JUSTIA

SIGHT FOR USE BY DAY AND AT NIGHT AND FIREARM

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This disclosure relates to a sight intended to be used by day and at night, the sight comprising:—an interface for attachment to a firearm,—a camera capturing part of the environment for sighting a target, —a sensor for measuring the illumination of the environment of the sight,—a screen for displaying the

of controlling the luminosity of the screen depending on the measured illumination, the camera and the screen being configured so that a user of the viewer sights a target with both eyes open.

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a national phase entry under 35 U.S.C. § 371 of International Patent Application PCT/EP2018/065701, filed Jun. 13, 2018, designating the United States of America and published in French as International Patent Publication WO 2018/229149 A1 on Dec. 20, 2018, which claims the benefit under Article 8 of the Patent Cooperation Treaty to French Patent Application Serial No. 1770622, filed Jun. 13, 2017.

TECHNICAL FIELD

The present disclosure relates to a sight for use by day and night. The present disclosure also relates to a weapon comprising such a sight.

BACKGROUND

In the military field, urban combat is a specific type of combat. In particular, in urban combat, the military wants to be able to simultaneously fire and move. In order to fire, the military needs to perceive its environment and be able to stay under cover. In addition, the

Sighting is performed with both eyes open and makes it possible to acquire a target quickly by day.

However, such sights are only usable by day since the acquisition speed is not fast enough for night use.

There is therefore a need for a sight allowing day and night use, notably by increasing the speed of acquiring a target.

BRIEF SUMMARY

For this, the present description will notably focus on a sight intended to be used by day and night, the sight comprising an attachment interface for attachment to a firearm, a camera acquiring a part of the environment for sighting a target, a measuring sensor for measuring the illumination of the environment of the sight and a screen for displaying the part of the environment acquired by the camera. The screen has a brightness. The sight also comprises a controller suitable for controlling the brightness of the screen according to the measured illumination.

According to particular embodiments, the sight comprises one or more of the following features, taken in isolation or according to all the technically possible combinations:

- - The camera and the screen are configured so that a user of the sight sights a target with both eyes open.
  - The screen has a diagonal the dimension of which is between 4 centimeters and 6 centimeters.
  - The controller is capable of displaying a sight reticle on the screen and is suitable for controlling the contrast between the sight reticle and the screen according to the measured illumination.
  - The camera has a magnification between 0.95 and 1.05.
  - The sight comprises a control button determining the operating mode of the camera, a first operating mode wherein the magnification of the camera is between 0.95 and 1.05 and a second operating mode wherein the magnification of the camera is between 1.95 and 2.05.
  - The camera comprises an image sensor, the measuring sensor being the image

measured illumination.

The present description also describes a firearm provided with a sight as previously described.

According to a particular embodiment, the firearm comprises a support for the user's head, the support being arranged so that the distance between the operator's head and the screen is between 8 centimeters and 15 centimeters when the user's head is resting on the support.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of embodiments of the present disclosure will appear upon reading the following description, of embodiments of the present disclosure, given by way of example only and with reference to the drawings, which are:

FIG. 1, a schematic view of an example of a firearm comprising a sight,

FIG. 2, a schematic representation of the sight in FIG. 1,

FIG. 3, a diagram illustrating a first example of configuration for using the sight in FIG. 1,

FIG. 4, a diagram illustrating a second example of configuration for using the sight in FIG. 1, and

FIG. 5, a schematic representation of another example of sight.

DETAILED DESCRIPTION

A firearm **10** is represented in FIG. 1.

The firearm **10** is a weapon that is used to aim and to fire at a target in a user's line of sight.

The firearm **10** is suitable for urban combat.

The firearm **10** is portable.

According to the example described, the firearm **10** is an assault rifle.

The firearm **10** notably comprises a barrel **12**, a stock **14**, a firing device **16**, a support **18** for the user's head and a sight **20**.

The firearm **10** also comprises other elements that are not described more precisely hereinafter, such as a magazine, or that are not represented, such as a pin, a flash suppressor, or a cocking lever.

The barrel **12** is a cylinder with a circular base having a diameter suitable for allowing the passage of small caliber ammunition.

The barrel **12** extends along a main direction. The main direction is symbolized by an X axis in FIG. 1. The main direction is therefore denoted by “main direction X” subsequently.

A first transverse direction is also defined, the first transverse direction being perpendicular to the main direction. The first transverse direction is symbolized by a Y axis in FIG. 1. The first transverse direction is therefore denoted by “first transverse direction Y” subsequently.

A second transverse direction is also defined, the second transverse direction being perpendicular to the main direction X and to the first transverse direction Y. The second transverse direction is symbolized by a Z axis in FIG. 1. The second transverse direction is therefore denoted by “second transverse direction Z” subsequently.

The stock **14** is capable of supporting the barrel **12** and being held on the user's shoulder.

The firing device **16** is capable of launching ammunition.

According to the example represented, the firing device **16** comprises a trigger guard **22** and a trigger **24**.

In other examples, the firing device **16** also comprises a safety.

The support **18** for the user's head corresponds to the heel of the stock **14**. The support **18** is capable of allowing a quick positioning of the user's head and always in the same place.

The sight **20** enables the user to sight a target.

The sight **20** is capable of operating at an operating temperature and of being stored at a storage temperature.

This means that each component of the sight **20** is capable of operating at the operating temperature and of being stored at the storage temperature.

According to the example described, the operating temperature is between −10° and 40°. The term “between” is understood in its broad meaning. In other words, a quantity is between a first value and a second value means that the quantity is greater than or equal to the first value and that the quantity is less than or equal to the second value.

In the case described, the storage temperature is between −50° and 60°.

The sight **20** has a weight strictly less than 500 grams.

The sight **20** comprises a protective shell **26** intended to protect all the components of the sight **20**.

For example, the protective shell **26** is in the form of a wall in a first material.

The first material is, for example, plastic, aluminum or a composite material.

The protective shell **26** has a dimension along the main direction X referred to as length in the rest of the description.

The length of the protective shell **26** is between 50 millimeters (mm) and 300 mm.

According to the example described, the length is equal to 150 mm.

The protective shell **26** also has a dimension along the first transverse direction Y referred to as height in the rest of the description.

The height is between 50 mm and 70 mm.

According to the example described, the height is equal to 70 mm.

The protective shell **26** also has a dimension along the second transverse direction Z referred to as depth in the rest of the description.

The protective shell **26** comprises, in the case described, an attachment interface **28**.

The attachment interface **28** is an interface for attaching the sight **20** to the firearm **10**.

For example, the attachment interface **28** is a Picatiny interface.

As a variant, the attachment interface **28** is a set of screws capable of engaging with corresponding orifices in the stock **14**.

The sight **20** comprises a camera **30**, a control button **32**, a sensor **34**, a screen **36**, a controller **38** and a power supply **40**.

The camera **30** is capable of acquiring a part of the environment for sighting a target.

The camera **30** comprises an optical system **42** and an image sensor **44**.

The optical system **42** serves to capture a part of the environment of the sight **20** and to send the captured image to the image sensor **44**.

The optical system **42** has a large field of observation. A field of observation is termed "large" when the field is greater than or equal to 40%.

According to the example described, the field provided by the optical system **42** is equal to 50°. The field mentioned in this context is the total field of the optical system **42**.

The optical system **42** comprises a single lens.

According to the present example, the optical system **42** comprises a lens serving as an eyepiece **46**.

As a variant, the optical system **42** is more complex.

For example, the optical system **42** comprises two lenses or more than two lenses.

It is also conceivable to use lenses the focal length of which is variable, notably with the aid of mechanical rings.

The optical system **42** is provided with a digital magnifier that can be activated by the user.

Two positions, or more precisely two operating modes, thus exist for the optical system **42**, a first position wherein the digital magnifier is deactivated and a second position wherein the digital magnifier is activated.

In the first position, which is represented in FIG. 2, the magnification G of the optical system **42**, i.e., the magnification of the camera **30**, has a first value G1.

In the second position, the magnification G of the optical system **42**, i.e., the magnification of the camera **30**, has a second value G2.

The ratio between the second value G2 and the first value G1 is strictly greater than 1, so that the second position corresponds to a magnifier position.

According to one embodiment, the ratio between the second value G2 and the first value G1 is strictly greater than 1.5, preferably strictly greater than 1.8.

The first value G1 is, for example, between 0.95 and 1.05.

In the illustrated case, the first value G1 is equal to 1.

The second value G2 is, for example, between 1.95 and 2.05.

In the example described, the second value G2 is equal to 2.

As a variant, the second value G2 is strictly greater than 2.5.

Furthermore, according to one embodiment, the second value G2 is selected by the user of the sight **20**.

Thus, for the case of FIG. 2, the ratio between the second value G2 and the first value G1 is equal to 2.

The image sensor **44** is a sensor sensitive to radiation in the visible range.

Additionally, the image sensor **44** is also sensitive to radiation in the infrared range.

The image sensor **44** is a set of pixels. By misnomer, each pixel is termed a "photodetector" in the rest of the description.

According to another example, the image sensor **44** is a charge coupled device (also denoted by the acronym CCD).

In the case described, the camera **30** is capable of operating in the spectral band extending between 400 nanometers (nm) and 1200 nm.

The sensitivity of the camera **30** is between 50 μlux and 50 lux, which defines its dynamics.

Such dynamics make it a level 4 night camera **30**.

Such dynamics are achieved by the implementation of an automatic iris and an automatic gain control.

The iris makes it possible to reduce the brightness in the event of too intense illumination.

The automatic gain control makes it possible to electronically adjust the gain of each photodetector of the image sensor **44** and thus to optimize the rendered image.

The control button **32** makes it possible to control the digital magnifier.

The control button **32** is manually operable by the user.

The sensor **34** is a measuring sensor for measuring the illumination of the environment of the sight **20**.

The sensor **34** has a large dynamic range. The sensor **34** is capable of measuring illuminations between 10 μlux and 100 lux.

The screen **36** is a display screen of part of the environment.

The screen **36** is a digital screen.

For example, the screen **36** is an OLED type of screen (stands for "Organic Light-Emitting Diode").

In this sense, the screen **36** is an indirect display screen of the environment.

The screen **36** has a brightness.

A commonly used definition for brightness was defined by the International Commission on Illumination (CIE) in 1976. This is the definition that is selected for the rest of the description.

In this definition, the brightness is denoted by L* and is calculated from the luminance of the light produced by a primary source (in this case the screen **36**) expressed in candelas per square meter with respect to the luminance of white taken as a reference.

The formula for calculation is then given by the following system:

$$L^* = \begin{cases} 116 * \left(\frac{LL}{LL_B}\right)^{\frac{1}{3}} - 16 & \text{if } \frac{LL}{LL_B} > \left(\frac{6}{29}\right)^3 \\ 903.3 * \frac{LL}{LL_B} & \text{if } \frac{LL}{LL_B} \leq \left(\frac{6}{29}\right)^3 \end{cases}$$

Where:

- LL designates the luminance of the light produced by the screen **36**, and
- LL_B designates the luminance of white on the screen **36** taken as a reference.

The camera **30** and the screen **36** are configured so that a user of the sight **20** sights a target with both eyes open.

This notably implies that the image displayed on the screen **36** is an image at “infinity” or collimated.

Furthermore, the optical system **42** is capable of operating at a hyperfocal distance. This means that no focusing adjustment is performed between a minimum distance (a few meters) up to infinity.

For a target sighted over 100 meters or more, the optical system **42** is therefore such that the screen **36** displays an image at “infinity” allowing the user to sight with both eyes open.

Furthermore, the camera **30** and the screen **36** are arranged for minimizing the observation of the protective shell **26** of the sight **20** by the eye looking at the scene to be observed in direct view. This facilitates the superimposition of the images seen by both eyes.

In the example represented, the display screen **36** is perpendicular to the main direction X. The screen **36** therefore has a height and a depth.

The ratio between the height and the depth is between 1 and 2.

The screen **36** also has a diagonal.

The dimension of the diagonal is between 4 cm and 6 cm.

According to the example provided, the dimension of the diagonal is equal to 5 centimeters.

The screen **36** also has a good quality of reproduction of the image acquired by the camera **30**. This means that the dynamics of the screen **36** follow the brightness of the scene observed by the naked eye. Indeed, in order to facilitate image merging, the brightness of the scenes should be very similar. The brain always has a tendency to give priority to the brightest scene.

The support **18** and the screen **36** are arranged in space so that the distance between the user's head and the screen **36** is between 8 centimeters and 15 centimeters when the user's head is supported on the support **18**. In such a context, the distance between the user's head and the screen **36** is the distance between the eye sighting the screen **36** and the center of the screen **36**. This distance is denoted by d in FIGS. 3 and 4.

The controller **38** is suitable for controlling the brightness of the screen **36** according to the illumination measured by the sensor **34** for measuring the illumination.

Such control is indicated by dashed lines in FIG. 2.

Control is such that the brightness of the screen **36** appears identical to the brightness of the scene observed with the naked eye for the user. One way of achieving such control is for both brightnesses to be identical.

The power supply **40** of the sight **20** is an electrical power supply.

According to one example, the power supply **40** is a cell.

The battery is, in one particular case, an AA cell.

According to a variant, the power supply **40** is an assembly comprising elements, the elements being selected from a cell, an accumulator and a battery.

The operation of the firearm **10**, and, in particular, of the sight **20**, is now described with reference to FIGS. 3 and 4, which illustrate two particular configurations of using the sight **20**.

As a preliminary remark, it should be noted that the sight **20** can be used for different applications depending on the user's mission. Thus, according to circumstances, the sight **20** serves as equipment for facilitating observation, sighting or firing at one or more predefined targets.

In the first configuration illustrated in FIG. 3, the user sees the scene with one eye facing the screen **36** and one eye looking at the scene directly. In the example represented, it is the right eye OD that looks at the screen **36** and the left eye OG that looks at the scene directly.

The left eye OG thus observes a scene at infinity without sighting means with a natural magnification. This natural magnification is usually equal to 1. The field of view of the left eye CVG is bounded by two solid lines in FIG. 3. The direction of sighting of the left eye OG is further indicated, denoted by DVG.

The right eye OD observes the screen **36** that displays the image of a scene at "infinity" with a magnification equal to 1, which is identical to the natural magnification. The field of view of the right eye CVD is bounded by two solid lines in FIG. 3. The direction of sighting of the right eye OD is further indicated, denoted by DVD. The direction of sighting DVD of the right eye OD is parallel to the direction DVG of sighting of the left eye OG.

Then the user's brain merges the direct observation of a scene by the left eye OG with the observation through the screen **36** by the right eye OD.

In this first configuration, the fact is advantageously used that the image displayed on the screen **36** is an image of the scene at "infinity" with a magnification of 1 with good optical quality.

In such a configuration, the presence of an eyepiece is not necessary. However, this implies

In the second configuration illustrated in FIG. 4, the user sees the scene with their eye O for the part of the field of view, which is not obscured by the screen **36** and sees the other part of the scene by looking at the screen **36**. The part of the field of view that is not obscured by the screen **36** is denoted by CVO (visual field seen directly by the eye) and the part of the scene by looking at the screen **36** is denoted by CVE (visual field seen directly by the screen **36**). The sighting direction being common to both configurations, the sighting direction is denoted by DV.

The other part of the scene being at "infinity," the user's brain merges the two images.

The second configuration works even if the scene displayed on the screen **36** is with a higher magnification than 1, i.e., with a magnifying effect.

When the distance of the sight **20** is correctly adjusted (distance from eye to sight **20**) thus allowing each eye to convey an image consistent with each other in image size, brightness and color the brain merges (superimposes the two images) to give the impression of a single image.

The sight **20** is therefore a day/night sight for urban combat, the main features of which are being a short distance optronic sighting system. The term "short distance" in this context, is understood to mean a sighting distance of less than 200 meters.

Furthermore, the sight **20** is one of indirect view since the screen **36** is used.

The sight **20** is capable of operating without an eyepiece.

The sight **20** allows the user of the firearm **10** to have simultaneous firing and mobility capabilities. These capabilities are accessible to the user of the weapon by day or night.

The sight **20** offers the user the ability to fire with both eyes open.

The sight **20** also allows the user to perceive the environment at a short distance.

The use of the sight **20** allows the user to fire while remaining under cover. This advantage is independent of the illumination conditions so that the user can fire while remaining under cover both day and night.

According to the embodiments, the adaptation is implemented automatically or non-automatically.

The sight **20** offers the user great robustness.

The sight **20** also has a small space requirement and low weight, which ensures operational efficiency up to 400 meters.

The sight **20** also provides the user with rapid target acquisition, which may allow the user to save themselves in some cases. Notably, the operation of adjusting fire, i.e., placing the eye in the axis of the sight **20** is avoided. Since this operation is tricky, for sights **20** according to the prior art, the speed of acquisition of the target is much slower.

Furthermore, the sight **20** may be produced at a reduced cost.

Thus, the sight **20** makes the firearm **10** suitable for urban combat regardless of the lighting conditions. As a result, the firearm **10** is usable both by day and by night.

The sight **20** is compatible with night vision goggles.

Other embodiments are also possible for the sight **20**.

Another embodiment of the sight **20** is shown in FIG. 5.

The sight **20** according to FIG. 2 and the sight **20** according to FIG. 5 being similar, only the differences between the two sights **20** are described in what follows. The valid remarks for both sights **20** are not repeated here for ease of reading.

In the example of FIG. 5, the measuring sensor **34** (FIG. 2) is the image sensor **44** (FIG. 2) of the camera **30**.

Furthermore, the screen **36** is adjustable between at least two distinct positions.

For example, the screen **36** is mounted on a ball joint so that the screen **36** is adjustable along all the possible axes.

The screen **36** is further provided with a protective bellows.

It should be noted that the lateral positions offset to the right or the left are also possible for a lateral observation in a firing position concealed behind an obstacle, like a wall.

In such an embodiment, the advantages mentioned for the sight **20** according to the embodiment of FIG. 2 are also valid.

Furthermore, the sight **20** of FIG. 5 is lighter and the sight **20** makes other firing configurations possible, such as firing at the hip from above or laterally for concealed fire. These configurations have operational advantages.

Other variants are also conceivable.

According to another variant, the measuring sensor **34** (FIG. 2) comprises two separate sensors, a first sensor intended for daytime illumination conditions and a second sensor intended for night-time illumination conditions.

Such a variant gains in accuracy at the expense of the weight of the sight **20**.

According to one variant, the merging between the two images also makes it possible to transmit information to the user via the screen **36**.

When the distance of the sight **20** is correctly adjusted (thus allowing each eye to convey an image consistent with one another in image size, brightness and color) the brain merges (superimposes the two images) to give the impression of a single image on which the information is embedded on the screen **36**.

In a specific embodiment, the information is the operating information on the firearm **10**.

The information is, for example, sighting information.

As a variant, the information is operating information for the sight **20**, such as the battery charge level.

According to an alternative or additional embodiment, the information on the screen **36** is a sight reticle.

For example, the sight reticle is a cross.

In such a variant, the user of the firearm **10** (FIG. 1) has speedy access to the information that the user needs to make their decision. Such speed increases the user's responsiveness to a threat.

Advantageously, the sight reticle is usually displayed in black, creating a contrast with the screen **36**.

By definition, subsequently, the reticle/screen **36** contrast is defined as the difference between the luminance of the reference white of the screen **36** and the luminance of the color selected for displaying the sight reticle on the screen **36**.

The controller **38** (FIG. 2) is also capable of controlling the reticle/screen **36** contrast according to the illumination measured by the sensor **34**.

As a variant, the controller **38** uses a database comprising a set of reticles, each reticle being associated with a set of usage conditions. The controller **38** is then capable of determining the conditions for a given situation and selecting the suitable reticle in the database.

According to a variant, the magnification of the camera **30** is adjustable to exactly match the natural magnification of the user of the firearm **10**.

According to another variant, the sight **20** also comprises a light source arranged for using the optical system **42** (FIG. 2) of the camera **30**.

For example, the light source is a light-emitting diode capable of emitting in a range of non-visible wavelengths but detectable by the camera **30**.

Typically, the range of wavelengths is included in the infrared domain.

For example, depending on the types of observation, the wavelength ranges are one or more of the following: a wavelength range between 400 nm and 600 nm, a wavelength range between 500 nm and 900 nm and a range between 400 nm and 1200 nm, a wavelength range between 2 μm and 5 μm (also known as band 2) and a wavelength range between 8 μm and 12 μm (also known as band 3).

As a variant, the light source is a laser.

According to a particular case, the intensity of the light source is adjustable.

According to another particular case, the sight **20** is provided with a diffuser the position of which is adjustable, the diffuser being on the path of the light source in the case where it is desired to designate the target.

In this variant, the fact that the sight **20** has a wider bandwidth than all the night vision systems conventionally deployed on the battlefield is advantageously used for providing the sight **20** with an additional function of target designation or of illumination of an environment.

According to another variant, the screen **36** comprises multiple operating modes.

For example, according to a particular case, the screen **36** comprises a mode termed "night vision through goggles" wherein the screen **36** displays a residual brightness to enable the use of night vision goggles. The residual brightness is the brightness that would be observed with the naked eye by a user equipped with night vision goggles.

In one particular case, the transition into the mode termed "night vision" is performed with the aid of an addition of an attenuating filter.

For example, the position of the attenuating filter is controllable by the control button **32**.

Such an operating mode allows the use of the firearm **10** with night vision goggles.

Using a mode termed "night vision through goggles" adapting the brightness of the screen **36** to the sensitivity of the goggles thus allows the superimposition of the view of the observed scene through goggles and the image displayed by the screen **36**. The experiments conducted by the applicant have shown that the sight **20** could be used with an efficiency of over 100 meters against 25 meters for a sight **20** of the prior art. Furthermore, for the user, the ease of acquisition is much superior with the sight **20** as described.

According to another particular case, the sight **20** has a "direct view" mode and a "through-screen view" mode.

For this, the sight **20** is provided with a direct optical view.

The mechanism comprises, for example, prisms or reflecting strips.

In a particular example, the switching of the mechanism is controlled from outside by the user.

According to another particular example, the switching of the mechanism is controlled by the controller **38** (FIG. 2) and thus by the ambient lighting conditions.

The advantage of such a sight **20** lies in benefiting from the best of the two views (direct and indirect) and notably increasing the autonomy of operation.

As a variant, the optical system **42** (FIG. 2) comprises a mechanical and non-digital magnifier.

For example, the optical system **42** is provided with a retractable magnifying lens having at least two positions, each position corresponding to a different magnification of the system.

For example, in the first position, the magnifying lens makes it possible to obtain a first magnification G1 in the first position and the magnifying lens makes it possible to obtain a second magnification G2 in the second position.

The present disclosure corresponds to all technically possible combinations of the previously described embodiments.

Claims

1. A sight for use by day and at night, the sight comprising: the camera and the screen configured so that a user of the sight sights the target with both eyes open.

> an attachment interface for attachment to a firearm,
>
> a camera for acquiring a part of an environment for sighting a target,
>
> a measuring sensor for measuring illumination of the environment of the sight,
>
> a screen for displaying the part of the environment acquired by the camera, the screen having a brightness, and

2. The sight of claim 1, wherein the screen has a diagonal, the dimension of which is between 4 centimeters and 6 centimeters.

3. The sight of claim 1, wherein the controller is configured to display a sight reticle on the screen and to control a contrast between the sight reticle and the screen according to the measured illumination.

4. The sight of claim 1, wherein the camera has a magnification of between 0.95 and 1.05.

5. The sight of claim 1, further comprising a control button for determining an operating mode of the camera (30), a first operating mode being wherein a magnification of the camera is between 0.95 and 1.05, and a second operating mode being wherein the magnification of the camera is between 1.95 and 2.05.

6. The sight of claim 1, wherein the camera comprises an image sensor, the measuring sensor being the image sensor.

7. The sight of claim 1, wherein the screen is adjustable between at least two distinct positions (P1, P2).

8. The sight of claim 1, further comprising a direct optical view, switching between a view with the screen and the direct optical view being controlled by the controller according to the measured illumination.

9. A firearm comprising a sight for use by day and at night, the sight comprising: the camera and the screen configured so that a user of the sight sights the target with both eyes open.

an attachment interface for attachment to the firearm,

a camera for acquiring a part of an environment for sighting a target,

a measuring sensor for measuring illumination of the environment of the sight,

a screen for displaying the part of the environment acquired by the camera, the screen having a brightness, and between 8 centimeters and 15 centimeters when the user's head is resting on the support.

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