

SYSTEM FOR IDENTIFYING AT LEAST ONE BEACON

FIELD OF THE INVENTION

5 The technical field of the invention concerns systems for identifying beacons with night vision goggles or a night vision scope, in particular in dim lighting conditions. The beacons may be carried by individuals, animals, vehicles, or placed in strategic locations.

The invention particularly advantageously applies in the military field. Indeed, for friend or foe
10 identification on a battlefield, also known under the acronym IFF for "*Identification, Friend or Fo*
e", the beacons may be carried by the soldiers. In this context, the invention enables a soldier equipped with a scope or with goggles to identify friendly forces, reliably and inconspicuously. Thus, this system enables to prevent friendly fire incidents and to optimize the coordination
15 between friendly units, while providing a response capability adaptable to the various operational scenarios.

BACKGROUND

In the context of military operations, it is known to use night vision devices **110**. As
20 schematically illustrated in Figures 1 and 3 of the state of the art, a night vision device **110** is conventionally in the form of a scope intended to be placed in front of a sensor, a user's eye, or both eyes when two devices are juxtaposed to form night vision goggles, also known under the acronym **NVG**.

25 This night vision device **110** integrates a plurality of elements placed on the optical axis **a1** of the sensor or of the user's eye, to transform the image of the observed scene. More specifically, the scope comprises, from the scene external to the sensor or to the user's eye, a lens **12**, an image intensifier tube **130**, and an eyepiece **14**. Lens **12** conventionally comprises one or a plurality of lenses enabling to capture the photons of the electromagnetic radiation of the observed scene.
30 Eyepiece **14**, similarly to lens **12**, comprises one or a plurality of lenses enabling to capture and incidentally to visualize the photons of the light signal transmitted by image intensifier tube **130**.

Image intensifier tube **130** comprises at least three distinct elements: a photocathode **16**, an electron multiplier **18**, and a phosphorescent screen **20**.

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Photocathode **16** is in the form of a semi-transparent photosensitive layer receiving the photons of the incident electromagnetic radiation, that is, the photons transmitted by lens **12**. For this purpose, an input window **15** transmits the photons from lens **12** to photocathode **16** while guaranteeing the tightness of the external wall **23** of image intensifier tube **130**.

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Photocathode **16** is generally made in the form of a thin metal or semiconductor film placed against a layer of glass or of a material transparent to light. The material of photocathode **16** is selected according to its sensitivity to the image of the observed scene. The interaction of the photons of the incident electromagnetic radiation of the observed scene with photocathode **16** causes, by photoelectric effect, the emission of electrons, referred to as photoelectrons.

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These photoelectrons are then submitted to a first electric field within a first acceleration area **17**, enabling to direct photoelectrons towards electron multiplier **18**. This first electric field is created by applying a voltage between photocathode **16** and electron multiplier **18**, typically a voltage in the order of from 50 to 500 volts to guarantee at best a rectilinear path of electrons.

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Electron multiplier **18**, also referred to as electron amplifier, conventionally comprises a microchannel plate **25** covered with electrodes. This microchannel plate is also known under the acronym GMC in French or MCP in English literature. It is formed in a plate of resistive or dielectric material with a thickness typically in the range from 0.2 to 1 millimeter.

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The microchannels **25** of this plate have an axis of revolution $\alpha 2$ inclined by an angle $\alpha 3$ of a few degrees, typically between 4 and 12 degrees, relative to the normal to the surface of electron multiplier **18**, so as to induce multiples collisions of photoelectrons **28** in microchannels **25**.

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In addition to the first electric field created between photocathode **16** and electron multiplier **18**, a second electric field is created between the input and the output of electron multiplier **18** by means of the electrodes placed on either side between the input and the output of microchannel plate **25**.

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This electric field enables to charge the internal semiconductor layer of microchannels **25**, so that the multiples collisions of photoelectrons **28** in microchannels **25** generate a high number of secondary electrons **29**. This electric field also enables, on the one hand, to accelerate the first secondary electrons **29** within microchannels **25**, so that these first secondary electrons **29** collide again with the surface of microchannels **25**, generating in turn other secondary electrons **29**, and so on, generating by this physical process a high number of secondary electrons **29**; and on the other hand to accelerate secondary electrons **29** by energy input, to orient them from the input of microchannels **25** to the output of microchannels **25**. Typically, the photoelectrons **28** are multiplied by a factor in the range from 10^2 to 10^4 in electron multiplier **18**.

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At the output of microchannels **25**, these secondary electrons **29** are then linearly displaced towards phosphorescent screen **20**, within a second acceleration area **19**, under the effect of a third electric field generated between the output of electron multiplier **18** and phosphorescent screen **20**, typically an electric field generated by a voltage in the range from 4 to 10 kV.

Phosphorescent screen **20** enables to transform the secondary electrons **29** into photons generating a light intensity. It is in the form of a phosphorescent layer or of a layer of a luminophore material deposited on a substrate, conventionally made of glass. At the output of phosphorescent screen **20**, the formed image is transmitted to eyepiece **14** by optical means, conventionally a fiber optic network **21**, possibly enabling to flip the image formed on phosphorescent screen **20** to obtain a correct viewing of the observed scene.

To generate the three electric fields, electronic components **22** are conventionally arranged around an inner vacuum enclosure **24**. The night vision system **110** thus formed thus comprises optical elements, electronic components **22**, and optionally a system for viewing the observed scene on eyepiece **14**.

A night vision system **110** currently available on the market conventionally enables to capture and to amplify photons over a wavelength range λ from 450 nanometers to 900 nanometers. More specifically, the operational wavelength range λ of a night vision system **110** is mainly conditioned by the sensitivity spectrum of photocathode **16**.

As illustrated in Figure 2, the sensitivity spectrum of photocathode **16** is defined according to the wavelength of the photons received by photocathode **16** and to the quantum efficiency, also known under the acronym **QE**, that is, to the ratio of the number generated photoelectrons **28** to the number of photons received by photocathode **16**. For a sensitivity spectrum of a night vision system **110** of the state of the art, quantum efficiency **QE** is conventionally greater than 1% between 450 nanometers and 900 nanometers and smaller than 0.001% outside this operational wavelength range λ .

In addition to the photons of the observed scene, this operational wavelength range λ also enables to capture signals.

For example, as described in document EP 0 560 470, an identification friend or foe (IFF) system may be implemented by using night vision goggles **NVG** to detect a beacon **B** carried by an ally. Figure 4 of the state of the art illustrates a possible implementation of the teachings of document EP 0 560 470. In this example, night vision goggles **NVG** are associated with a device **310** for activating beacon **B**. Thus, activation device **310** generates a signal **Sa** which activates beacon **B**

so that beacon **B** generates in return a manifestation signal **Sm** detectable via night vision goggles **NVG**. For this purpose, beacon **B** may use an infrared diode that flashes in the operational wavelength range λ of night vision goggles **NVG** when it is activated.

- 5 Other similar solutions are described in documents US5299227, US5375008, US20070236384, and WO2022/103941.

In all these solutions, the detection of beacons **B** is performed in the operational wavelength range λ of night vision system **110**. Now, the detection of a beacon **B** in operational wavelength range
10 λ necessarily degrades the quality of the obtained image since the signal received from a beacon **B** substitutes to the information of the observed scene.

Further, the development of night vision systems **110** on battlefields generates a decrease in the stealth of carriers of beacons **B** since the opposants/enemies may be equipped with night vision
15 goggles **NVG** also enabling to detect the manifestation signal **Sm** transmitted by beacons **B** since night vision goggles **NVG** are practically all sensitive in the wavelength range λ from 450 nanometers to 900 nanometers.

There thus exists a need to improve beacon identification systems of the state of the art so as to
20 guarantee the image quality and to preserve the stealth of beacon carriers.

DISCUSSION OF THE INVENTION

The invention provides addressing this technical problem by using night vision goggles or a
25 scope integrating a tube with an extended operational wavelength range to perform beacon detection outside the wavelength ranges used to form the images of the scene.

More specifically, the invention originates from an observation according to which the use of a diffraction grating interposed between the input window and the photocathode enables to
30 modify the shape of the operational wavelength range and to obtain a quantum efficiency in the range from 0.001 to 1% in a specific wavelength range, from 1,000 to 1,100 nanometers, preferably from 1,050 to 1,075 nanometers.

The invention thus provides using beacons emitting a manifestation signal between 1,000 and
35 1,100 nanometers, preferably between 1,050 and 1,075 nanometers, associated with night vision goggles or a scope integrating an image amplifier tube operating in a first wavelength range, referred to as image-forming wavelength range, to observe the scene and in a second wavelength range, referred to as detection wavelength range, to detect beacons.

Indeed, although the quantum efficiency is not sufficient in the detection wavelength range from 1,000 nanometers to 1,100 nanometers to form an image of the scene, this quantum efficiency is sufficient to capture beacon manifestation signals.

5 Thus, the invention concerns a system for identifying at least one beacon, the beacon integrating a device for emitting electromagnetic radiation at a wavelength in the range from 1,000 to 1,100 nanometers, the system comprising night vision goggles or a scope integrating an image amplifier tube comprising:

- an input window configured to receive and transmit photons;
- 10 ▪ a photocathode, bonded to an inner surface of said input window, capable of converting photons transmitted by the input window into photoelectrons; the photocathode having a sensitivity spectrum defined according to the wavelength of the photons received by the photocathode and to the quantum efficiency of the photocathode, that is, to the ratio of the number of generated photoelectrons to the number of photons received by the photocathode;
- 15 ▪ an electron multiplier capable of multiplying the photoelectrons into secondary electrons; and
- a phosphorescent screen transforming the secondary electrons into photons.

20 The invention is characterized in that the image amplifier tube also comprises a diffraction grating placed between the input window and the photocathode so as to diffract photons in said photocathode and to enable the photocathode to exhibit a quantum efficiency:

- higher than 1% in an image-forming wavelength range and;
- in the range from 0.001 to 1% in a detection wavelength range, distinct from said image-forming wavelength range, said detection wavelength range being at minimum from
- 25 1,000 to 1,100 nanometers;

said image amplifier tube being configured to capture an electromagnetic radiation emitted by said beacon in said detection wavelength range.

30 The characteristic according to which the detection wavelength range is at minimum from 1,000 to 1,100 nanometers is to be understood in correlation with the wavelength of the beacon. Thus, according to this characteristic, the detection wavelength range of the photocathode corresponds at least to the emission wavelength range of the beacon, selected between 1,000 and 1,100 nanometers.

35 The invention thus enables to detect beacons without degrading the formed images since the beacon detection wavelength is not comprised in the image-forming wavelength range, for example from 450 nanometers to 900 nanometers.

Further, the invention also improves the stealth of beacon carriers. Indeed, conventional night vision goggles, which detect photons in the wavelength range from 450 nanometers to 900 nanometers, cannot capture the manifestation signals of beacons in the wavelength range from 1,000 to 1,100 nanometers, preferably from 1,050 to 1,075 nanometers. Preferably, the image
 5 amplifier tube is configured to capture manifestation signals originating from the at least one beacon at a 1,064-nanometer wavelength.

Preferably, to obtain an efficient detection in the detection wavelength range, the photocathode is formed based on antimony and on at least one alkaline metal, such as NaKCs, SbNaKCs,
 10 SbNaK, SbKCs, SbRbKCs, or SbRbCs alloys.

In addition to the image amplifier tube, the night vision goggles or the scope may also comprise a beacon activation device. Preferably, this beacon activation device is configured to transmit an activation signal while the beacon comprises a module for receiving said activation signal,
 15 so as to transmit the electromagnetic radiation at the wavelength in the range from 1,000 to 1,100 nanometers in the form of a manifestation signal as a response to the activation signal transmitted by the activation device.

For example, the beacon activation device may be formed of a radio frequency transmitter or
 20 of an optical transmitter, the beacon reception module respectively corresponding to an antenna or an optical receiver. For an optical transceiver, the optical transmitter may be a laser diode with a wavelength in the range from 1,400 to 1,800 nanometers, and the beacon reception module may correspond to a photodiode capable of capturing a wavelength in the range from 1,400 to 1,800 nanometers. Indeed, the transmission and the reception of this activation signal
 25 in this wavelength range also ensures a significant stealth for the beacon carrier.

Further, to improve the range of the detection, the night vision goggles or the scope may be configured to observe a scene in which is placed a specific observation area defined by the emission angle of said activation device and the viewing angle of the night vision goggles or of
 30 the scope, the detection of said beacon being only performed in said specific observation area. Indeed, by targeting a specific area of its observation area, the emission angle of the activation device may be decreased to improve the range of the activation signal. Typically, it is possible to obtain a detection of a beacon at more than three kilometers (1.86 miles) with this strategy.

35 Further, the image amplifier tube may comprise a mechanism for regulating the light gain with a view to adapting the output luminance of the tube. This function is called "*auto-gating*" in literature and enables to limit saturation and to increase dynamics for scenes with very strong light intensity variations. This mechanism relies on the rapid detection of light variations to adjust, within a few milliseconds, the generation of photoelectrons and stabilize the brightness at

the output of the image intensifier tube typically between 6 and 12 candela/m² according to the types of phosphor used (green P43 or white P45).

5 The implementation of this auto-gating mechanism is performed by periodically adjusting the electric potential of the photocathode. Thus, when a significant brightness variation is detected at the output of the image intensifier tube, the auto-gating mechanism steps in to modify, within a few milliseconds, the duty cycle of the periodic voltage applied to the photocathode. This modification of the duty cycle enables to adapt the number of photoelectrons generated by the photocathode which will then be multiplied by the electron multiplier. The voltage applied across
10 the electron multiplier will itself be adjusted to adapt the number of secondary electrons and, accordingly, the output luminance of the tube.

This principle of adaptation of internal electric charges of the tube enables not to exceed the predetermined luminance threshold. This threshold is for example a MOB threshold, acronym
15 for the expression "*Maximum of Brightness*".

This dynamic control of the amplification guarantees not only a protection of the image intensifier tube against risks linked to too high a light intensity, but also offers a better vision of the observed scene by adapting the image resolution to the surrounding conditions, with no
20 saturation or visual dazzling phenomenon. Accordingly, operators benefit from a clearer and more stable night vision, even facing sudden light variations, which is crucial for applications such as military or surveillance operations.

However, the activation period specific to the level of the photocathode of the auto-gating
25 mechanism induces phases during which the image amplifier tube can detect no beacon. To avoid for the beacon to transmit a manifestation signal only outside detection ranges of the image amplifier tube, the beacon may be configured to transmit a signal for a significant time period longer than the specific activation period of the auto-gating mechanism.

30 However, this solution increases the power consumption, and thus the bulk, of beacons. To solve this problem with an asynchronous detection, the activation device may have a variable activation period. With this embodiment, the beacon can be detected when the specific activation period of the image amplifier tube coincides with the activation period of the activation device. This solution limits the necessary emission time of beacons but may generate a latency in the beacon
35 detection speed, the time for the two activation periods to coincide.

To avoid this latency, a synchronous detection may be performed by connecting the activation device with the device for managing the specific activation period of the auto-gating mechanism. In this embodiment, the activation device has an activation period synchronized to the specific activation period of the auto-gating mechanism of the image amplifier tube.

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BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood on reading of the following description, given as an example only, and made in relation with the appended drawings, where identical references designate identical or the like elements, and in which:

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Figure 1 shows a simplified cross-section view of a night vision device of the state of the art;

Figure 2 shows the variation of the quantum efficiency of the night vision device of Figure 1;

Figure 3 shows a perspective view of the night vision device of Figure 1;

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Figure 4 shows a simplified view of a beacon identification system of the state of the art implementing two night vision devices of Figure 1;

Figure 5 shows a simplified cross-section view of a night vision device according to the invention;

Figure 6 shows the variation of the quantum efficiency of the night vision device of Figure 5;

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Figure 7 shows a simplified view of a beacon identification system according to the invention implementing two night vision devices of Figure 5;

Figure 8 shows an example of images observed by night vision goggles integrating two night vision devices of Figure 7;

Figure 9 shows four timing diagrams of asynchronous triggering of a beacon with the identification system of Figure 7; and

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Figure 10 shows four timing diagrams of synchronous triggering of beacon with the identification system of Figure 7.

DETAILED DESCRIPTION OF THE INVENTION

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Figure 5 shows a night vision device **11** integrating an image intensifier tube **13** according to the invention. As illustrated in Figure 1 of the state of the art, night vision device **11** is in the form of a scope intended to be placed in front of a sensor, a user's eye, or both eyes when two devices are juxtaposed to form night vision goggles. This night vision device **11** integrates a plurality of elements placed on the optical axis **a1** of the sensor or of the user's eye so as to transform the image of the observed scene. More specifically, the scope comprises, from the scene external to the sensor or to the user's eye, a lens **12**, the image intensifier tube **13** of the invention, and an eyepiece **14**.

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As previously described, lens **12** comprises one or a plurality of lenses enabling to capture the photons of the electromagnetic radiation of the observed scene. Eyepiece **14**, similarly to lens **12**, comprises one or a plurality of lenses enabling to capture and incidentally to visualize the photons of the light signal transmitted by image intensifier tube **13**.

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Image intensifier tube **13** comprises at least three distinct elements integrated in an inner vacuum enclosure **24**: a photocathode **16**, an electron multiplier **18**, and a phosphorescent screen **20**.

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As previously described, photocathode **16** appears in the form of a semitransparent photosensitive layer receiving the photons of the incident electromagnetic radiation, that is, the photons transmitted by lens **12**. For this purpose, an input window **15** transmits the photons from lens **12** to photocathode **16** while guaranteeing the tightness of an outer wall **23** of image intensifier tube **13**.

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Photocathode **16** is generally made in the form of a thin metal or semiconductor film placed against a layer of glass or of a material transparent to light. The material of photocathode **16** is selected according to its sensitivity to the image of the observed scene. The interaction of the photons of the incident electromagnetic radiation of the observed scene with photocathode **16** causes, by photoelectric effect, an electron emission.

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More specifically, photocathode **16** is bonded to a diffraction grating **30**, itself bonded to an inner surface of input window **15**.

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Diffraction grating **30** is formed of a periodic arrangement of patterns, for example indentations, dents, recesses, notches, or stripes, formed in input window **15**. A diffraction material is preferably placed between the patterns of the diffraction grating **30** of input window **15** to form a planar surface for the deposition of photocathode **16**. For example, input window **15** may be made of glass, quartz, or borosilicate glass. The patterns of the diffraction grating **30** of input window **15** may be formed by known etch techniques, such as holography, ion etching, and/or diamond etching techniques.

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The patterns are then preferably filled with a diffraction material having an optical refraction index n different from that of input window **15**, such as for example Al_2O_3 ($n \sim 1,7$), TiO_2 ($n \sim 2,3-2,6$), Ta_2O_5 ($n \sim 2,2$), or HfO_2 . This diffraction material may be deposited by known physical vapor deposition techniques, such as cathode sputtering, evaporation, or electron beam physical vapor deposition, also known under the acronym EBPVD.

The difference between the optical indices of the diffraction material present in said patterns and of the material of input window **15** is preferably greater than or equal to 0.2.

Photocathode **16** is preferably made of a semiconductor material, preferably an alkaline compound based on antimony. Such an alkaline material may be selected from among the following materials: SbNaKCs, SbNa₂KCs, SbNaK, SbKCs, SbRbKCs, or SbRbCs. Preferably, photocathode **16** is made of antimony and sodium.

At the output of photocathode **16**, the emitted electrons, referred to as photoelectrons, are then submitted to a first electric field within a first acceleration area **17** enabling to direct the photoelectrons to electron multiplier **18**. This first electric field is formed by applying a voltage between photocathode **16** and electron multiplier **18**, typically a voltage in the range from 50 to 500 volts to guarantee a rectilinear path of electrons.

In addition to the first electric field created between photocathode **16** and electron multiplier **18**, a second electric field is created between the two surfaces of electron multiplier **18** by means of the electrodes placed on either side of microchannel plate **25**.

This electric field enables to charge the internal semiconductor layer of microchannels **25** so that the multiples collisions of photoelectrons **28** in microchannels **25** generate a high number of secondary electrons **29**. This electric field also enables, on the one hand, to accelerate the first secondary electrons **29** within microchannels **25**, so that these first secondary electrons **29** collide again with the surface of microchannels **25**, generating in turn other secondary electrons **29**, and so on, generating by this physical process a high number of secondary electrons **29**; and on the other hand to accelerate secondary electrons **29** by energy input, to orient them from the input of microchannels **25** to the output of microchannels **25**. Typically, photoelectrons **28** are multiplied by a factor in the range from 10^3 to 10^6 in electron multiplier **18**. At the output of microchannels **25**, these secondary electrons **29** are then linearly displaced towards phosphorescent screen **20**, within a second acceleration area **19**, under the effect of a third electric field generated between electron multiplier **18** and phosphorescent screen **20**, typically an electric field generated by a voltage in the range from 4 to 10 kV.

Phosphorescent screen **20** enables to transform secondary electrons **29** into photons generating a light intensity. It appears in the form of a phosphorescent layer or of a layer of a luminophore material deposited on a substrate, conventionally made of glass.

At the output of phosphorescent screen **20**, the formed image is transmitted to eyepiece **14** by optical means, conventionally a fiber optic network **21** possibly enabling to turn over the image formed on phosphorescent screen **20** to obtain a correct viewing of the observed scene.

- 5 To generate the three electric fields, electronic components **22** are conventionally arranged around inner vacuum enclosure **24**. The night vision system **11** thus formed thus comprises optical elements, electronic components **22**, and possibly a system for viewing the observed scene on eyepiece **14**.
- 10 As illustrated in Figure 6, the image intensifier tube **13** thus formed, with the association of photocathode **16** and of diffraction grating **30**, has a sensitivity spectrum with a quantum efficiency **QE** having a maximum smaller than the maximum quantum efficiency **QE** of an image intensifier tube **130** of the state of the art.
- 15 Further, it can be observed that the sensitivity spectrum is also more extended. It is thus possible to detect photons between 400 nanometers and 1,064 nanometers, and no longer between 450 nanometers and 900 nanometers.

More specifically, according to the invention, the image intensifier tube **13** thus formed has a quantum efficiency **QE**:

- higher than 1% in an image-forming wavelength range and;
- in the range from 0.001 to 1% in a detection wavelength range, distinct from said image-forming wavelength range, the detection wavelength range being at minimum in the range from 1,000 to 1,100 nanometers, preferably from 1,050 to 1,075 nanometers.

25 This detection wavelength range enables to capture a manifestation signal **Sm** of at least one beacon **B**. Thus, as illustrated in Figure 7, the invention provides using night vision goggles **NVG**, or a night vision scope, integrating an image intensifier tube **13**, such as previously described, to capture a manifestation signal **Sm** from at least one beacon **B** in the detection wavelength range. Preferably beacon **B** transmits a manifestation signal **Sm** at the precise 1,064-nanometer wavelength.

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Beacon **B** may be formed of an electronic package integrating an electric power supply and means for transmitting manifestation signal **Sm**, for example an infrared diode.

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Further, beacon **B** may transmit a manifestation signal **Sm** permanently or as a response to an activation signal **Sa**. Preferably, as illustrated in Figure 7, activation signal **Sa** may be transmitted from night vision goggles **NVG**, or the night vision scope. For this purpose, night vision goggles **NVG**, or the night vision scope, integrate an activation device **31**.

Activation device **31** may be formed of a tube integrating an electric power supply and means for transmitting activation signal **Sa**. It should be noted that the electric power supply of activation device **31** may be provided by night vision goggles **NVG**, or the night vision scope, for example by electronic components **22**. Activation signal **Sa** may be a light or radio frequency signal. Thus, when the activation device **31** of beacon **B** integrates a radio frequency transmitter, beacon **B** integrates an antenna and manifestation signal **Sm** is transmitted only as a response to the reception of activation signal **Sa**.

As a variant, when the activation device **31** of beacon **B** integrates an optical transmitter, for example a laser diode, beacon **B** integrates an optical receiver, for example a photodiode, and manifestation signal **Sm** is also transmitted only as a response to the reception of activation signal **Sa**. The laser diode and the photodiode may be configured to operate at a wavelength in the range from 1,400 nanometers to 1,800 nanometers, for example 1,550 nanometers.

So that beacon **B** can receive activation signal **Sa**, it is necessary for the propagation range and the propagation angle **F31** of activation device **Sa** to be adjusted in order for activation signal **Sa** to reach beacon **B**. In the same way, the power and the propagation angle **Fb** of beacon **B** have to be configured so that manifestation signal **Sm** reaches the detection angle **Fnvg** of night vision goggles **NVG**, or of the night vision scope.

To increase the detection range of a beacon **B**, it is possible to decrease the propagation angle **F31** of activation signal **Sa**. It is also possible to use a propagation angle **F31** of activation signal **Sa** smaller than the viewing angle **Fnvg** of night vision goggles **NVG**, or of the night vision scope. In this embodiment, beacons **B** can only be detected on a specific area **Zp** of observation of the images observed by night vision goggles **NVG**, or the night vision scope.

In the example of Figure 8, night vision goggles **NVG** enable to view binocular night images and, in these images, a specific central observation area **Zp** enables to detect beacons **B**.

Further, night vision goggles **NVG**, or the night vision scope, may integrate a light gain regulation mechanism, also referred to as "auto-gating" in literature, limiting the opening time of image amplifier tube **13** to each specific activation period **Pal** of the auto-gating mechanism. To avoid for beacon **B** to only transmit a manifestation signal **Sm** outside detection ranges of

image amplifier tube **13**, beacon **B** may be configured to transmit a signal for a significant time longer than the specific activation period **Pal** of the auto-gating mechanism.

As a variant, with an asynchronous detection such as illustrated in Figure 9, activation device **31** may have a variable activation period **P31**. With this embodiment, beacon **B** may be detected when the specific activation period **Pal** of image amplifier tube **13** coincides with the activation period **P31** of activation device **31**. Thus, on the last timing diagram of Figure 9 relative to the detection of image amplifier tube **13**, beacon **B** is not detected on the two first transmitted manifestation signals **Sm** but it is detected on the last two manifestation signals **Sm**.

With a synchronous detection such as illustrated in Figure 10, activation device **31** is connected to the device for managing the specific activation period **Pal** of the auto-gating mechanism, for example by electronic components **22**. In this embodiment, activation device **31** exhibits an activation period **P31** synchronized to the specific activation period **Pal** of the auto-gating mechanism of image amplifier tube **13**. Thus, in this embodiment, on the last timing diagram of Figure 10 relative to the detection of image amplifier tube **13**, beacon **B** is detected on the four transmitted manifestation signals **Sm**.

Thus, the invention enables to detect beacons **B** without degrading the images formed by image amplifier tube **13** since the detection wavelength of beacons **B** is not comprised within the image-forming wavelength range, for example from 450 nanometers and 900 nanometers. Further, the invention also improves the stealth of the carriers of beacons **B** since the detection wavelength of beacons **B** is not detected by conventional night vision systems which capture photons in the wavelength range λ from 450 nanometers to 900 nanometers.

CLAIMS

1. System for identifying at least one beacon (B), the beacon (B) integrating a device for emitting electromagnetic radiation at a wavelength in the range from 1,000 nanometers to 1,100 nanometers, the system comprising night vision goggles (NVG) or a scope integrating an image amplifier tube (13) comprising:
 - an input window (15) configured to receive and transmit photons;
 - a photocathode (16), bonded to an inner surface of said input window (15), capable of converting photons transmitted by the input window (15) into photoelectrons (28);
 - the photocathode (16) having a sensitivity spectrum defined according to the wavelength of the photons received by the photocathode (16) and to the quantum efficiency (QE) of the photocathode (16), that is, to the ratio of the number of generated photoelectrons (28) to the number of photons received by the photocathode (16);
 - an electron multiplier (18) capable of multiplying the photoelectrons (28) into secondary electrons (29); and
 - a phosphorescent screen (20) transforming the secondary electrons (29) into photons; *characterized in that* the image amplifier tube (13) also comprises a diffraction grating (20) placed between the input window (15) and the photocathode (16) so as to diffract photons in said photocathode (16) and to enable the photocathode (16) to exhibit a quantum efficiency (QE):
 - higher than 1% in an image-forming wavelength range and;
 - in the range from 0.001 to 1% in a detection wavelength range, distinct from said image-forming wavelength range, said detection wavelength range being at minimum from 1,000 nanometers to 1,100 nanometers;
 the image amplifier tube (13) being configured to capture an electromagnetic radiation emitted by said beacon (B) in said detection wavelength range.
2. System for identifying at least one beacon (B) according to claim 1, *wherein* the photocathode (16) is formed based on antimony and on at least one alkaline metal.
3. System for identifying at least one beacon (B) according to claim 1 or 2, *wherein* the image amplifier tube (13) is configured to capture manifestation signals (Sm) originating from the at least one beacon (B) at a wavelength in the range from 1,050 to 1,075 nanometers, preferably 1,064 nanometers.

4. System for identifying at least one beacon (B) according to one of claims 1 to 3, *wherein* the night vision goggles (NVG) or the scope also comprises a device (31) for activating the beacon (B), configured to transmit an activation signal (Sa), said beacon (B) comprising a module for receiving said activation signal (Sa) so as to transmit the electromagnetic radiation at the wavelength in the range from 1,000 nanometers to 1,100 nanometers in the form of a manifestation signal (Sm) as a response to the activation signal (Sa) transmitted by the activation device (31).
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5. System for identifying at least one beacon (B) according to claim 4, *wherein* the device (31) for activating the beacon (B) is formed of a radio frequency transmitter, the module for receiving said beacon (B) being formed of an antenna.
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6. System for identifying at least one beacon (B) according to claim 4, *wherein* the device (31) for activating the beacon (B) is formed of an optical transmitter, the reception module of said beacon (B) being formed of an optical receiver.
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7. System for identifying at least one beacon (B) according to claim 6, *wherein* the optical transmitter is a laser diode with a wavelength in the range from 1,400 nanometers to 1,800 nanometers, the reception module of said beacon (B) being formed of a photodiode capable of capturing a wavelength in the range from 1,400 nanometers to 1,800 nanometers.
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8. System for identifying at least one beacon (B) according to one of claims 4 to 7, *wherein* the night vision goggles (NVG) or the scope are configured to observe a scene (Sc) in which is placed a specific observation area (Zp) defined by the emission angle (F31) of said activation device (31) and the viewing angle (Fnvg) of the night vision goggles (NVG) or of the scope, the detection of said beacon (B) being only performed in said specific observation area (Zp).
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9. System for identifying at least one beacon (B) according to one of claims 4 to 8, *wherein* the image amplifier tube (13) comprises an auto-gating mechanism, the activation device (31) having a variable activation period (P31-1).
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10. System for identifying at least one beacon (B) according to one of claims 4 to 8, *wherein* the image amplifier tube (13) comprises an auto-gating mechanism with a specific activation period (Pal), the activation device (31) having an activation period (P31-2) synchronized to said specific activation period (Pal) of the auto-gating mechanism of said image amplifier tube (13).
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