

Druckexemplar

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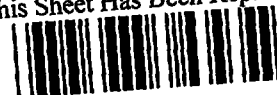
5 The present invention relates to weapon sights, and more particularly to a weapon aiming system having both day and night aiming capability.

10 Military and law enforcement personnel who use weapons, such as handguns and rifles, have long sought ways to improve their aim. By improving their shooting accuracy, an operator increases his own effectiveness and chance of survival, while minimizing the possibility of innocent bystanders being shot.

15 Virtually every handgun and rifle comes equipped with a mechanical bore sight. The typical bore sight comprises a first upstanding member at the far end of the barrel and a second upstanding member at the close end of the barrel. The two members are of equivalent height. To use the bore sight, the operator visually sights down the length of the
20 barrel of the gun, aligning the tops of the two members with the desired target. Usually, one or both of the members are laterally and vertically adjustable, so that the sight can be accurately calibrated for the particular operator.

25 It is also typical for operators of weapons to use the mechanical bore sight in conjunction with an optical scope. The scope would be mounted onto the upper surface of the weapon between the bore sight and the operator, and is usually equipped with magnification, such as three
30 times magnification (3x). The operator can see the bore sight through the scope, as well as the distant target. This combination of bore sight and scope enables the operator to accurately aim at and strike these distant

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targets. However, it should be apparent that this sighting method is only operable in daylight conditions.

Modern technology has enabled great advances in weapon sighting. Most notably, the use of lasers has
5 resulted in great improvements in sighting accuracy. A laser sight for a weapon comprises a low intensity laser which is mounted on top of the weapon. When the laser is activated, it points in the direction parallel to the barrel of the weapon. The spot of light formed by the
10 laser provides a reticle for the operator to aim with. The operator simply shines the laser spot on the desired target. By seeing the laser spot on the desired target, the operator has instant feedback information assuring that the weapon is accurately aimed. The use of laser
15 sighting systems can enable even relatively inexperienced operators to accurately hit their desired targets.

A significant drawback with laser sighting systems is that the laser light is also visible to observers, which can trace the source of the laser light back to the
20 operator. This would effectively give away the location of the operator, putting him at risk to retaliation by hostile forces. This problem is compounded at night, when hostile forces are utilizing night vision systems which can see the infrared light beam generated by the laser
25 sight.

To solve this problem, one could design a passive sighting system utilizing a red-light source, such as a light emitting diode (LED), mounted at a point at the near end of the weapon barrel,
30 and a combining mirror placed further down the length of the barrel and facing the LED. The mirror would have a coating which reflects red light yet allows all other frequencies of light to pass through. The red light formed by the LED would be reflected in the mirror, and be collimated in a
35 direction parallel to the gun barrel and toward the operator, to form a virtual image of the red LED at an

infinite distance aligned with the barrel. The virtual image would provide a reticle for the operator which cannot be seen by others. The operator would look through the mirror, see the distant target and the virtual image of the red LED suspended at the sight point of the weapon. To aim the weapon, the operator would center the virtual image on the desired target. As with earlier systems, the position of the mirror could be adjusted to calibrate for alignment with the barrel, and for the specific operator. This passive red dot aiming system could enable the operator to accurately strike his target, without illuminating the target or broadcasting his position.

A problem with this type of passive system, would be that it is only effective during daylight conditions. At night, the operator would be unable to see the distant target, although the red light would continue to be visible. To remedy this problem, a night vision system could be utilized. A night vision system intensifies the ambient light to produce an image. These systems require some residual light, such as moon or starlight, in which to operate. The ambient light is intensified by the night vision system to produce an output image which is visible to the human eye. The present generation of night vision systems utilize image intensification technologies to intensify the low level of visible ambient light and also make visible the light from the infrared (IR) spectrum. The image intensification process involves conversion of the received ambient light into electron patterns and projection of the electron patterns on a phosphor screen for conversion of the electron patterns into light visible to the observer. This visible light is then viewed by the operator through a lens provided in the eyepiece of the system.

Night vision systems could be either mounted to the weapon itself, or could be worn by the operator as a goggle in either a face mask mounted or helmet mounted

configuration. When mounted to the weapon, the night vision systems could use 3x magnification as in the day light optical scopes. In contrast, night vision systems used as a goggle would not use 3x magnification, but
5 instead would remain at one times (1x) magnification, otherwise it would be difficult for the operator to function.

Night vision systems combined in a single optical scope with a passive red dot aiming system providing an internal reticle could provide an
10 operator with accurate aiming capability at night, or in conditions of darkness. However, the operator would be unable to use the same system during the day. Operation of a night vision system during daylight would quickly cause damage to the internal image intensification tube. Thus
15 the operator would have to remove the combined night vision red dot aiming system from the weapon and replace it with a red dot aiming system for use during daylight hours. Each time the aiming device was changed it would have to be recalibrated or re-aligned for the weapon and
20 for the operator. In addition, the operator would have to carry both a daytime red dot aiming system, and a combined night vision scope/red dot aiming system for use at night. Since most law enforcement and military forces operating at night already utilize either face mask mounted or
25 helmet mounted night vision systems, as described above, the use of a combined night vision scope/red dot aiming system would be redundant.

Combination scopes having night vision capability and red dot aiming systems which are switchable between day and night use are available in the prior art. These
30 combination devices utilize a plurality of internal hinged mirrors to allow the observed image and reticle dot to bypass the image intensification tube during daytime usage. The operator can reconfigure the mirrors to direct
35 the ambient light into the image intensification tube when desired. While this combined scope enables the operator

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to use the red dot aiming system in both daylight and night conditions, it adds considerable weight, bulk and complexity to the weapon. This is especially apparent during daytime, when the additional weight of the night
5 scope portion is not in use. A further problem with this combination is that the plurality of moving mirrors can easily fall out of alignment, rendering the device useless.

US-A-4822994 discloses a three piece structure two
10 of which pieces form an optical aiming portion in the form of a daytime telescopic sight and the first of which pieces has means for mounting the aiming portion onto a weapon. By detaching the second of the pieces and inserting the third between the first two, the
15 third being an image intensifier module, a nighttime facility is provided.

US-A-4629295 discloses another night vision system in which the night vision system is combined with a daytime viewing system. The optical output of the
20 night vision system is transmitted into the optical, daytime, system.

DE-A-3423320 and UK-A-2084347 disclose a night sight showing how to integrate an aiming image, provided by a light source, into the night sight. No
25 separate daytime use of such aiming image is thus catered for.

According to the invention there is provided a modular weapon aiming system operable during day and night conditions for use with a weapon having a barrel,
30 the system comprising:

an optical aiming portion having means for mounting the aiming portion to the weapon; and a night vision portion for intensifying a received image, the

night vision portion not being permanently coupled to the aiming portion and being arranged to be positioned so as to be used in conjunction with the aiming portion, characterised in that the aiming portion has a
5 light source and is arranged to produce a virtual image of the light source at an infinite distance in substantially linear alignment with a barrel, the virtual image providing a reticle, and the night vision portion being positionable in substantially linear
10 alignment behind the aiming portion to render the reticle visible through the night vision portion.

It will thus be seen that the present invention may be implemented so as to provide: a modular, day/night, aiming system which combines a red dot
15 aiming system with a night vision system; a modular, day/night, aiming system wherein the red dot aiming system does not need to be recalibrated when switched between day usage and night usage; a day/night aiming system which combines a red dot aiming system with a
20 night vision system in which the night vision system can be simply removed from the weapon for usage during the day; and a modular, day/night, aiming system which combines a red dot aiming system with a helmet mounted or face mask mounted night vision system.

25 For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, wherein:

Fig. 1 shows a perspective view of a day/night
30 aiming system according to an embodiment of the present invention, mounted to an assault type weapon;

Fig. 2 shows a block diagram of the embodiment of Fig. 1;

Fig. 3 shows a side view of the embodiment of Fig. 1;

Fig. 4 shows a side view of the embodiment of Fig. 1 with the night vision portion removed;

5 Fig. 5 shows a perspective view of a second embodiment of the present invention; and

• Fig. 6 shows a perspective view of a third embodiment of the present invention.

5 Law enforcement and military forces have a critical need for accurate weapon aiming systems for use during either day or night conditions. The day/night aiming system of the present invention is shown in Fig. 1, as mounted to an assault weapon.

10 Referring next to the diagram of Fig. 2, there is shown a red dot aiming system 10 used in conjunction with a night vision system 30. The red dot aiming system 10 has a light source 12 and combining mirror 14. It is anticipated that the light source comprise a red light
15 emitting diode (LED), because of the LED's high reliability, low weight, and low power consumption. The combining mirror 14 is provided of a transparent material and has a coating which reflects only red light frequencies; substantially all other frequencies of light
20 are visible through mirror 14. The mirror 14 has a concave surface facing in the direction of operator 5, which collimates the reflected light so that it appears to come from an infinite distance.

The night vision system 30 has an eyepiece 32, an
25 image intensification tube 36 and an objective lens 34. Ambient light, denoted by the broken arrows, passes through the objective lens 34 and is focused onto image intensification tube 36. As well known in the art, the image intensification tube 36 provides a visible image
30 which can be seen by operator 5 through eyepiece 32.

An image intensification tube converts the light image projected through objective lens 34 to an electron pattern. The electrons are multiplied, and transmitted onto a phosphor screen. The phosphor screen produces a
35 light image corresponding to the electron pattern, and is seen by the operator looking through eyepiece 32.

As shown in Fig. 2, the image of the red LED 12 is reflected in mirror 14, into a lower portion of objective lens 34. It should be apparent that light striking objective lens 34 which is parallel to the line of sight 62 of the lens, as denoted by the broken lines, will appear at the center of the image intensification tube 36. Since the night vision system 30 is aligned with the bore sight of the weapon, the reticle dot will appear in the center of the field of view of eyepiece 32, as a generally whitish dot in the generally greenish scene generated by the night vision system.

Now referring to Fig. 3, there is shown a red dot aiming system 10 in conjunction with monocular night vision scope 30, both mounted onto weapon 20. The red dot aiming system 10 shown is the Elbit FALCON Red-Dot Aimer, which is commercially available. The weapon 20 shown is an M-16 assault rifle, which is currently in use by the United States and various other military and police forces around the world. The weapon 20 has a barrel 22, a grip 24, and a stock 26. It should be apparent that the above principles can be readily applied to any other type of red dot aiming system and any other type of weapon.

Red dot aiming system 10 has a housing 16 which provides a mounting surface 18 for attachment to the exemplary weapon 20. The housing 16 has a forward attachment 42 and a rear attachment 44, which both attach to weapon barrel 22. Manipulation of adjustments 42 and 44 changes the linear alignment of red dot aiming system 10 with barrel 22, and is performed by the operator to calibrate the system. The raised portion 52 of housing 16 provides a mounting ring to hold mirror 14. LED 12 is provided in a rear portion of housing 16, at a point closer in position to the operator. The LED 12 and mirror 14 are shrouded so that reflected light from the LED is not directly visible from the side or front of housing 16 to other observers.

The red dot aiming system 10 is calibrated by the operator so that the virtual image of LED 12 appears at an infinite distance in linear alignment with the barrel 22 of the weapon 20. Anywhere the operator places his eye within a range of ± 20 degrees relative to the stock 26 of weapon 20, the virtual image of the red dot observed in mirror 14 will always be aligned with barrel 22. Thus, the operator using the red dot aiming system 10 can accurately aim the weapon to strike a desired target by centering the reticle dot on the target and firing the weapon.

Night vision system 30 is also shown in Fig. 3, mounted on weapon 20 in a position behind that of the red dot aiming system 10. The exemplary night vision system 30 is of the monocular type, and has an optical portion comprising an eyepiece 32, an objective lens 34, a sleeve 38, and a housing 46 attached to the optical portion. The image intensification tube 36, substantially described above, is contained within sleeve 38. As known in the art, ambient light enters objective lens 34, is processed by image intensification tube 36, and is observed by looking into eye piece 32.

Mounting plate 48 is provided on housing 46 to attach the night vision system 30 to weapon 20. The mounting plate 48 has a dovetail shape, and is configured to be engaged by carriage 54 which is secured to the weapon 20. The carriage 54 mechanically secures the mounting plate 48, but is intended to allow the operator to easily remove the night vision system 30 from the weapon 20 by disengaging the carriage 52.

There are four anticipated modes of operation for the day/night aiming system. During night usage, the operator can use the red dot aiming system 10 in conjunction with either a mounted or unmounted night vision system 30. Fig. 3 shows the first mode of operation as having the red dot aiming system 10

and night vision system 30 mounted to weapon 20, as substantially described above. In this embodiment, the objective lens 34 would have 3x magnification, and would be of a diameter greater than that of mirror 14. Accordingly, the field of the night vision system 30 would be larger than, and would encompass that of, mirror 14 of red dot aiming system 10. The virtual image of the red LED 12 would appear as a white dot centered on the phosphor screen of image intensifier tube 36.

The block diagram of Fig. 2 shows the line of sight 62 of observer 5 passing through night vision system 30 and above mirror 14. Since objective lens 34 has 3x magnification, the observer looking through eyepiece 32 would be viewing light which has partially passed through mirror 14. Thus, in this mode of operation, the operator can focus on a distant target, while looking partially through mirror 14. It should be apparent from the above discussion, that alignment of the night vision system 30 to the weapon 20 is unnecessary, since only the red dot aiming system 10 need be calibrated, and that removal or installation of the night vision system 30 does not alter the calibration of the red dot aiming system 10.

In the second mode of operation, the red dot aiming system 10 mounted on weapon 20 would be further used in conjunction with a night vision system 30 which is detached from weapon 20. The night vision system 30 can be either a helmet mounted system, as shown in Fig. 6, or a face mask mounted system, as shown in Fig. 5. These systems typically use 1x magnification only, since it would be too difficult for an operator to function normally with high powered lenses. Using either of these night vision systems, the operator can continue to use the red dot aiming system 10, so long as the night vision system is positioned within the field of view of mirror 14. As described above, a white reticle dot image is formed on the image intensification tube 42,

corresponding with the bore sight of weapon 20. However, the reticle dot image will only appear centered in the field of view of the night vision system if held in alignment with the barrel 22. Further, the line of sight of the detached night vision system 30 must coincide with the line of sight 64 of the mirror 14, as shown in Fig. 2.

The third and fourth modes of operation are during daylight conditions, in which the night vision system 30 is no longer required and can be simply removed from its mount on weapon 20. This third mode of operation is shown in Fig. 4. The red dot aiming system 10 would continue to be operational, and would not require any additional calibration. Since the estimated weight of the night vision system 30 is 620 grams, it should also be apparent that the removal of the night vision system 30 would significantly reduce the effective weight of weapon 20.

Finally, in the fourth mode of operation, the operator can install a daylight vision scope having 3x magnification. The daylight scope would mount into carriage 54, in place of the night vision system 30. As with the first mode of operation, the operator would see the reticle dot in the center of the eyepiece of the daylight scope.

It will be apparent to those skilled in the art that the light source need not be a red dot but could have other color components, although it is preferably matched to the mirror's transmission properties so that the light is reflected back to the operator.



Claims:

1. A modular weapon aiming system operable during day and night conditions for use with a weapon (20) having a barrel (22), the system comprising:
5 an optical aiming portion (10) having means (42, 44) for mounting the aiming portion to the weapon; and
a night vision portion (30) for intensifying a received image, the night vision portion not being permanently coupled to the aiming portion (10) and
10 being arranged to be positioned so as to be used in conjunction with the aiming portion (10), characterised in that the aiming portion (10) has a light source (12) and is arranged to produce a virtual image of the light source (12) at an infinite distance in substantially
15 linear alignment with a barrel (22), the virtual image providing a reticle, and the night vision portion (30) being positionable in substantially linear alignment behind the aiming portion to render the reticle visible through the night vision portion.

~~20 2. An aiming system according to Claim 1, wherein the light source (12) is a red-light emitting diode (LED).~~

~~3. An aiming system according to Claim 1 or 2 wherein the aiming portion (10) comprises a combining
25 mirror (14).~~

~~4. An aiming system according to Claim 3, wherein the mirror (14) is formed of a substantially transparent material which reflects substantially only light frequencies contained in the emission spectrum of
30 its light and which has a generally concave surface facing in the rearward direction.~~

~~5. An aiming system according to Claim 3 or 4, wherein the aiming portion further comprises a housing (16) having a mounting ring (52) holding the mirror
35 (14) and a shroud surrounding the edges of the mirror
to shield the mirror from undesired lateral~~



Claims:

1. ~~A modular weapon aiming system operable~~
during day and night conditions for use with a weapon
(20) having a barrel (22), the system comprising:
 - 5 an aiming portion (10) having a light source (12)
and means (42, 44) for mounting the aiming portion to
the weapon, the aiming portion being arranged to
produce a virtual image of the light source (12) at an
infinite distance in substantially linear alignment
10 with a barrel (22), the virtual image providing a
reticle; and
a night vision portion (30) for intensifying a
received image, the night vision portion not being
permanently coupled to the aiming portion (10) and
15 being arranged to be positioned in substantially linear
alignment behind the aiming portion to render the
~~reticle visible through the night vision portion.~~
2. An aiming system according to Claim 1,
wherein the light source (12) is a red-light emitting
20 diode (LED).
3. An aiming system according to Claim 1 or 2
wherein the aiming portion (10) comprises a combining
mirror (14).
4. An aiming system according to Claim 3,
25 wherein the mirror (14) is formed of a substantially
transparent material which reflects substantially only
light frequencies contained in the emission spectrum of
its light and which has a generally concave surface
facing in the rearward direction.
- 30 5. An aiming system according to Claim 3 or 4,
wherein the aiming portion further comprises a housing
(16) having a mounting ring (52) holding the mirror
(14) and a shroud surrounding the edges of the mirror
to shield the mirror from undesired lateral
35 observation.
6. An aiming system according to any one of



Claims 1 to 5, wherein the night vision portion (30) comprises an eyepiece (32), an objective lens (34) and an image intensification tube (36).

7. An aiming system according to Claim 6,
5 wherein the aiming portion (10) is arranged to produce an image of the light source (12), visible through the eyepiece (32) in substantially linear alignment with the barrel (22) when the aiming portion is mounted on a weapon and the night vision portion (3) is positioned
10 in substantially linear alignment behind the aiming portion.

8. An aiming system according to Claim 6 or 7 when appended to Claim 3, wherein the diameter of the mirror (14) is smaller than the diameter of the
15 objective lens (34).

9. An aiming system according to Claim 6, 7, or 8, wherein the objective lens (34) is arranged to provide three times magnification.

10. An aiming system according to any one of the
20 preceding claims, wherein the night vision portion (30) is monocular.

11. An aiming system according to any one of the preceding claims, wherein the mounting means (42, 44) comprises a mounting plate arranged to be lockably
25 received by a carriage affixed to the weapon.

12. An aiming system according to any one of the preceding claims, comprising means for mounting the night vision portion (30) on a weapon in said substantially linear alignment behind the aiming
30 portion (10), so that the night vision portion (30) can be removed from a weapon during day usage.

13. An aiming system according to any one of Claims 1 to 11, wherein the night vision portion (30) is detached from the weapon.

35 14. An aiming system according to Claim 13, wherein the night vision portion (30) is arranged to be



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mounted to a face mask.

15. An aiming system according to Claim 13, wherein the night vision portion (30) is arranged to be mounted to a helmet.

- 5 16. A weapon having a barrel (22), the weapon comprising a modular weapon aiming system according to any one of the preceding claims and a carriage for receiving the aiming portion (10) of the system.