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Networkable devices for internal illumination of traffic cones and other traffic channelizing devices

Abstract

Devices, systems and methods for causing light (visible or invisible) or other forms of energy to be emitted from traffic cones or other traffic channelizing or marking devices such as barrels, tubes, some buoys, some types of signs, etc.

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Background/Summary

RELATED APPLICATION (1) This application claims priority to U.S. Provisional Patent Application No. 63/309,426 entitled Networkable Devices for Internal Illumination of Traffic

Cones and Other Traffic Channelizing Devices filed Feb. 11, 2022, the entire disclosure of which is expressly incorporated herein by reference.

FIELD

(1) The present disclosure relates generally to the fields of electronics, traffic engineering and public safety and more particularly to devices and methods useable for channelizing vehicular traffic, warning drivers of hazards, and enhancing traffic safety.

BACKGROUND

(2) Pursuant to 37 CFR 1.71(e), this patent document contains material which is subject to copyright protection and the owner of this patent document reserves all copyright rights whatsoever.

(3) Applicants are developing a variety of electronic flares and other systems for traffic guidance and safety, examples of which are described in U.S. Pat. No. 8,564,456 entitled Sequenced vehicular traffic guiding system; U.S. Pat. No. 8,154,424 entitled Sequenced Vehicular Traffic Guiding System; U.S. Pat. No. 9,288,088 entitled Synchronizing the Behavior of Discrete Digital Devices; U.S. Pat. No. 9,847,037 entitled Sequenced Guiding Systems for Vehicles and Pedestrians; U.S. Pat. No. 9,835,319 entitled Sequential and Coordinated Flashing of Electronic Roadside Flares with Active Energy Conservation; U.S. Pat. No. 10,551,014 entitled Portable Electronic Flare Carrying Case and System; U.S. Pat. No. 10,443,828 entitled Sequential and Coordinated Flashing of Electronic Roadside Flares with Active Energy Conservation; U.S. Pat. No. 10,536,519 entitled Synchronizing the Behavior of Discrete Digital Devices and 10,660,183 entitled Devices and Methods for Synchronized Signaling of the Positions of Moving Pedestrians or Vehicles, 11,013,091 entitled Devices and Methods for Synchronized Signaling of the Positions of Moving Pedestrians or Vehicles and United States Patent Application Publication No. 2001/0237777 entitled Devices and Methods for Channelizing Vehicular Traffic and Enhancing Workzone Safety, the entire disclosure of each such patent and published patent application being expressly incorporated herein by reference.

(4) This patent application describes new devices, systems and methods for internal illumination of traffic cones and other traffic channelizing devices. As explained below, certain electronic components and functions of the herein-described illuminating devices may be the same as or adaptations of electronic components and functions described in any of the above-listed patents and published patent application.

SUMMARY

(5) Described herein are devices, systems and methods for internal illumination of traffic cones or other traffic channelizing or marking devices such as barrels, tubes, some buoys, some types of signs, etc., having hollow or open interior spaces and wall(s) which is/are fully or partially translucent or allow light to pass therethrough.

(6) In accordance with the present disclosure there is provided an illumination device is attached to or integrated into a the traffic cone or other channelizing/marking device (e.g., a cone, barrel, tube, drum, buoy, etc.) and is equipped with emitters configured to cast light (visible and/or invisible) and/or other energy into an interior space of the cone or other channelizing/marking device such that at least some of the light or other energy will pass through at least partially translucent wall(s) of the thereby making the cone or other channelizing/marking device more visible to, or more detectable by, oncoming vehicles or pedestrians.

(7) Further in accordance with the present disclosure there is provided an illuminating device formed on or configured for attachment at or near a bottom of the traffic cone or other traffic channelizing/marking device that has a hollow inner space and a wall that is fully or partially translucent, said illumination device comprising: a base member; a plurality of emitters positioned on the base so as to cast light and/or other energy onto an inner surface of the fully or partially translucent wall such that at least some of said light or other energy will pass though the fully or

partially translucent wall; a rechargeable power source; radiofrequency transmitting and receiving apparatus configured for radiofrequency communication with one or more other devices; and electronic circuitry configured for powering and controlling the emitters.
(8) Further in accordance with the present disclosure there is provided an illuminating device formed on or configured for attachment at or near a bottom of the traffic cone or other traffic channelizing/marking device that has a hollow inner space and a wall that is fully or partially translucent, said illumination device comprising: top and bottom portions which combine to attach the illumination device to the traffic cone or other channelizing/marking device; a plurality of emitters positioned to cast light and/or other energy onto an inner surface of the fully or partially translucent wall such that at least some of said light or other energy will pass though the fully or partially translucent wall; a rechargeable power source; radiofrequency transmitting and receiving apparatus configured for radiofrequency communication with one or more other devices; and electronic circuitry configured for powering and controlling the emitters.
(9) Further in accordance with the present disclosure, there are provided methods for using illuminating devices as disclosed herein comprising: causing the illuminating device to be attached to or incorporated in the traffic cone traffic cone or other traffic channelizing/marking device; and using the illuminating device to cause visible light. Invisible light or other energy to be emitted from the traffic cone traffic cone or other traffic channelizing/marking device.
(10) Further aspects, elements, variations and details of the presently disclosed devices, systems and methods may be appreciated from the accompanying drawings and the details descriptions of certain embodiments or examples set forth below.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The accompanying FIGS. **1** through **16** show certain non-limiting examples or embodiments of a novel illumination device and related systems and methods. These drawings are illustrative but not limiting. These drawings are not intended to show all possible examples and embodiments of the herein-disclosed devices, systems and methods.
(2) FIG. **1** is a front perspective view of one embodiment of a system according to the present disclosure comprising a traffic cone, networkable illuminating base with attachment clamps and charging electrodes.
(3) FIG. **1**A is a partial sectional view through a portion of the base of the traffic cone of FIG. **1** showing a foot member that extends downwardly from the cone base.
(4) FIG. **2** is a top perspective view of the networkable illuminating base with the attachment clamps and charging device of the FIG. **1** embodiment.
(5) FIG. **3** is a bottom perspective view of the networkable illuminating base and attachment clamps of the FIG. **1** embodiment.
(6) FIG. **4** is a perspective view of another of a system according to the present disclosure comprising a traffic cone, networkable illuminating base with upper and lower portions and charging electrodes.
(7) FIG. **5** is a front elevational view of the system of FIG. **4**.
(8) FIG. **6** is a bottom view of the system of FIG. **4**.
(9) FIG. **7** is a partial bottom perspective view of the system of FIG. **4**.
(10) FIG. **8** is a partial cross-sectional view through line **8**-**8** of FIG. **7**.
(11) FIG. **9**A is an enlarged view of a portion of the system of FIG. **4**.
(12) FIG. **9**B is an enlarged view of a portion of the system of FIG. **4** showing a charging indicator, which is visible through a window or opening formed in the top portion of the networkable illuminating base.

(13) FIG. **10** is a perspective view of the bottom portion of the system of FIG. **4**.
(14) FIG. **11** is a partial view of the top portion of the system of FIG. **4** showing certain internal components.
(15) FIG. **12** shows a circuit assembly component and charging electrodes of the system of FIG. **4**.
(16) FIG. **12**A is a sectional diagram showing the circuit assembly and charging electrodes if FIG. **12** positioned within the system following attachment to the base of a traffic cone.
(17) FIG. **12**C is an enlarged view of an electronics housing component of the circuit assembly shown in FIG. **12**.
(18) FIG. **13** is a partial enlarged view of the bottom portion of the system of FIG. **4** showing the light emitting circuit and associated structural elements upon which it is mounted.
(19) FIG. **14** is a sectional diagram showing stackable units comprising traffic cones with networking illuminating bases attached thereto, stacked one atop another.
(20) FIG. **14**A is an enlarged view of portion **14**A of FIG. **14**.
(21) FIG. **15** is a bottom view of an alternative top portion of the system of FIG. **4** incorporating optional strengthening ribs.
(22) FIG. **16** is a partial cut-away view of the alternative top portion of FIG. **15** when positioned on the bottom portion as in typical use.

DESCRIPTION AND EXAMPLES

(23) The following describes certain aspects of the present disclosure and, where relevant, refers to the non-limiting examples shown in the accompanying drawings.
(24) The accompanying drawings show non-limiting examples of systems **10** and **100** useable for illumination and networking of traffic cones and other traffic channeling/marking devices. The term “illumination,” as used herein, shall be construed to encompass not only illumination by visible light but also, additionally or alternatively, illumination by invisible light (e.g., infrared) or emission of other signals or forms of energy (e.g., GPS, sonic, ultrasonic, electronic, radio, etc.) that can be detected by a suitable sensor or detector device located on or associated with an oncoming vehicle or pedestrian. This includes, but is not limited to, infrared and other types of signals that are detectable and useable by autonomous vehicles. The term “vehicles” as used herein shall not be limited to motor land vehicles, but shall be construed to include aircraft, trains, trams, subways and other rail vehicles, and watercraft or marine vessels.
(25) FIGS. **1** through **3** show a first embodiment of a system **10** which comprises a traffic cone C with an illumination device **12** that is attachable to the traffic cone C by way of clamps **14**, **14***a*. The traffic cone C comprises an upstanding conical body defined by a frusto-conical sidewall, all or part(s) of which is/are translucent. The traffic cone C has a hollow inner space within the frusto-conical sidewall with an opening at the bottom end of the hollow inner space. A cone base BC comprises a flange that extends about the perimeter of the open bottom end of the conical body.
(26) As illustrated in FIG. **1**A, the traffic cone C in this example has a plurality of optional foot members F that extend downwardly from the bottom side of the cone base BC. These foot members F may be formed of rubber or elastomeric material and are configured to provide stable points of contact with an underlying road surface upon which the traffic cone C is placed. Not all traffic cones include such foot members F and, as explained below, the illumination device may be configured for use with traffic cones that have, or do not have, such foot members F.
(27) In addition, it is to be noted that although the example shown in the drawings utilizes a traffic cone C, the illumination device described herein may be alternatively useable with other types of traffic channelizing and marker devices having translucent walls, such as tubular delineators, plastic drums or barrels, etc.
(28) As seen in FIGS. **2** and **3**, the illumination device **12** comprises a base **16** having a central aperture **18** that is slightly smaller in diameter than the open bottom end of the conical body of the traffic cone C. Optional passages, slots or openings **20**, **20***a*, **20***b* are formed in the base **16**. These passages, slots or openings **20**, **201**, **20***b* are located and configured to correspond to the foot

members that extend downwardly from the cone base BC. When the illumination device **12** is attached to the traffic cone C as seen in FIG. **1**, the foot members F of the traffic cone C will extend through the passages, slots or openings **20**, **201**, **20***b* Such that the bottoms of the foot members F will contact an underlying road surface on which the system **10** is placed.

(29) As shown on the bottom view of FIG. **3**, in alternative embodiments of the illumination device **12** intended for use with traffic cones or other traffic channelizing or marking devices that do not include foot members F, a plurality of foot members or layer(s) of elastomeric or rubber material **36** may optionally be provided on the bottom surface of the base **16** to provide for non-slip contact between the system **10** and an underlying road surface on which the system **10** is placed.

(30) As seen in FIG. **2**, upstanding projections **24** are formed along the edge of the central aperture **18**. Light emitters **28** (e.g., light emitting diodes (LEDS, emitting visible or infrared light) or radio-transmitters (for autonomous vehicles utilizing infrastructure to vehicle communication) and associated circuitry (e.g., wires and/or circuit boards which drive and control the LEDs) are mounted on these upstanding projections **24** so as to cast light upwardly onto an adjacent inner surface and the opposite surface of the fully or partially translucent side wall of the traffic cone C. At least some of this light passes through or will pass through the fully or partially translucent wall, thereby internally illuminating the traffic cone C to enhance its visibility to oncoming vehicular traffic. In the example shown, the projections **24** comprise curved ridges. However, these projections **24** may take any suitable configuration or form such as, for example, one or more bumps, bosses, protrusions, rim(s), etc. In addition to serving as mounting structures for the light emitters **28**, these upstanding projections **24** may also function as guides or locators to facilitate proper positioning of the illumination device **12** on the traffic cone C or other traffic channelizing/marking device. For this purpose, the projections **24** shown in the drawings are slanted, curved or tilted inwardly so that the top ends of the projections **24** can loosely insert into the open bottom end of the hollow inner space of the traffic cone C and will progress to a more snug fit as the traffic cone C is pushed down to its operative installed position with the bottom side of the cone base BC abutting against the top surface of the base **16** of the illumination device **12**. Thereafter, the clamps **14**, **14***a* are applied to attach the illumination device **12** to the traffic cone C. Alternatively, in some embodiments, the projections **24** or other aspects of the illumination device **12** may be configured to snap fit or otherwise firmly engage the traffic cone C without the need for the use of clamps **14** or **14***a*.

(31) In the example shown, each of the clamps **14** and **14***a* is equipped with a stacking electrode contact **30** configured to form electrical engagement with neighboring illumination devices **12** when a plurality of these devices **12** are stacked one atop another. In addition, one of the clamps **14***a* is also equipped with a charging electrode contact **30***a*. When a number of traffic cones C with attached illumination devices **12** are stacked one atop another, the stacking electrode contacts **30** will engage one another thereby interconnecting the electrical circuitry of all illumination devices **12** in the stack. A charging cap **32** is connected by cable **33** to a power source such as a 12 volt or 110 volt power outlet and positionable on clamp **14***a* of one of the stacked illumination devices **12** (e.g., the one on the top of the stack). In this manner, power from the power source is initially delivered to only one of the stacked devices **12** via its charging contact **30***a* and such charging power then distributes to all of the other devices **12** in the stack via the serially engaged stacking electrodes **30**. In this way, a single connection to a power source is useable to charge the batteries **38** located in battery compartments **34** of all devices **12** in the stack.

(32) Furthermore, the electrodes are situated such that rotation of any member of the stack by 90 degrees will allow continued charging of the entire stack. The circuit is designed to automatically reverse and maintain proper polarity during charging using a single electrode. The operator need not line up the cones in a particular stacking arrangement to achieve proper charging polarity. Any stacking order and orientation based upon corner-to-corner alignment will suffice.

(33) When the illumination devices **12** have been charged, the charging cap **32** is removed and the

fully charged systems **10** (i.e., traffic cones C with attached illumination devices **12**) may be deployed in a row, array or any other desired configuration on a road surface. Alternatively, the system of multiple traffic cones may delineate a temporary landing zone for both rotary and fixed wing aircraft, guide vehicles and pedestrians at special events or mass evacuation, or guide autonomous vehicles that incorporate sensors tuned to the infrared or radio spectrum.

(34) In routine operation, illumination devices **12** as shown in FIGS. **1** through **3** are useable in conjunction with traffic cones which have foot members F as follows: 1. Position each illumination device **12** on a traffic cone C such that the upstanding projections **24** insert upwardly into the hollow inner space of the cone adjacent to the inner surface of the cone sidewall and the foot members F of the cone C are aligned with and protrude downwardly through openings **20**, **20***a* and **20***b*. 2. Use clamps **14** to clamp each illumination device **12** to the adjacent cone base BC at locations where the clamps **14** will also engage single stacking electrode contacts on the illumination devices **12**. 3. Use clamps **14***a* to clamp each illumination device **12** to the adjacent cone base BC at locations where the clamps **14***a* will engage both single stacking electrode contacts on the illumination devices **12** and charging electrode contacts on the illumination devices **12**. 4. Stack the traffic cones C with the attached illumination devices **12** one atop another. 5. Connect the cable **33** of the charging cap **32** to a suitable power source (e.g., either a 12V or 110V power source) and place the charging cap **32** on the clamp **14***a* that is attached to the top unit of the stack, thereby delivering charging electrical current the batteries **38** of all illumination devices **12** in the stack. 6. When adequately charged, detach the charging cap **32**, and deploy the traffic cones C with attached illumination devices **12** are desired locations on a road surface. 7. Power up all of the illumination devices **12** using switches on the devices **12** or a remote controller (e.g, laptop computer, smart phone, dedicated controller, etc.). Alternatively, the cone lamp, through the programming of the microcontroller and accelerometer, could be programmed to turn on automatically when dropped on the highway. The zero-G acceleration sensed by a falling cone (of a few centimeters or more) following by a rapid deceleration (negative G in the Z, X, or Y direction) would be sensed and result in a command to turn on the device. 8. Optionally, for illumination devices **12** equipped to communicate and function as nodes of a mesh or other network, use switches on the devices **12** or a remote controller (e.g., laptop computer, smart phone, dedicated controller, etc.) to control synchronized emission of light from the light emitters in a desired pattern or sequence, examples of which are described in incorporated U.S. Pat. No. 10,443,828 entitled Sequential and Coordinated Flashing of Electronic Roadside Flares with Active Energy Conservation; U.S. Pat. No. 10,536,519 entitled Synchronizing the Behavior of Discrete Digital Devices. 9. Optionally, for illumination devices **12** equipped to sense or receive and transmit information (e.g., device location, sensor-determined device status or event information, or other information, use the included transmitter(s) to directly or indirectly transmit such information to the intended data center, receiving device or service (e.g., General Motors OnSTar™ System, HERE Technologies System, WAZE or Smartway) via cellular, telephonic, internet, fiber-optic or other wired or wireless communication. 10. Unlike traditional passive traffic cones, this device will actively monitor its orientation relative to the horizontal and notify, via radio transmitters and/or cloud connectivity, personnel when it is struck by a vehicle, moved by a pedestrian, blown over by truck-induced wind wake, or high winds experienced during inclement weather. 11. Thereafter, when no longer needed or when due for re-charging, collect the traffic cones C with attached illumination devices **12** and repeat steps 4, 5 and 6 above.

(35) As described above, FIGS. **1** through **3** show an embodiment in which the illumination device **12** is essentially a one-piece device that attaches to a cone base CB by way of clamps **14**. FIGS. **4** through **16**, described below, show an alternative embodiment wherein the illumination device **101** is a two-piece structure comprising a top portion **102** and a bottom portion **104**.

(36) In the alternative embodiment shown in FIGS. **4** through **16**, the illumination device **101**, the bottom portion **104** is positioned beneath the cone base CB. The top portion **102** is then mounted

over top of the cone base CB and connected to bottom portion **104** so as to capture the cone base CB between the top 102 and bottom 104 portions, thereby forming an assembled system **100** in which the translucent body of the cone C extends upwardly through a central aperture of the top portion **102**, as shown in FIG. **4**. As in the above described first embodiment, the bottom portion **104** may optionally have apertures **120** and/or slots **120***a* through which foot members F of the come base CB may protrude.

(37) Pairs of top charging electrodes **110**T are present on the top portion **102** and pairs of bottom charging electrodes **110**B are present on the bottom portion **104**, so that charging current will be supplied to a number of cones C simultaneously when the cones C are stacked one on top of another. Such charging electrodes **110**T, **110**B may be spring electrodes, as shown, or any other suitable type of contact plates or other electrode configurations.

(38) Referring in particular to FIGS. **7** and **10-12**, the top charging electrodes **110**T may extend upwardly from top platform circuit boards **136** which are present in the top portion **102**. Vertical circuit boards **132** extend downwardly from the top platform circuit boards **136**. The bottom end of each vertical circuit board **132** becomes connected, by way of connectors **114** such as pogo type connectors, to a bottom circuit board **132** in the bottom portion **104** when the top portion **102** becomes attached to the bottom portion **104**. When the top portion **102** is attached to the bottom portion **104** in this manner, the vertical circuit boards **132** may pass through recesses or outcropped passages **107** formed in side walls of the top portion **102**, as seen in FIGS. **4**, **5**, **6** and **9**A and provide electrical continuity between the circuitry in the bottom portion **104** and that of the top portion **102**.

(39) The top platform circuit boards **136** are connected to battery packages **112** having rechargeable batteries **114**, and include electronic circuit components which facilitate charging and, in some embodiments remote status checking, of batteries **114**. Some components of the top platform circuit boards **132** may be housed in enclosures or housings **138** which are connected to the vertical circuit boards **132** by hard wired, soldered connections **139**. One top platform circuit board **136***a* may additionally include communication components for communication, such as e.g., radio, cellular, satellite, internet or other apparatus, for control, monitoring, networking (e.g., mesh network) and/or other communication between neighboring devices **100** and/or with other locations or devices such as gateway devices, remote controllers or cloud based control/monitoring locations.

(40) As shown in FIG. **8**, the battery packages **112** may comprise adhesive pads **116** configured to contact and adhere to adjacent surfaces of the device **100** and/or cone base CB thereby firmly holding the batteries **114** in place after the illumination device **100** have been attached to the traffic cone C.

(41) As explained above, a number of stackable units comprising cones C having these illumination devices **101** attached thereto, can be stacked, one upon another, such that the top charging electrodes **110**T connect with bottom charging electrodes **110**B of neighboring devices **101** in the stack. When any one of the stacked devices **110** is connected to a source of charging electrical current, such current will distribute to each of the devices **100** in the stack. As shown in FIGS. **9**A and **9**B, windows or openings **103** may be formed in recesses or outcropped passages **107** formed in the side walls of the top portion **102** of each device, or at any other suitable locations. Charging indicator light emitting diodes **105** may be positioned on the vertical circuit boards **130** or at any other suitable locations to emit light through the windows or openings **103**, thereby indicating that that the batteries **114** of that device **100** are presently receiving charging current. This enables a user to visually verify that all devices **100** in a stack are in electrical contact with one another and receiving charging current as intended.

(42) As may be appreciated from FIGS. **7** and **13-14**A, LED circuit boards **110** having cone illumination LEDs **111** are mounted on supporting structures **108** of the bottom portion **104**. The supporting structures **108** are configured to protrude slightly into an area beneath the hollow or open inner space of the cone C. Light emitted from the cone illumination LEDs **111** illuminated the

walls of the cone C. All or part of the wall of the cone C is translucent (e.g., formed of material that allows light to pass therethrough and/or incorporates translucent or open areas or windows or fenestration through which light passes), This effectively causes the cone C to emit light (visible and/or invisible) or other form(s) of energy that visible to or detectable by oncoming vehicles or pedestrians. In some embodiments, the cone illumination LEDs **111** may emit visible light to visibly illuminate the cone C and other emitters may be located elsewhere on the device **110** to emit infrared light or other forms of energy for detection by appropriately equipped pedestrians or vehicles, such as self-driving or autonomous vehicles equipped to detect and use infrared light or other signals for navigation and/or guidance purposes.

(43) Referring specifically to FIGS. **14** and **14**A, the supporting structures **108** may have depressions or grooves **109** in upper edges thereof in which the LED circuit boards **110** are positioned. These depressions or grooves **109** may have a protective lip **113** which protects the LED circuit board **110** and its LEDs **111** from excessive wear or damage when the stackable units comprising cones C having these illumination devices **101** attached thereto are stacked on top of one another as seen in FIG. **14**. Additionally, the support members **108**, and the LED's **111** themselves may be constructed so as to optimize positioning of the LEDs **111** and even distribution of light from the LEDs over the wall of the cone C. In this regard, as shown in FIG. **14**A, the support structure **108** and depression or grove **109** may be configured to hold the cone illuminating LEDs **111** at a specific tilt angle A**1** relative to a horizontal axis to cast light from the cone illuminating LEDs **111** onto the wall of the cone contralateral to or across from the location of those particular LEDs **111**. Also, the beam angle A**2** of the cone illuminating LEDs **111** may be selected to provide appropriate or optimal distribution of light from the LEDs **111** over all or most of the wall of the cone. For standard traffic cones of the type commonly used on roadways in the United States, tilt angle A**1** may be in the range of 30 degrees to 70 degrees above horizontal and the LED beam angle A**2** may be in the range of 30 degrees to 120 degrees (15 to 60 degrees from centerline on each side). In the specific, non-limiting embodiment shown in the drawings, the tilt angle is 50 degrees and the LED beam angle is 120 degrees.

(44) Traffic cones and channelizing/marking devices can be subject to rough use and may sometimes be run over by a vehicle or otherwise subjected to crushing forces. As shown in FIGS. **15** and **16**, an alternative embodiment of the top portion **102***a* may optionally incorporate strengthening members **130** to enhance the strength and crush resistance of the illumination device **101**. These optional strengthening members **130** may comprises ribs, bosses, waffle structures or other configurations.

(45) As used herein, the term “road surface” is to be interpreted broadly as meaning any surface on which the traffic cones C with attached illumination devices **12** are placed, including not only paved or unpaved roadway surfaces but also parking lots, runways, driveways, floors, roofs, floating upon fluid or water surfaces, any other surfaces on which the system **10** may be operatively placed.

(46) Optionally, any illumination device **12**, **101** may have an electronics compartment **36** or other location(s) which house electronic components and circuitry for communication and/or control such as, for example, radiofrequency receiving and transmitting apparatus, sensor(s), satellite location determining apparatus (e.g., Global Positioning System (GPS), Global Navigation Satellite System (GNSS) devices or other geolocation systems), modems, energy emitters and other apparatus as described in any of the above incorporated United States Patents and Published United States Patent Applications.

(47) In some embodiments of illumination devices **12**, **101** may include components and circuitry configured to enable a plurality of these illuminating devices **12**, **101** to operate as nodes of a mesh network so that their light emitters **28** operate in synchronized or coordinated fashion as described in any of the above incorporated United States Patents and published United States Patent Application and, specifically for example, in U.S. Pat. No. 10,443,828 entitled Sequential and

Coordinated Flashing of Electronic Roadside Flares with Active Energy Conservation; U.S. Pat. No. 10,536,519 entitled Synchronizing the Behavior of Discrete Digital Devices. In other embodiments coordinated flashing of the devices **12** or **101** may be accomplished using other radio networks, including constant listening to neighbors while one device acts as a "coordinator" (previously referred to as Master/Slave network), external command timing with pre-numbered devices, light (including infrared light) transmission from one unit to the next unit in sequence for triggering purposes, and high precision real-time clocks with individual timing of sequential units based upon a stable clock. An alternative to mesh networks in which all devices are "equal", could be a network dependent upon an external timing signal derived from GPS receivers (highly accurate clock signals) or World Standard timing broadcasts (W W V in Ft. Collins, Colorado, for example). There are other sources of public domain timing signals broadcast worldwide that would aid in the coordinated flashing of multiple devices. If radio communication is used, low energy Bluetooth, Zigbee, Wi-Fi, or other proprietary networks are available and chosen based upon energy consumption, range, bandwidth requirements, etc.

(48) In some embodiments, the components and circuitry may include location determining (e.g., geolocation) apparatus for determining the current location of the device using a satellite system, Global Positioning System (GPS) a Global Navigation Satellite System (GNSS) or other geolocation system.

(49) In some embodiments, components and circuitry may include sensor(s) for sensing status of the illuminating device **12**, **101** and/or other events such as; a change in the operational status or operational mode of the illumination device, movement or tipping over of the illumination device, impact on the illumination device, failure of the illumination device, or movement of a vehicle over top of or past the illumination device. Such sensors may provide the necessary components to form a "cone array" surrounding working personnel and to alert them should a vehicle encroach the work area and strike or pass one or more of the cones. Further details regarding such systems and functionality are described in copending U.S. patent application Ser. No. 18/090,088 entitled Vehicular Incursion Alert Systems and Methods, the entire disclosure of which is expressly incorporated herein by reference.

(50) In some embodiments, the components and circuitry may also including transmitter(s) for transmitting information from the illumination device **12** or any incorporated components such as location determining apparatus and/or sensor(s) to a receiving device (in a vehicle in proximity, for example) or service via cellular, telephonic, internet, fiber-optic or other wired or wireless communication. Such transmission of information may be direct (e.g., radiofrequency, cellular or internet-based transmission from the illumination device **12** directly to the receiving device or service) or indirect (e.g., initial transmission of information from the illuminating device **12** to a gateway or intermediary device which then relays all or part of the information to the intended receiving device or service. Examples of receiving devices and services to which such information may be transmitted include but are not necessarily limited to: receivers or map displays in vehicles; receivers or map displays in a data center or other location, a receiving computer or smart phone (may require installation of suitable software application); a cloud based server; a data center; a control center; an in-vehicle information service (e.g., General Motors OnSTar™ System or HERE Technologies System) and/or a traffic and/or road condition monitoring service (e.g., WAZE or Smartway). Further details regarding direct or indirect data transmission of information from the illumination device **12** to receiving device(s) and/or service(s) are described in United States Patent Application Publication No. 2001/0237777 entitled Devices and Methods for Channelizing Vehicular Traffic and Enhancing Workzone Safety, which is expressly incorporated herein by reference, and actually incorporated herein by attachment hereto as Appendix A.

(51) In some embodiments, the traffic cone or other traffic channelizing/marking device may comprise a typical traffic barrel, or channelizer drum such as, for example, an orange or brightly colored barrel having a hollow interior, a vertical or slightly tapered or stepped side wall (at least a

portion of which is translucent) and a flange or other projection extending outwardly at the bottom end of the barrel. Commercially available examples of such traffic barrels or channelizer drums include but are not limited to the Commander™ Traffic Drum (Plasticade, Des Plaines, Illinois), The Director™ Traffic Safety Drum (Lakeside Plastics, Oshkosh, Wisconsin) and TrafFix Channelizer Drum™ (Trafix Devices, San Clemente, California). The illuminating devices described herein may be modified in size and configuration as needed for attachment to a traffic barrel, and the brightness, location, and number of LEDs or other emitters and the associated support structures on which they are positioned may be modified to internally illuminate the barrel of drum so that light (visible and/or infrared) or other energy is emitted through the wall of the barrel or drum and is visible to or detectable by oncoming pedestrians or vehicles. In barrels or drums that have near-vertical walls, light transmitted across to the contralateral side may be utilized. In some embodiments, the illuminating device as disclosed herein may be combined with or integrated in a typically rubber or plastic circular ring that rests on a flange or projection at the bottom of the barrel to weigh the barrel down and prevent movement from truck/car wake or wind would be used to mount a circuit board and batteries and LEDs. The electronics and radio transceiver could be separate and mounted inside the barrel for weather protection. Barrels equipped with internal illumination may also incorporate other sensors and components as disclosed herein and in the documents incorporated by reference to provide, for example, location (GNSS/GPS), accelerometers or other vibration sensors to register and report movement, impact, or roll-over, ambient light sensors, radio communication for direct channelizer-to-vehicle, channelizer-to-cloud, channelizer-to-external-modem to cloud, communication. Communication could follow the smart work zone protocol (WZDx—Work Zone Data Exchange).

(52) Although the description set forth hereabove refers to certain non-limiting examples or embodiments of the, various additions, deletions, alterations and modifications may be made to those described examples and embodiments without departing from the intended spirit and scope of the invention. For example, any elements, steps, members, components, compositions, reactants, parts or portions of one embodiment or example may be incorporated into or used with another embodiment or example, unless otherwise specified or unless doing so would render that embodiment or example unsuitable for its intended use. So, for example, any component, circuitry or functionality of the first embodiment 14 may be included in the second embodiment 101 where feasible, and vice versa. Also, where the steps of a method or process have been described or listed in a particular order, the order of such steps may be changed unless otherwise specified or unless doing so would render the method or process unsuitable for its intended purpose. Additionally, the elements, steps, members, components, compositions, reactants, parts or portions of any invention or example described herein may optionally exist or be utilized in the absence or substantial absence of any other element, step, member, component, composition, reactant, part or portion, unless otherwise noted. All reasonable additions, deletions, modifications and alterations are to be considered equivalents of the described examples and embodiments and are to be included within the scope of the following claims.

Claims

1. A system comprising a plurality of illuminating devices for attachment to and internal illumination of stackable traffic channelizing/marking devices which comprise cones, barrels, tubes, drums, buoys or signs, each having a body and a base flange, said body comprising a hollow inner space and a round, conical or frusto-conical side wall that is fully or partially translucent, said base flange extending outwardly about a perimeter of an open bottom end of the body, wherein: each of said illumination devices is configured for attachment to the base flange of one of the traffic channelizing/marking devices, and comprises; a plurality of light emitters positioned to cast light onto an inner surface of the fully or partially translucent side wall such that at least some of

said light will pass though the fully or partially translucent side wall; a rechargeable power source; charging circuitry for recharging the rechargeable power source; at least one top electrode positioned on a top portion of the illumination device that resides over top of the base flange of the traffic channelizing/marking device to which it is attached; at least one bottom electrode positioned on a bottom portion of the illumination device that resides beneath the base flange of the traffic channelizing/marking device to which it is attached; radiofrequency transmitter and radiofrequency receiver configured for radiofrequency communication with one or more other devices; and electronic circuitry configured for powering and controlling the light emitters; and, wherein attachment of each of said illumination devices to one of said stackable traffic channelizing/marking devices forms a plurality of a stackable units, each of said stackable units comprising a traffic channelizing/marking device with the illumination device attached thereto, such that: each stackable unit can sit, bottom side down, on an underlying road surface during use and, thereafter, can be lifted and removed from the road surface while the illumination device remains attached to the traffic channelizing/marking device; and the stackable units are stackable one upon another with the bottom electrodes of each stackable unit engaging the top electrodes of any stackable unit positioned therebelow, said engagement of top and bottom electrodes providing interconnection of the charging circuitry of all illumination devices in the stack such that connection of a power source to the charging circuitry of a single illumination device in the stack can distribute electrical power to the charging circuitry of all illumination devices in the stack.

2. A system according to claim 1 wherein the light emitters are located on one or more projections which extend upwardly into the hollow inner space of the traffic channelizing/marking device when the illumination device remains attached to the traffic channelizing/marking device in said operative position.

3. A system according to claim 2 wherein said one or more projections function as guides or locators to facilitate positioning of the illumination device in said operative position as it is attached to the traffic channelizing/marking device.

4. A system according to claim 2 wherein said one or more projections extend into the hollow inner space such that the light emitters are positioned adjacent to or in abutting contact with said inner surface of the fully or partially translucent wall.

5. A system according to claim 4 wherein said one or more projections are slanted or curved inwardly for ease of insertion into the hollow inner space.

6. A system according to claim 4 wherein said one or more projections comprises raised ridges having said light emitters and related light emitter circuitry mounted thereon.

7. A system according to claim 1 configured for attachment to a type of traffic channelizing/marking device that has downwardly extending foot members, wherein the base member of the illumination device has one or more passages, openings or cut outs through which the downwardly extending foot members to extend so that the foot members will contact an underlying road surface on which the device is placed.

8. A system according to claim 1 wherein each illumination device further comprises a geolocator selected from: a Global Positioning System (GPS), a Global Navigation Satellite System (GNSS), or other geolocating system which receives and utilizes signals from satellites to determine geolocation.

9. A system according to claim 8 wherein each illumination device further comprises a location transmitter for transmitting the location of the device directly, or indirectly via a gateway or intermediary device, to a receiving location selected from: a receiver in a vehicle; a map display in a vehicle; a remote computer; a remote map display, a cloud-based server, a data center, a control center, an in-vehicle information service, a traffic monitoring service.

10. A system according to claim 1 wherein each illumination device further comprises a sensor for sensing one or more of the following events: a change in the operational status or operational mode of the illumination device, movement or tipping over of the illumination device, impact on the

illumination device, failure of the illumination device, or movement of a vehicle over top of or past the illumination device.

11. A system according to claim 10 wherein each illumination device further comprises an information transmitter for transmitting information sensed by the sensor directly, or indirectly via a gateway or intermediary device, to a receiving location selected from: a receiver in a vehicle; a map display in a vehicle; a remote computer; a remote map display, a cloud based server, a data center, a control center, an in-vehicle information service, a traffic monitoring service.

12. A system according to claim 1 wherein the stacking electrodes automatically configure proper polarity, and engage one another so as to interconnect the rechargeable power sources of all illumination devices in the stack.

13. A system according to claim 1 further comprising an electrical power connector useable for connecting the charging circuitry of one of the illumination devices while the stackable units are stacked, to thereby deliver electrical power to the charging circuitry of all illumination devices in the stack.

14. A system according to claim 13, wherein the electrical power connector comprises a charging cap.

15. A system according to claim 13 wherein the electrical power connector comprises an electrical cord.

16. A system according to claim 1 wherein light emitters are positioned at light emitter locations adjacent to said side wall and configured to cast light across the hollow inner space and onto the inner surface of the side wall in areas contralateral to or across from the light emitter locations.

17. A system comprising a plurality of illuminating devices for attachment to and internal illumination of stackable traffic channelizing/marking devices which comprise cones, barrels, tubes, drums, buoys or signs, each having a hollow inner space and a side wall that is fully or partially translucent, wherein: each of said illumination devices comprises; a base member; a plurality of light emitters positioned on the base so as to cast light onto an inner surface of the fully or partially translucent side wall such that at least some of said light will pass though the fully or partially translucent wall; a rechargeable power source; charging circuitry for recharging the rechargeable power source; at least one stacking electrode; radiofrequency transmitter and radiofrequency receiver configured for radiofrequency communication with one or more other devices; and electronic circuitry configured for powering and controlling the light emitters; and, wherein each of said illumination devices is configured for attachment to one of said stackable traffic channelizing/marking devices to form a stackable unit comprising the traffic channelizing/marking device with the illumination device attached thereto, such that: the light emitters will cast light upwardly onto an inner surface of the fully or partially translucent wall so that at least some of that light will pass through the fully or partially translucent wall; each stackable unit can sit, bottom side down, on an underlying road surface during use and, thereafter, can be lifted and removed from the road surface while the illumination device remains attached to the traffic channelizing/marking device; and the stackable units are stackable one upon another with the stacking electrodes engaging one another, said engagement of the stacking electrodes providing interconnection of the charging circuitry of all illumination devices in the stack such that connection of a power source to the charging circuitry of a single illumination device in the stack can distribute electrical power to the charging circuitry of all illumination devices in the stack; wherein the stacking electrodes are situated such that rotation of any illumination device in the stack by 90 degrees will allow continued interconnection of the charging circuitry of all illumination devices in the stack such that connection of a power source to the charging circuitry of a single illumination device in the stack will distribute electrical power to the charging circuitry of all illumination devices in the stack.

18. A system according to claim 17 wherein the light emitters are positioned at light emitter locations adjacent to said side wall and configured to cast light across the hollow inner space and

onto the inner surface of the sidewall in areas contralateral to or across from the light emitter locations.