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Redpath et al.

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(54) **METHOD OF USING LIGHT STRIPING FOR FIRE RESCUE NAVIGATION**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 13/013,427, filed on Jan. 25, 2011, now abandoned.

(51) **Int. Cl.**
G02B 27/20 (2006.01)

(52) **U.S. Cl.**
USPC **362/259**; 362/103; 362/253

(58) **Field of Classification Search**
USPC 362/259, 103, 108, 234, 253; 2/5
See application file for complete search history.

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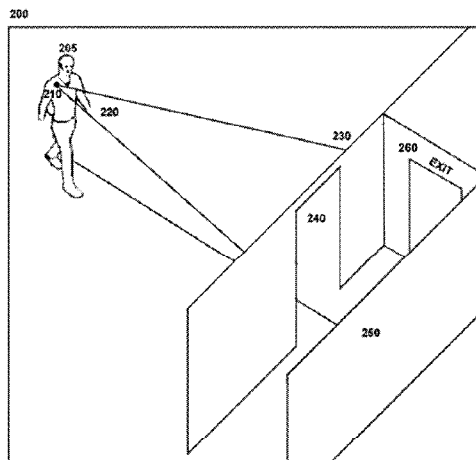
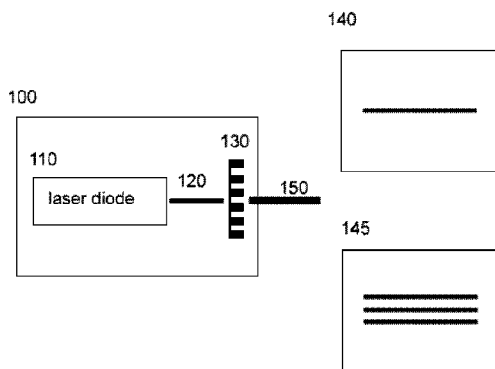
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(57) **ABSTRACT**

The present invention provides a method of using a laser lighting apparatus for fire rescue navigation in a smoke-filled structure. The laser lighting apparatus is portably carried at a user's body and directly operated by the user to perform the steps of turning the laser lighting apparatus on to output one or more coherent light planes; projecting the one or more coherent light planes on objects in the smoke-filled structure to produce one or more light stripes on surfaces of the objects; and identifying the objects in the smoke-filled structure from the one or more light stripes.

5 Claims, 3 Drawing Sheets



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EXHIBIT
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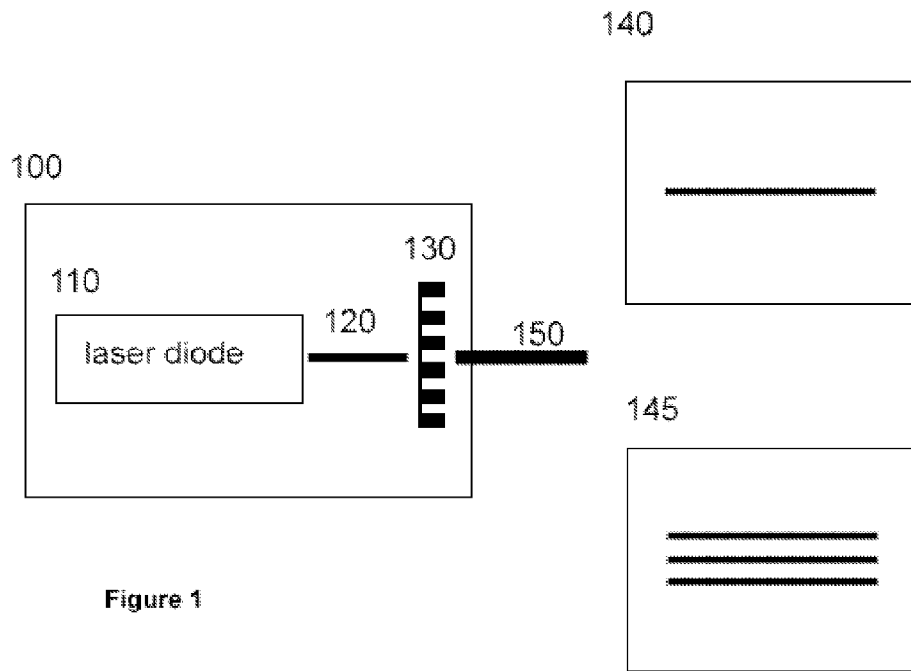


Figure 1

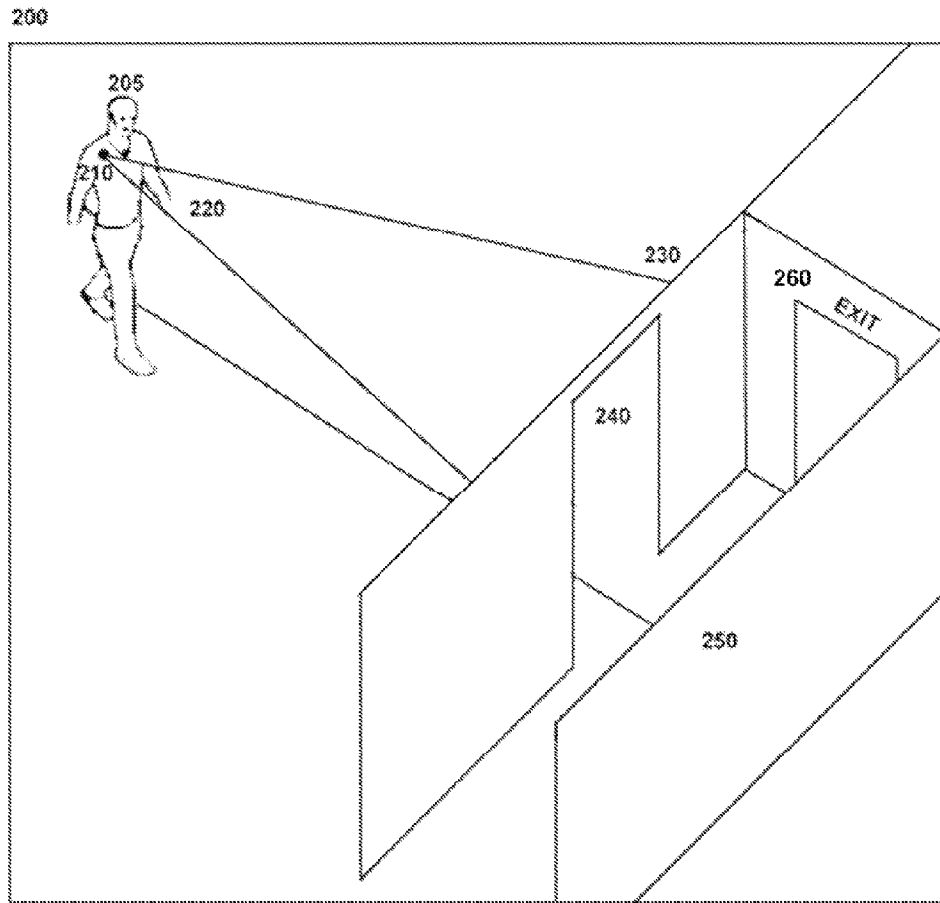


Figure 2

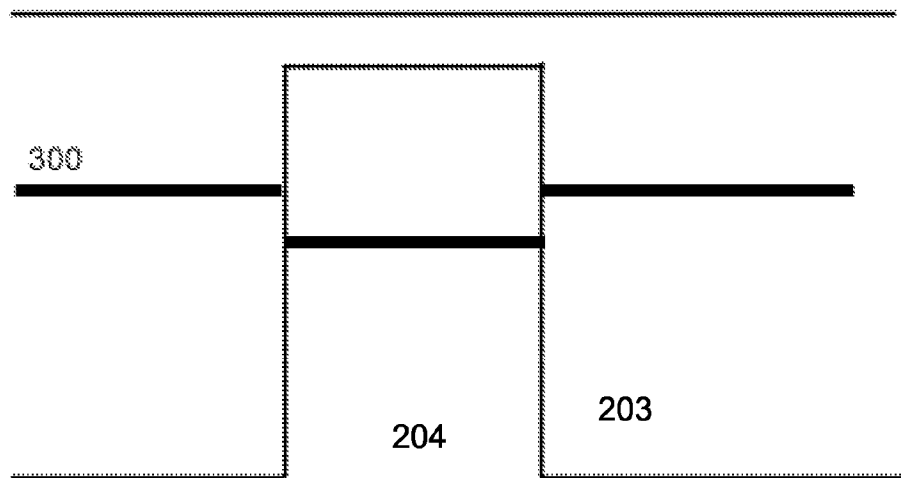


Figure 3

METHOD OF USING LIGHT STRIPING FOR FIRE RESCUE NAVIGATION

The present application is a continuation-in-part application of, and claims a priority to the U.S. Non-provisional application Ser. No. 13/013,427 filed on Jan. 25, 2011 now abandoned.

BACKGROUND

1. Field of the Invention

The present invention relates to a method for fire rescue navigation, and more particularly relates to a method of using light striping to provide illumination and navigation in smoke-filled structures.

2. Description of the Prior Art

Visibility inside a burning building is very limited because of heavy smoke or flame. When a building is on fire, firefighters have to enter various parts of the building for emergency rescue, but because of poor visibility in the smoke-filled building, the firefighters may become disorientated and may be unable to find exits or notice holes or damages in the floor, which is very dangerous and also makes it hard to implement effective rescue. So smoke area lighting is a critical problem for fire rescue. The typical practice is to place a flashlight at the exit, with the beam of the flashlight pointing in the direction from which the firefighter expects to exit later. However, the flashlight beam usually does not penetrate very far. This is because the flashlight emits white or incoherent light. The full spectrum light illuminates the smoke molecules which reflect the light, thereby reducing penetration of the flashlight beam through the smoke and also causing blinding light to occur.

Coherent light such as a laser beam can penetrate smoke areas without the blinding reflection of commonly used flashlight sources and thus be considered as a distinguished lighting source for use in smoke-filled structures. But a single laser beam still cannot achieve a satisfactory lighting effect for fire rescue since a single laser beam is simply a point when projected on an object. Meanwhile, using multiple lasers would be an issue as each laser requires power supply and heat dissipation, and thus would increase the power consumption and the limitation of the operating environment. Therefore, a new technique is desirable to use a single laser source to produce multiple beams of coherent light, one or more light planes for illumination and navigation in smoke-filled structures.

In addition, prior arts of using a light striping method to reconstruct a 3D dimensional form of an object have existed since the 1980's in the field of 3D measurements. A light striping vision system uses one or more light stripes projected onto a 3D object by a line laser source to detect the image coordinates of the light stripes and obtain 3D coordinates of the surface points of an object. The line laser source generates one or more coherent light planes that can create a 3D visual effect when illuminating an indoor space. So it can be conceived to utilize a similar light striping vision system to provide illumination and navigation for fire rescue.

The conventional light striping vision system has never been envisioned for fire rescue navigation and never been designed as a portable device that can be easily carried and directly controlled by a human being. In this respect, the laser lighting apparatus and method for fire rescue navigation of the current invention substantially departs from the conventional design of light striping vision systems for 3D object

measurements, and is aimed at providing an improved lighting apparatus and method for illumination and navigation in smoke-filled structures.

SUMMARY OF THE INVENTION

According to an aspect of the current invention, a laser lighting apparatus for fire rescue navigation is disclosed in view of the above problems associated with existing smoke area lighting devices. The laser lighting apparatus utilizes a laser source together with a diffraction grating to create one or more light planes projecting on objects in a smoke-filled structure and thus allow a human being, e.g. a firefighter therein to identify obstacles or exits and implement effective emergency rescue. The apparatus only needs a single laser source but allows for one or more light planes to illuminate and navigate the smoke-filled structure, thereby addressing the emergency use of power and limiting the detrimental result of heat dissipation.

Due to the use of a diffraction grating in the laser lighting apparatus, the laser beam emitted by the single laser source may be diffracted by the diffraction grating into a laser light plane that can penetrate a smoke-filled structure, project onto objects within the smoke-filled structure and create a 3D visual effect therein. Therefore, the contours of the projected objects can be easily identified by the firefighter.

According another aspect of the current invention, a method of using the laser lighting apparatus for fire rescue is disclosed. When a user, e.g. a firefighter, carrying the laser lighting apparatus of the invention on his/her body enters a smoke-filled building, the laser lighting apparatus can be controlled by the user to turn on and output one or more light planes. The one or more light planes will project on objects in the building, thereby producing deformed light stripes on surfaces of the objects that can be observed by the firefighter for recognizing the objects in the building.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 schematically illustrates a laser lighting apparatus for fire rescue navigation according to an embodiment of the present invention;

FIG. 2 is a schematic diagram illustrating the use of the laser lighting apparatus of FIG. 1 in a smoke-filled room according to an embodiment of the present invention; and

FIG. 3 is a schematic diagram illustrating a projected light stripe in the smoke-filled room of FIG. 2 that can be used for navigation therein.

DETAIL DESCRIPTIONS OF THE INVENTION

The particulars of the invention will become apparent from the following detailed discussion of preferred embodiments of the invention with reference to the accompanying drawings.

FIG. 1 schematically illustrates an exemplary laser lighting apparatus 100 according to an embodiment of the invention. The laser lighting apparatus 100 comprises a laser diode 110 for emitting a laser beam 120 and a diffraction grating 130 for receiving the laser beam 120, diffracting the laser beam 120 and generating an outgoing light beam 150. One skilled in the art of creating enclosures for lighting can be referenced to apply an enclosure for the embodiment, so as to get a product of laser lighting apparatus for use in fire rescue.

Because of the effect of diffraction, a projection of the outgoing light beam 150 of the laser lighting apparatus 100 on a flat target normal thereto is a light stripe as illustrated at 140,

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