Apparatus and method are disclosed for guiding a payload to a target location. The apparatus comprises a laser radiation source, a laser radiation reflecting arrangement for generating substantially spatially homogeneous reflected laser radiation, an activator for activating the radiation source to generate laser radiation and an electrical power source for powering the apparatus.
TARGET LOCATION DESIGNATION APPARATUS

[0001] The present invention relates to target location designation apparatus and particularly, but not exclusively to target location designation apparatus for guiding a payload to a target location.

[0002] When payloads are deployed from vehicles, it is known to guide the payload to a desired target location using location designators. Known location designators typically comprise a laser source which is used to illuminate the target location from a remote position. The laser radiation is generally directed at the target location such that laser radiation reflected from the target location, such as a building, is collected by a sensor disposed upon the payload and utilised to guide the payload toward the target location.

[0003] The known designators involve illuminating the target locations from a nearby location and since the sensor associated with the payload is receptive to reflected laser radiation, a clear line of sight is required between the designator and the target location. Moreover, the designation of a target location in this manner requires the location of an operator local to the target location to operate the designator. This is often unsuitable, particularly where the target location is cited in a hostile or harsh environment, or in situations where the payload is designed to explode on reaching the target location.

[0004] We have now devised an improved target designation apparatus.

[0005] In accordance with a first aspect of the present invention there is provided target location designation apparatus for guiding a payload to a target location, the apparatus comprising:

[0006] a laser radiation source,

[0007] a laser radiation reflecting arrangement for generating substantially spatially homogeneous reflected laser radiation,

[0008] an electrical power supply for powering the laser radiation source, and

[0009] an activator for electrically coupling the power supply with the laser radiation source to activate the laser radiation source.

[0010] In an embodiment, the activator comprises a receiver which is arranged to receive a trigger signal for activating the laser radiation source. The receiver may be receptive to a radio signal generated from a remote location, such that the laser radiation source may be activated without the requirement for a line of sight to the target designation apparatus. In an alternative embodiment, the activator may comprise a timer which is arranged to activate the laser radiation source at a predetermined time, or following a pre-determined time delay following deployment of the apparatus.

[0011] The electrical power supply may comprise a battery or similar. Alternatively, or in addition thereto, the electrical power supply may comprise or further comprise a solar panel.

[0012] The laser radiation reflecting arrangement is arranged to simulate laser radiation which is reflected off objects, such as buildings and terrain, since the sensors disposed on payloads are generally sensitive to this reflected radiation when homing in on the intended target. Preferably, the laser radiation reflecting arrangement comprises a grating. Alternatively, the reflecting arrangement may comprise a radiation dispersion element for simulating reflected laser radiation.

[0013] Preferably, the laser radiation source is configured for generating laser pulses. Alternatively, the laser radiation source may be configured to generate continuous laser radiation.

[0014] In a further embodiment, the laser radiation source may comprise a plurality of separate sources for generating the substantially spatially homogeneous reflected laser radiation through an increased angular range.

[0015] In accordance with a second aspect of the present invention there is provided a method of guiding a payload to a target location, the method comprising the steps of:

[0016] locating a target location designation apparatus according to the first aspect at the target location, and

[0017] activating the laser radiation source of the apparatus to cause substantially spatially homogeneous reflected laser radiation to be generated for guiding the payload to the target location.

[0018] The method may comprise activating the laser radiation source at a pre-determined time or following a pre-determined time delay, using a timer.

[0019] Alternatively, the method may comprise activating the laser radiation source using a trigger signal from a transmitter remotely located to the apparatus.

[0020] Further preferred features of the method of the second aspect may comprise one or more of the preferred features of the target location designation apparatus of the first aspect.

[0021] Embodiments of the present invention will be described by way of example only and with reference to the accompanying drawings, in which:

[0022] FIG. 1 is a schematic illustration of a target location designation apparatus according to an embodiment of the present invention;

[0023] FIG. 2 is a flow chart outlining the steps associated with a method of designating a target location according to any embodiment of the present invention.

[0024] Referring to FIG. 1 of the drawings, there is illustrated a target location designation apparatus 10 according to an embodiment of the present invention for guiding a payload 20 to a target location 30. The apparatus 10 comprises a housing 11, a laser radiation source 12 disposed within the housing 11 and a laser radiation reflecting arrangement 13 which is arranged to reflect the laser radiation incident thereon from the laser radiation source 12 to create substantially spatially homogenous laser radiation which is output through a window 14 disposed within the housing 11. The laser radiation output from the housing 11 is arranged to simulate laser radiation which may be reflected off objects such as buildings, vehicles (not shown) and the like, and is arranged to guide payloads 20 to the desired target location 30.

[0025] The laser radiation source 12 may comprise a diode laser, and may be tuneable to generate laser radiation at a preferred lasing wavelength, such as an infra-red wavelength or a wavelength in the visible region of the spectrum. The source 12 may also be operable to generate continuous laser radiation or alternatively pulsed laser radiation. In this manner, the reflected laser radiation which is output from the housing 11 may be appropriately configured according to the particular sensor 21 used on the payload 20.

[0026] The apparatus 10 further comprises an electrical power supply 15, such as a battery arrangement 15a or similar, or alternatively a solar panel 15b for acquiring electrical power during periods of sunlight illumination. However, it is
also envisaged that the solar panel 15b may be used to charge the battery arrangement 15a, and as such the battery arrangement 15a may be used in conjunction with the solar panel 15b. The power supply 15 to the laser radiation source is controlled by an activator 16 which is arranged to electrically couple the laser radiation source 12 with the electrical power supply 15. The activator 16 is disposed within the housing 11 and in an embodiment, the activator 16 may comprise a receiver 16a for receiving a trigger signal from a remote source. Upon receiving the signal, the activator 16 is arranged to electrically couple the power supply 15 with the laser radiation source 15. For example, the receiver 16a may be arranged to receive a radio signal from a transmitter (not shown) remotely located to the apparatus 10. In an alternative embodiment, the activator 16 may comprise a timer 16b which may be configured to electrically couple the laser radiation source 12 with the power supply 15 and thus cause the laser radiation source 12 to switch to an operational state at a particular time. Alternatively, the timer 16b may be arranged to switch the laser radiation source 12 to an operational state after a pre-determined time delay.

[0027] In order to simulate the reflection of laser radiation that is currently used to guide payloads 20 to the desired target location 30, the laser radiation reflecting arrangement 13 may comprise a grating 13a or a dispersive element 13b. The reflecting arrangement 13 is disposed within the housing 11 and the laser radiation from the source 12 is incident upon the reflecting arrangement 13 such that the radiation reflected therefrom is output through the window 14 of the housing 11 such that it can be detected and thus utilised by the sensors 21 disposed on payloads 20 for guiding the payloads 20 to the target location 30. In a further embodiment, it is envisaged that the laser radiation source 12 may comprise a plurality of separate laser radiation sources (not shown) for separately illuminating the reflecting arrangement 13, such that the radiation reflected therefrom may be output through the window 14 through a greater angular range and thus provide for an improved and/or earlier detection by the payload sensor 21.

[0028] Referring to FIG. 2 of the drawings, there is illustrated a flowchart outlining the steps associated with a method 100 of designating a target location 30 according to an embodiment of the present invention. When designating a target location 30 using the apparatus 10, the apparatus 10 is physically sited at the desired target location 30 at step 101, in advance of the required delivery time of the payload 20.

[0029] Once the apparatus 10 has been appropriately sited, then the activator 16 may be activated at step 102, to electrically couple the power supply 15 with the laser radiation source 12 to cause laser radiation to be generated. As discussed above, in the case that the activator 16 comprises a timer 16b, the timer 16b may be activated upon siting the apparatus 10 at the target location 30 to commence a countdown representative of the desired time delay. Alternatively, the timer 16b may simply be used to electrically couple the power supply 15 with the laser radiation source at a desired time. In a further alternative, in the case that the activator 16 comprises a receiver 16a, then an operator (not shown) may cause the activator 16 to electrically couple the laser radiation source 12 with the power supply 15 by transmitting a trigger signal to the receiver 16a using a transmitter (not shown) remotely located to the receiver 16a. In each of the above embodiments, it is envisaged that the apparatus 10 will remain inert for a period of time after being sited at the target location 30.

[0030] Upon activating the activator 16, the apparatus 10 is arranged to output simulated, reflected laser radiation through the window 14 disposed within the housing 11 at step 103, so that the reflected radiation can be detected by a sensor 21 on the intended payload 20, so that the payload 20 can be guided to the target location 30.

[0031] The apparatus 10 and method 100 according to the above described embodiments thus obviate any requirement for a clear line of sight to the target location 30 for the designation thereof and further removes the necessity for an operator of the designator to be located in the vicinity of the target location 30.

1. Target location designation apparatus for guiding a payload to a target location, the apparatus comprising:
   a. laser radiation source;
   b. a laser radiation reflecting arrangement for generating substantially spatially homogeneous reflected laser radiation;
   c. an electrical power supply for powering the laser radiation source; and
   d. an activator for electrically coupling the power supply with the laser radiation source to activate the laser radiation source.

2. Target location designation apparatus according to claim 1 wherein the activator comprises a receiver which is arranged to receive a trigger signal for activating the laser radiation source.

3. Target location designation apparatus according to claim 1 wherein the activator comprises a timer, which is arranged to activate the laser radiation source at a predetermined time, or following a pre-determined time delay.

4. Target location designation apparatus according to claim 1 wherein the electrical power source comprises a battery.

5. Target location designation apparatus according to claim 1 wherein the electrical power source comprises a solar panel.

6. Target location designation apparatus according to claim 1 wherein the laser radiation reflecting arrangement is arranged to simulate laser radiation which is reflected off objects.

7. Target location designation apparatus according to claim 1 wherein the laser radiation reflecting arrangement comprises a grating.

8. Target location designation apparatus according to claim 1 wherein the reflecting arrangement comprises a laser radiation dispersion element for simulating reflected laser radiation.

9. Target location designation apparatus according to claim 1 wherein the laser radiation source is configured to generate laser pulses.

10. Target location designation apparatus according to claim 1 wherein the laser radiation source is configured to generate continuous laser radiation.

11. Target location designation apparatus according to claim 1 comprising a plurality of separate laser radiation sources.

12. A method of guiding a payload to a target location, the method comprising:
   a. locating a target location designation apparatus according to claim 1 at the target location, and
activating the apparatus to cause substantially spatially homogeneous reflected laser radiation to be generated for guiding the payload to the target location.

13. A method according to claim 12, comprising activating the laser radiation source at a pre-determined time or following a pre-determined time delay, using a timer.

14. A method according to claim 13, comprising activating the laser radiation source using a trigger signal from a transmitter remotely located to the apparatus.

15. A target location designation apparatus for guiding a payload to a target location, the apparatus comprising:
   a laser radiation source;
   laser radiation reflecting arrangement including at least one of a grating and dispersive element, and arranged to reflect laser radiation incident thereon from the laser radiation source to create reflected laser radiation that emits from the apparatus;
   an electrical power supply including one or more batteries for powering the apparatus; and
   an activator for activating the laser radiation source, the activator including at least one of:
   an electronic receiver arranged to receive a wireless trigger signal for activating the laser radiation source; and
   a timer circuit arranged to activate the laser radiation source at a predetermined time, or following a pre-determined time delay.

16. The target location designation apparatus according to claim 15, wherein the electrical power source further comprises a solar panel.

17. The target location designation apparatus according to claim 15, wherein the laser radiation source is configured to generate laser pulses.

18. The target location designation apparatus according to claim 15, wherein the laser radiation source is configured to generate continuous laser radiation.

19. The target location designation apparatus according to claim 15, wherein the reflected laser radiation that emits from the apparatus is substantially spatially homogenous reflected laser radiation.

20. A method of guiding a payload to a target location using the target location designation apparatus of claim 15, the method comprising:
   remotely activating the apparatus, the apparatus being located at the target location, thereby causing the apparatus to generate reflected laser radiation at the target location; and
   guiding the payload to the target location using the reflected laser radiation.