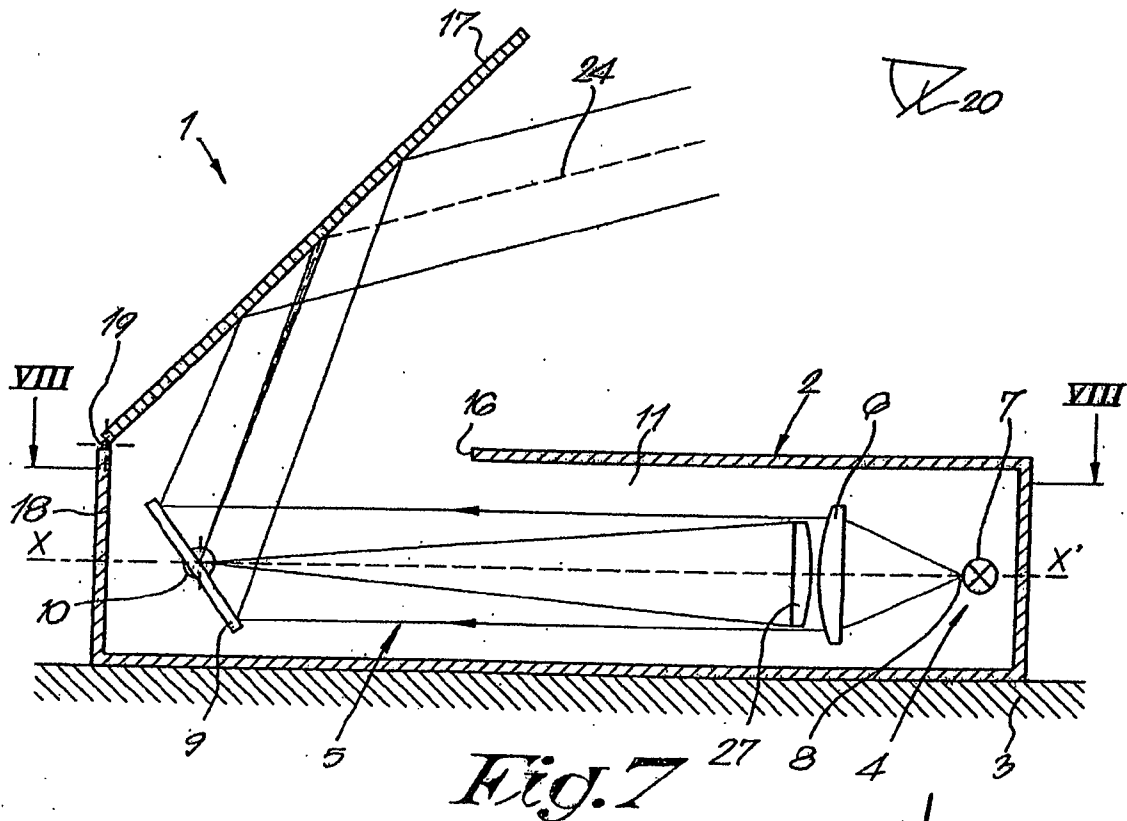
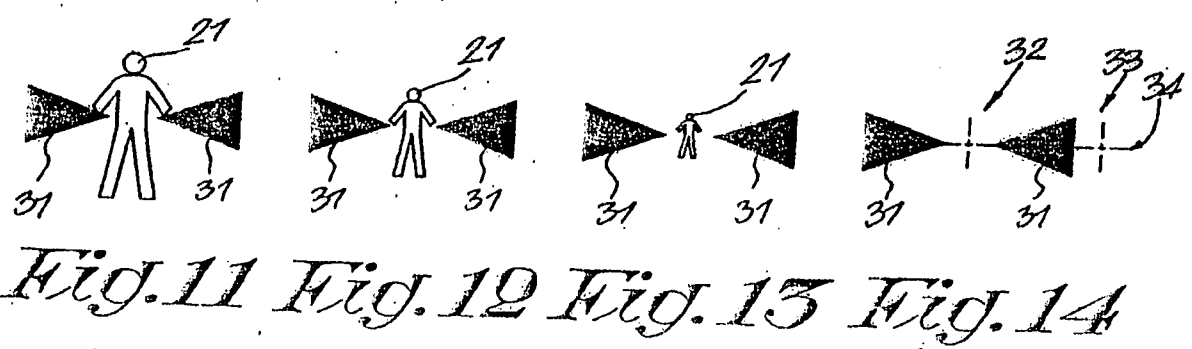
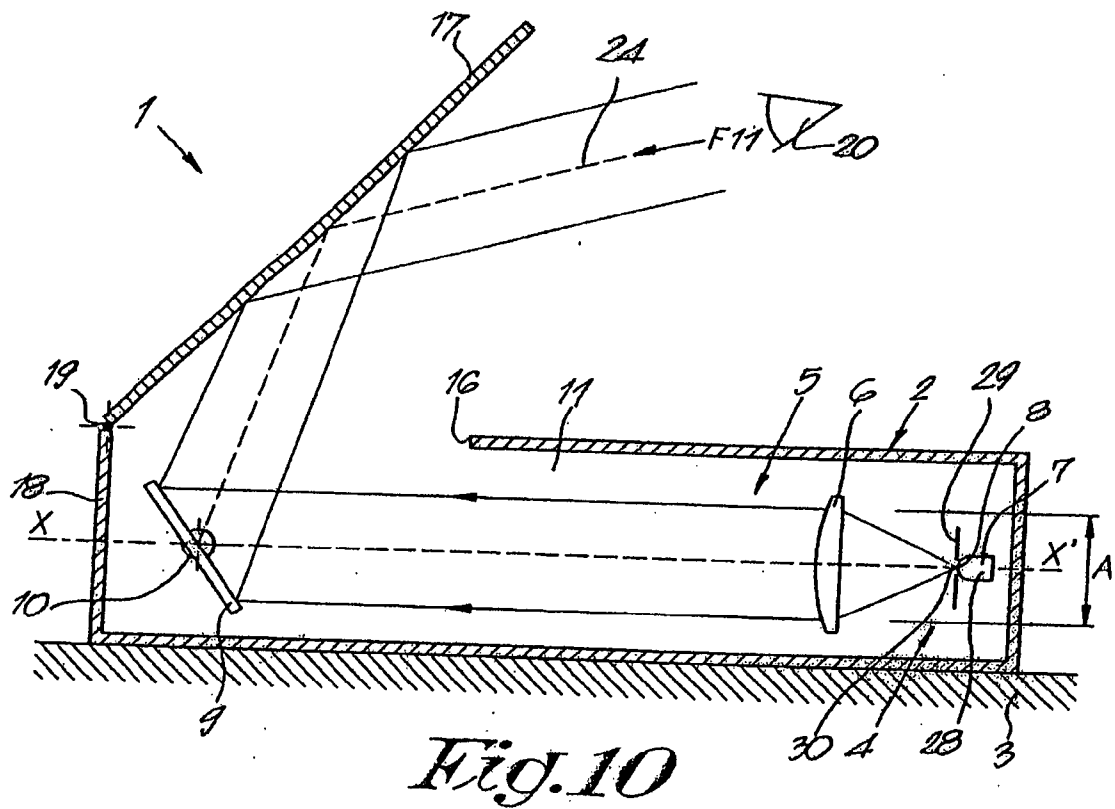
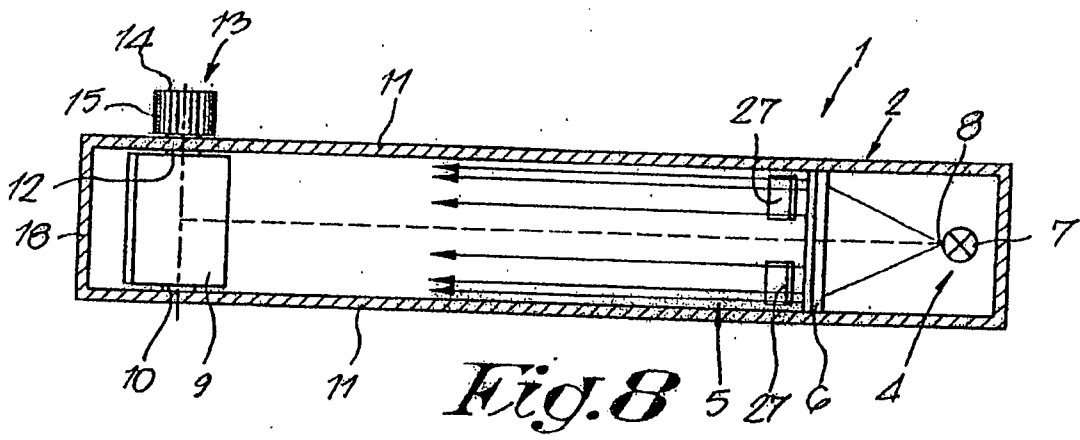


Fig. 7



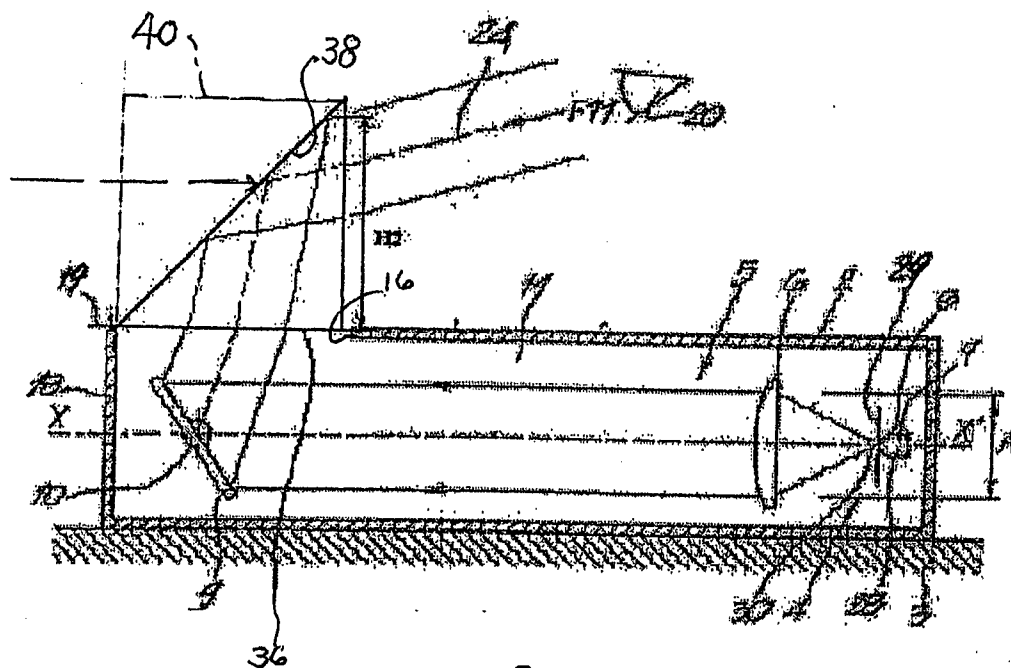


Fig. 15