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(54) **KEYBOARD BACKLIGHTING WITH DEPOSITED LIGHT-GENERATING SOURCES**

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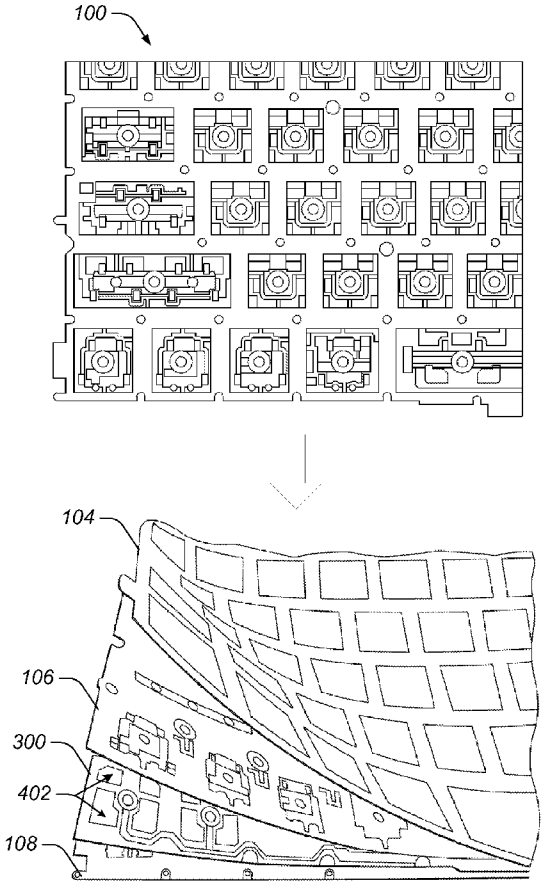
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H01H 13/88	(2006.01)
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(52) **U.S. Cl.**

CPC ***H01H 13/83*** (2013.01); ***G06F 3/0202*** (2013.01); ***H01H 13/88*** (2013.01); *H01H 2219/048* (2013.01); *H01H 2219/062* (2013.01); *H01H 2229/002* (2013.01)

(57) **ABSTRACT**

Techniques and devices provide backlighting for keys of a keyboard or keypad.



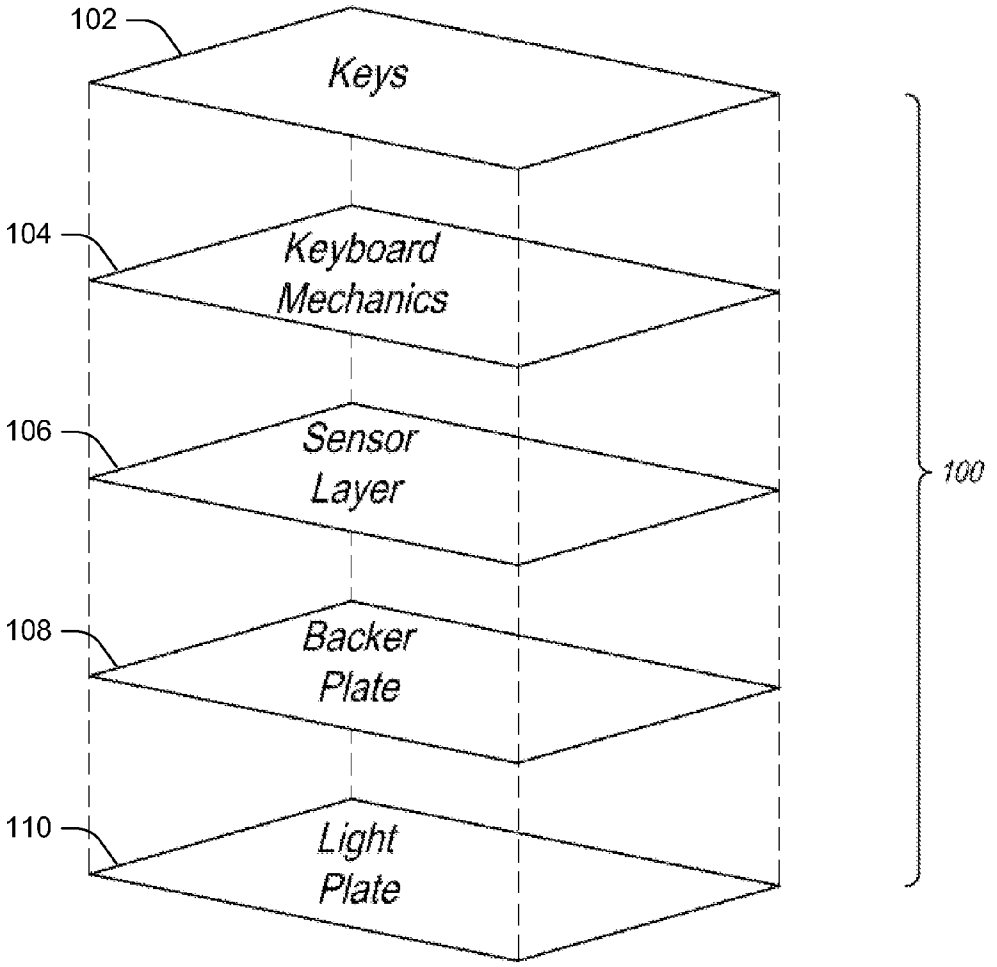

102
Keys
104
Keyboard Mechanics
106
Sensor Layer
108
Backer Plate
110
Light Plate
100

Fig. 1

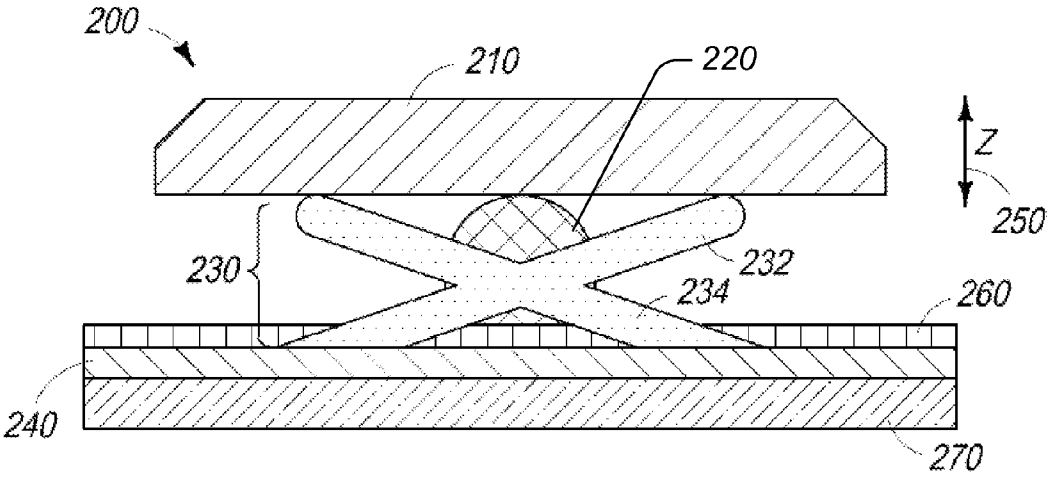


Fig. 2

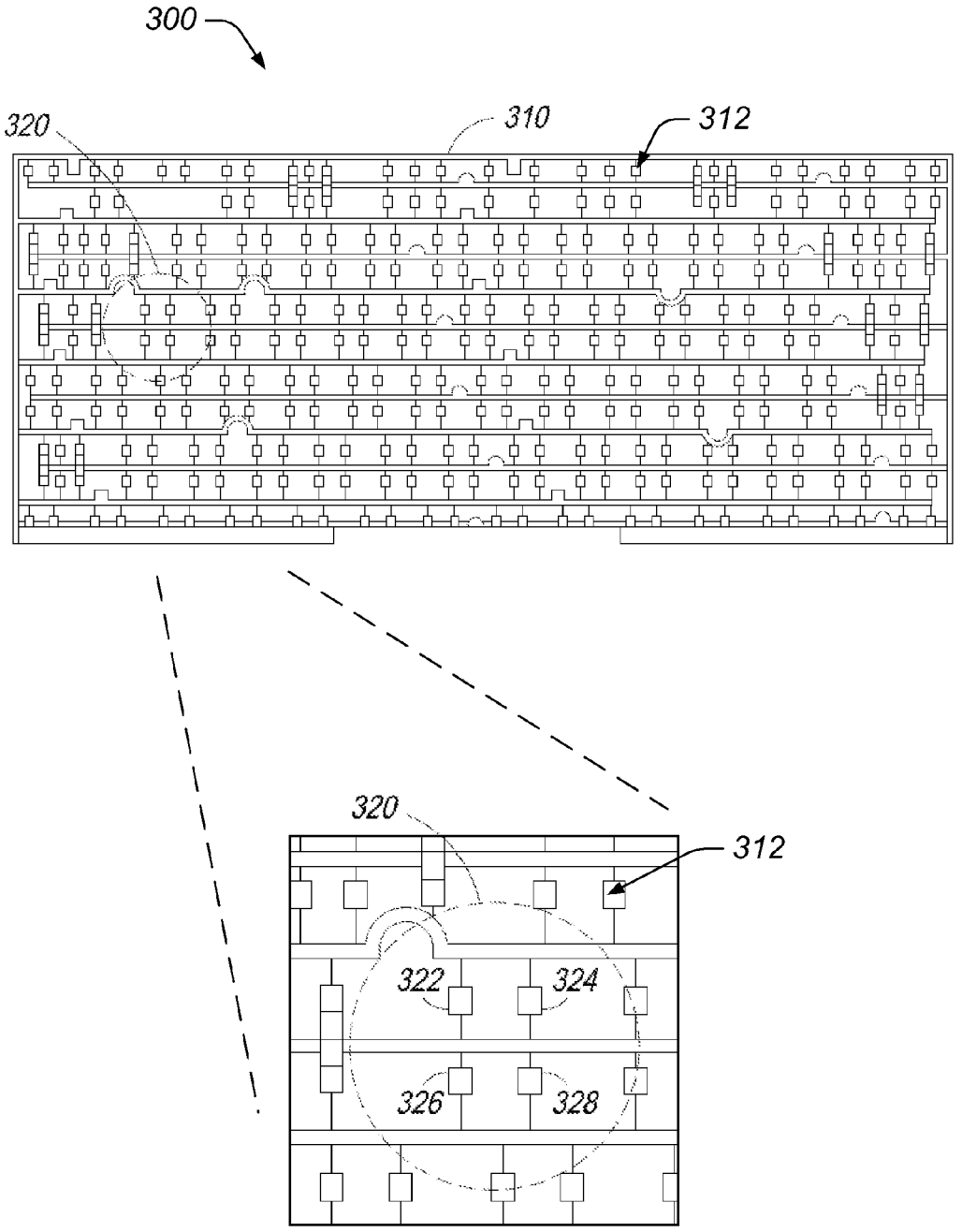


Fig. 3

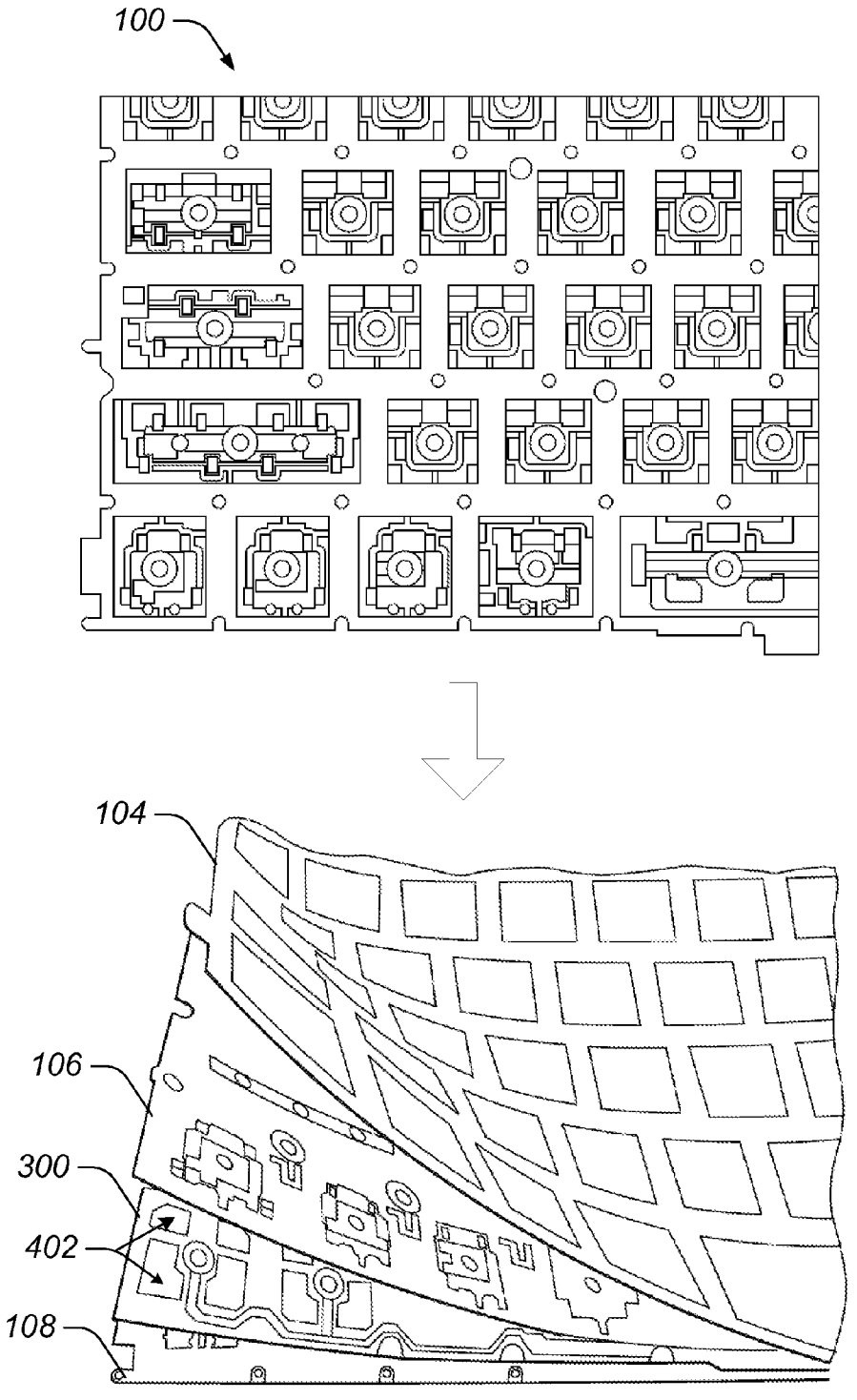


Fig. 4

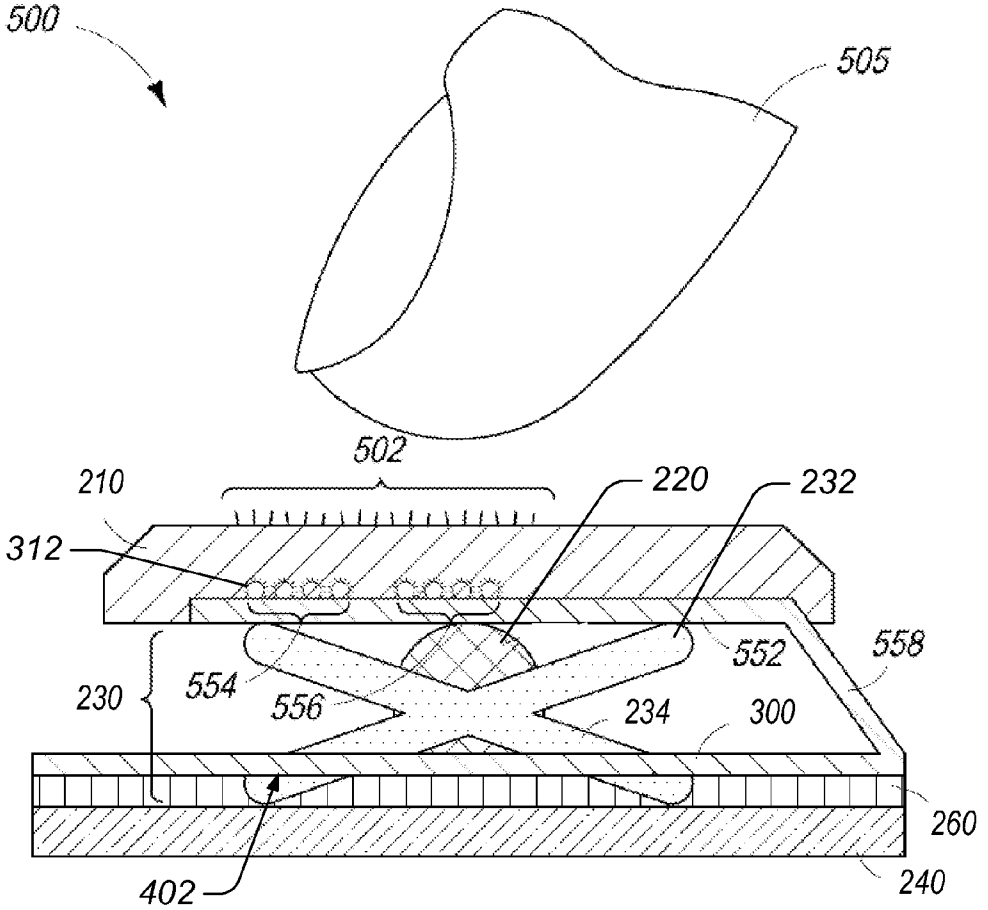

500
505
502
210
220
232
312
552
558
554
556
230
234
300
260
402
240

Fig. 5

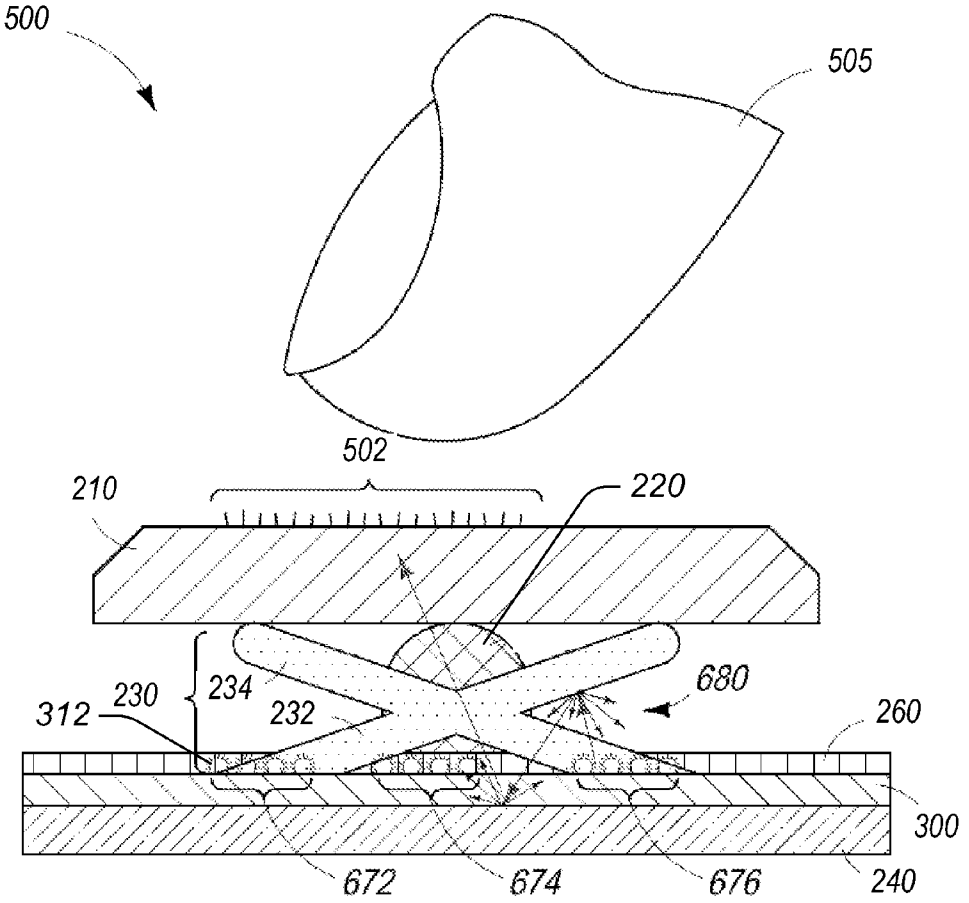


Fig. 6

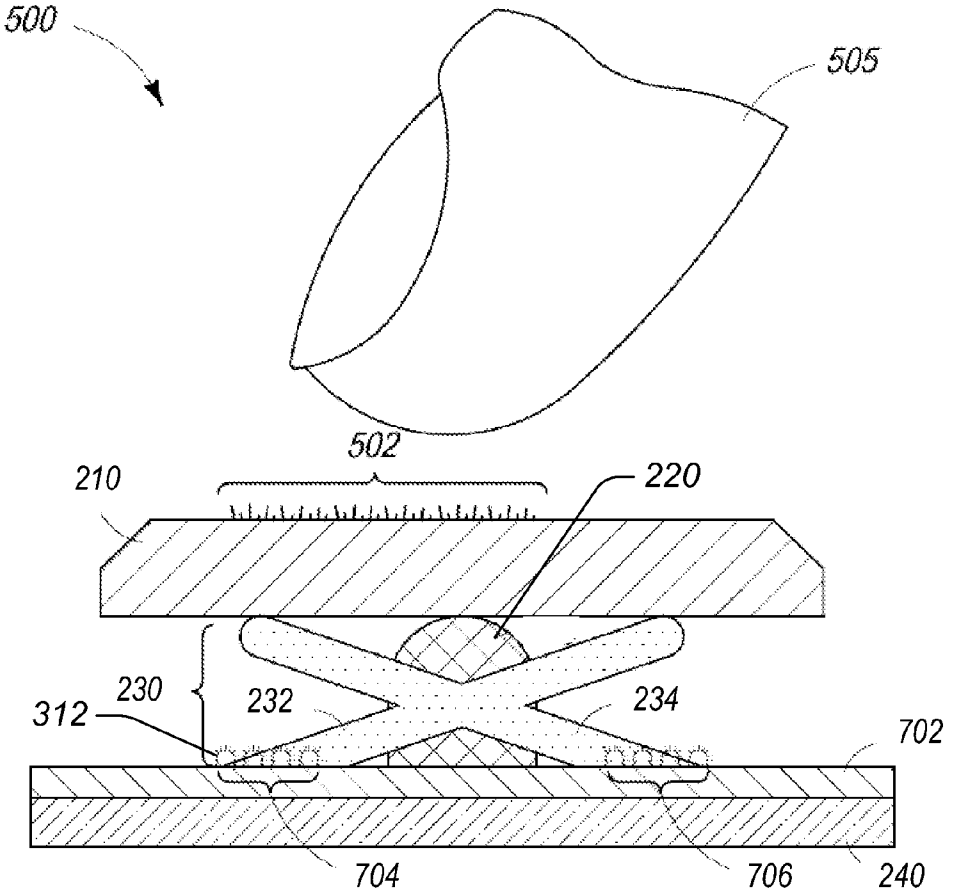


Fig. 7

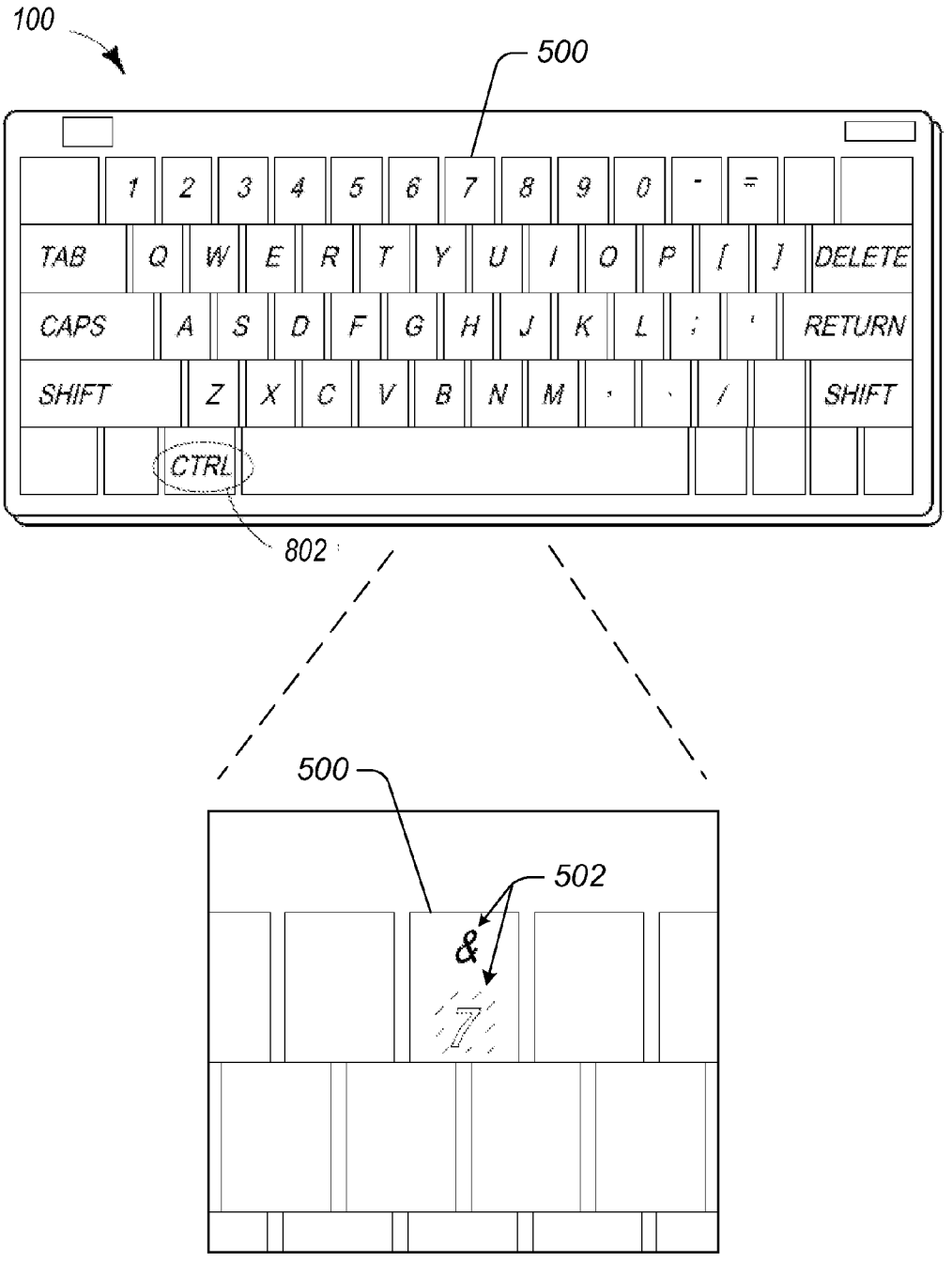

100
500
1 2 3 4 5 6 7 8 9 0 - =
TAB Q W E R T Y U I O P [ ] DELETE
CAPS A S D F G H J K L ; ' RETURN
SHIFT Z X C V B N M , . / SHIFT
CTRL
802
500
502
&
7

Fig. 8

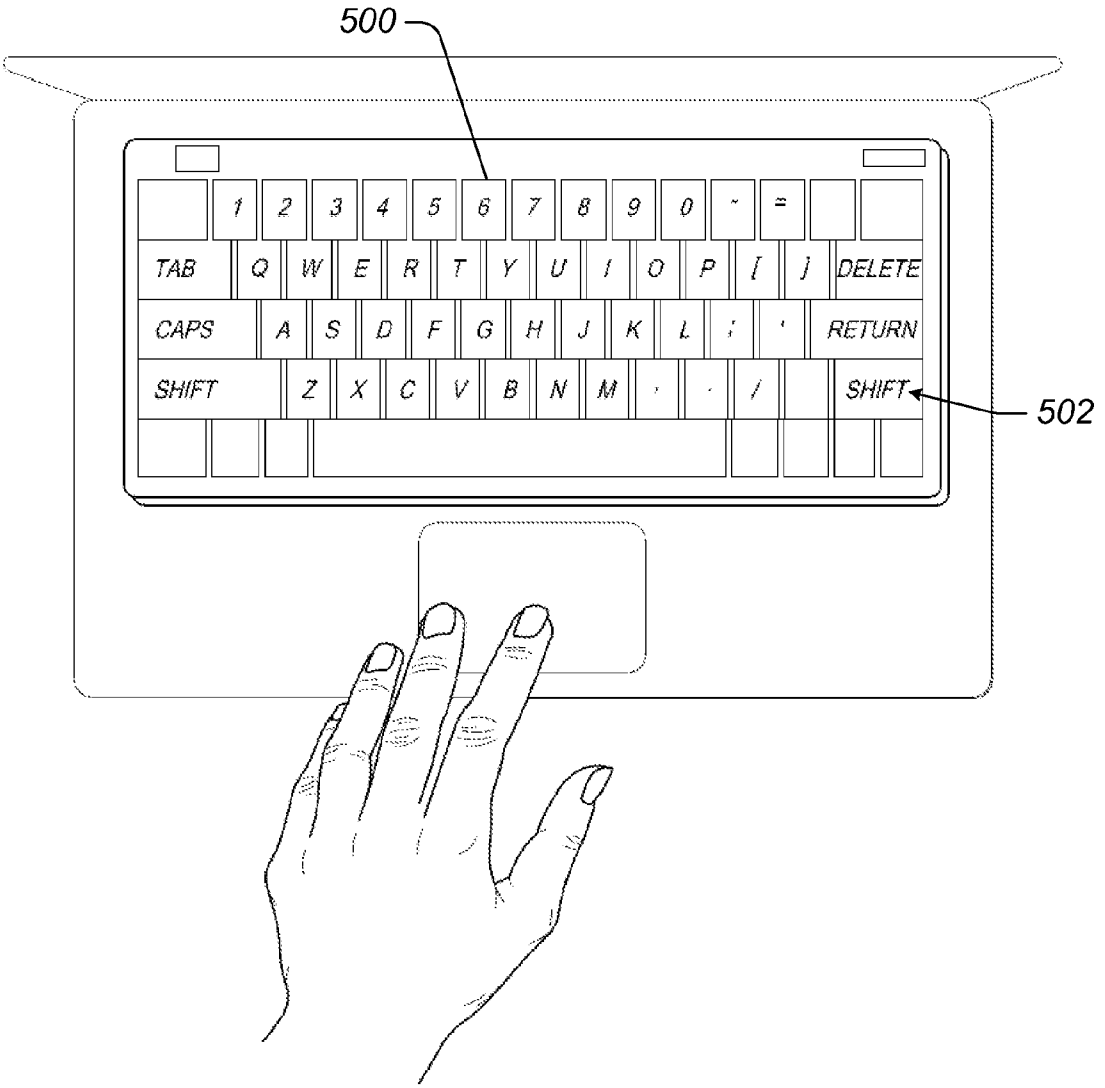

500
1 2 3 4 5 6 7 8 9 0 ~ =
TAB Q W E R T Y U I O P [ ] DELETE
CAPS A S D F G H J K L ; ' RETURN
SHIFT Z X C V B N M , . / SHIFT
502

Fig. 9

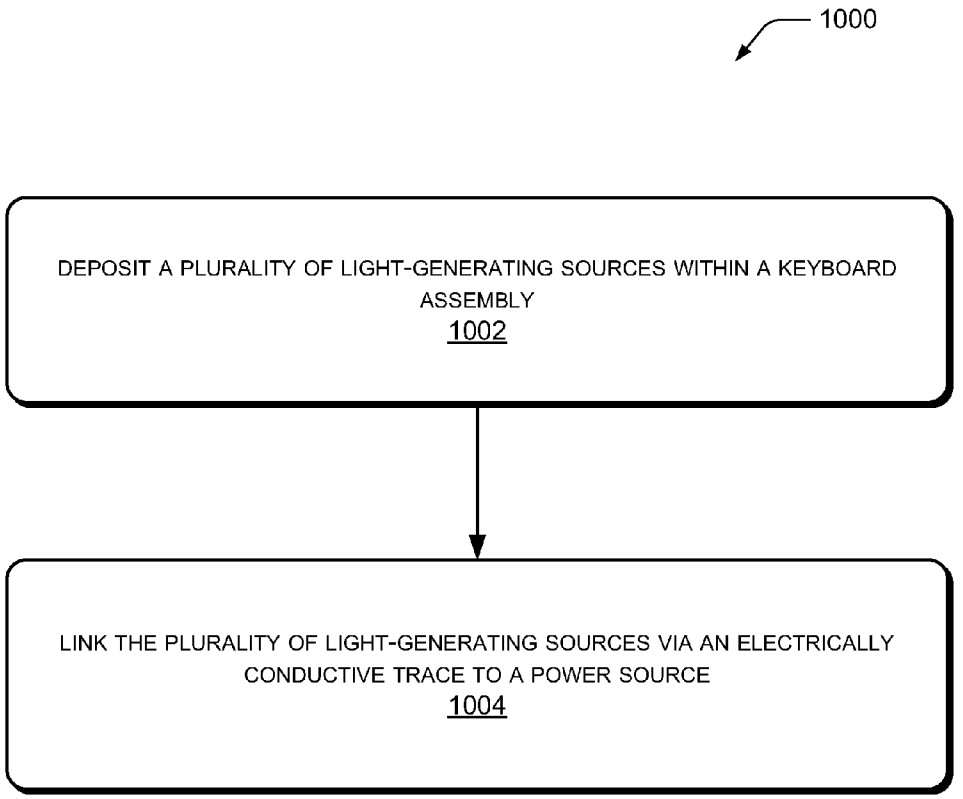

1000
DEPOSIT A PLURALITY OF LIGHT-GENERATING SOURCES WITHIN A KEYBOARD ASSEMBLY
1002
LINK THE PLURALITY OF LIGHT-GENERATING SOURCES VIA AN ELECTRICALLY CONDUCTIVE TRACE TO A POWER SOURCE
1004

Fig. 10

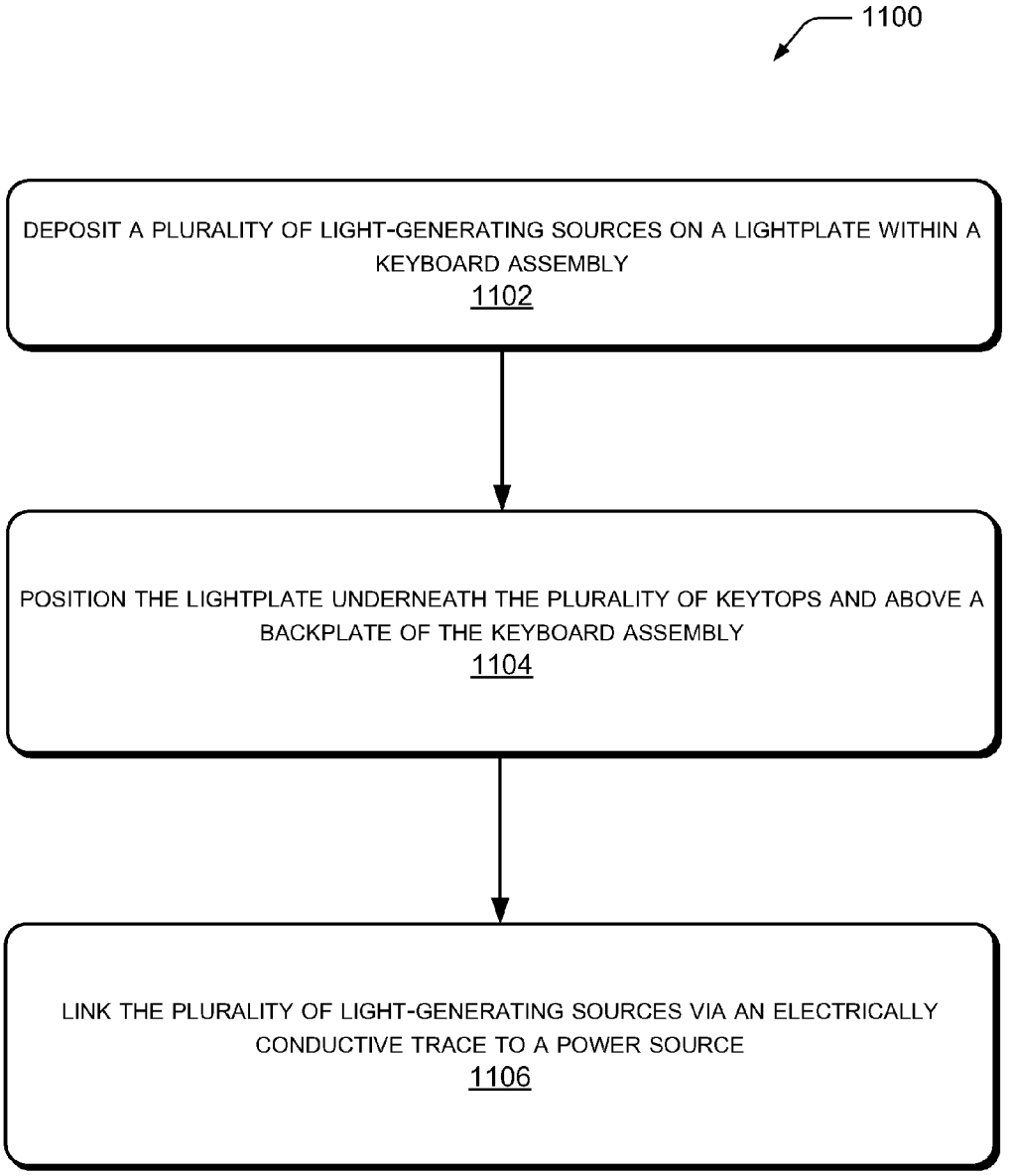

1100
DEPOSIT A PLURALITY OF LIGHT-GENERATING SOURCES ON A LIGHTPLATE WITHIN A KEYBOARD ASSEMBLY
1102
POSITION THE LIGHTPLATE UNDERNEATH THE PLURALITY OF KEYTOPS AND ABOVE A BACKPLATE OF THE KEYBOARD ASSEMBLY
1104
LINK THE PLURALITY OF LIGHT-GENERATING SOURCES VIA AN ELECTRICALLY CONDUCTIVE TRACE TO A POWER SOURCE
1106

Fig. 11

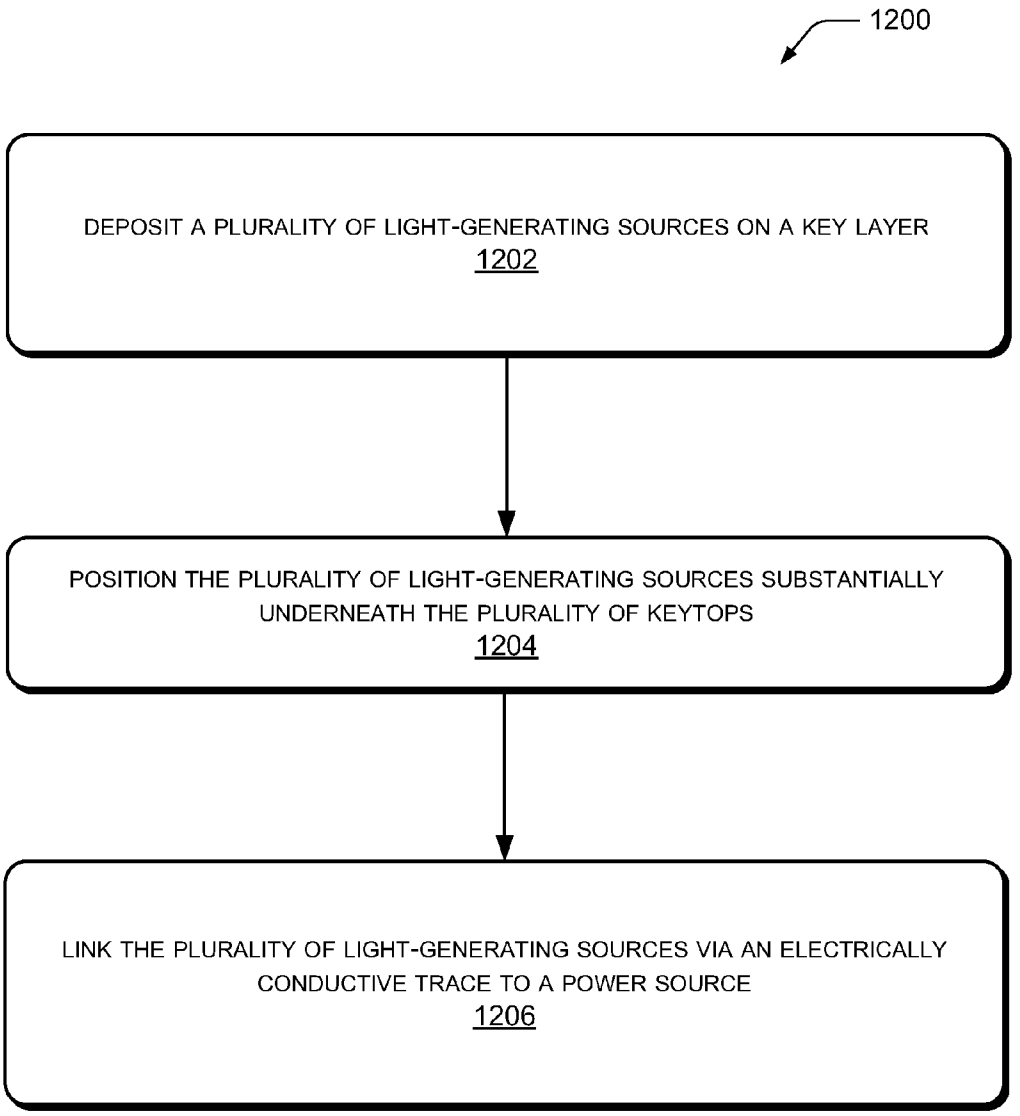

1200
DEPOSIT A PLURALITY OF LIGHT-GENERATING SOURCES ON A KEY LAYER
1202
POSITION THE PLURALITY OF LIGHT-GENERATING SOURCES SUBSTANTIALLY UNDERNEATH THE PLURALITY OF KEYTOPS
1204
LINK THE PLURALITY OF LIGHT-GENERATING SOURCES VIA AN ELECTRICALLY CONDUCTIVE TRACE TO A POWER SOURCE
1206

Fig. 12

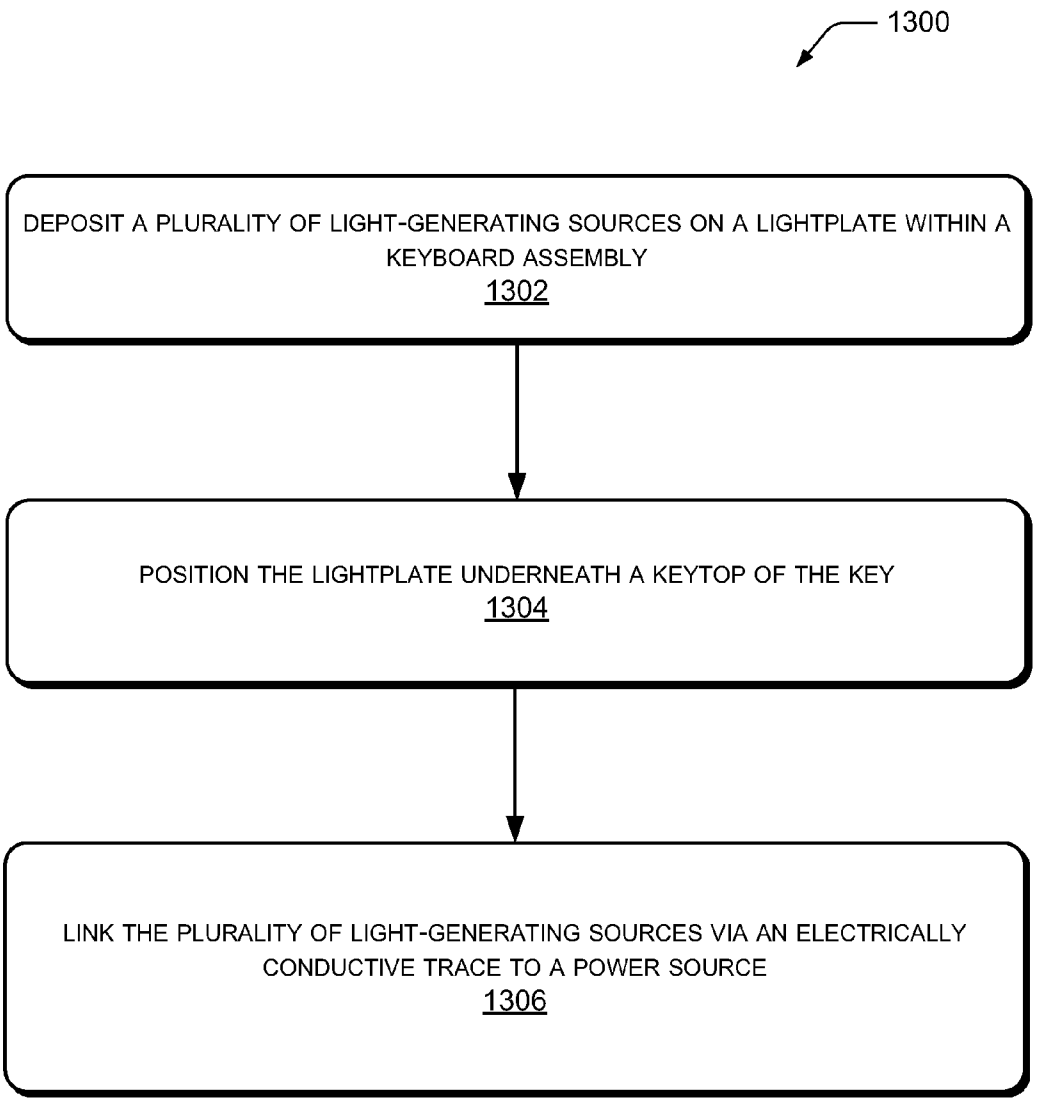

1300
DEPOSIT A PLURALITY OF LIGHT-GENERATING SOURCES ON A LIGHTPLATE WITHIN A KEYBOARD ASSEMBLY
1302
POSITION THE LIGHTPLATE UNDERNEATH A KEYTOP OF THE KEY
1304
LINK THE PLURALITY OF LIGHT-GENERATING SOURCES VIA AN ELECTRICALLY CONDUCTIVE TRACE TO A POWER SOURCE
1306

Fig. 13

KEYBOARD BACKLIGHTING WITH DEPOSITED LIGHT-GENERATING SOURCES

PRIORITY CLAIM AND CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. §119(e)(1) of U.S. Provisional Applications: No. 61/834,406, filed Jun. 12, 2013; No. 61/834,418, filed Jun. 12, 2013; No. 61/834,669, filed Jun. 13, 2013; No. 61/835,504, filed Jun. 14, 2013; No. 61/836,086, filed Jun. 17, 2013; No. 61/836,632, filed Jun. 18, 2013; No. 61/837,132, filed Jun. 19, 2013; No. 61/894,824, filed Oct. 23, 2013; No. 61/903,396, filed Nov. 13, 2013; and No. 61/909,290, filed Nov. 26, 2013, which are hereby incorporated by reference in their entirety.

BACKGROUND

[0002] Due to their portability, connectivity, flexibility, and capabilities like that of a desktop computer, many people use laptops frequently and, indeed, daily. The keyboards of typical laptop computers and mobile devices (such as a smartphone) are thin, lightweight, and compact.

[0003] Unfortunately, conventional backlighting of keyboards adds complications, such as additional thickness to the overall keyboard assembly.

[0004] FIG. **1** shows an exploded view of a typical keyboard assembly **100** of a laptop computer or other mobile computing device. Such assemblies are also called keyboard stacks. The major components of this assembly **100** are shown without much detail. The primary purpose of FIG. **1** is to show the relationship amongst the major components of a typical keyboard assembly **100** of a laptop computer or mobile device.

[0005] Referring to FIGS. **1** and **2**, the keyboard assembly **100** includes the following major component layers (from top to bottom): Key layer **102**, keyboard mechanics layer **104**, a sensor layer **106**, a backplate layer **108**, and a lightplate layer **110**.

[0006] The key layer **102** includes, for example, a top bezel around one or more keytops **210**. Below the key layer **102** is the keyboard mechanics layer **104**. Typically, this layer **104** includes keypress functional components such as a resist-and-return structure **220** and a leveling structure **230**. Often, the resist-and-return structure **220** components include a collapsible elastomeric plunger (i.e., "rubber dome"). Similarly, the leveling structure **230** often comprises a scissor mechanism **232**, **244**, or the like. The keyboard mechanics are discussed more below with regard to FIG. **2**.

[0007] Under the keyboard mechanics layer **104** is the sensor layer **106**. The purpose of the sensor layer **106** is to detect a keypress of one or more of the keys **200**. To that end, it has electronic circuitry (e.g., one or more sensors **260**) to sense the downward pressing of the key **200** by a user. The most common type of sensor **260** utilizes a conductive or contact switch under each key. Other sensing technologies (such as capacitive and electrical resistance) may also be employed. The sensor layer **106** is also often called the "keyswitch" layer or the "sensor membrane" layer.

[0008] A conventional keyboard assembly **100** typically utilizes a sensor membrane layer **106** of at least three substrates and one or more conductive-based switches **260** to detect key depressions. A first substrate and second substrate each have contact switch circuitry. The first and second substrates are separated by a third non-conductive substrate disposed therebetween. The non-conductive substrate between the two conductive substrates has a hole therethrough that allows the underkey contacts of each conductive substrate to trampoline together upon a keypress. This action closes a switch **260** and indicates a keypress.

[0009] A controller (not shown) associated with the keyboard assembly **100** detects that a particular key **200** is depressed and sends that information to a processor or other computing device. Of course, other keyboard assemblies **100** can use different key press detection technologies, such as capacitive and resistive.

[0010] The keyboard mechanics **230** are attached to the rigid backplate **240** of the backplate layer **108**. Typically, such a backplate **240** (i.e., "backer") is made from a strong material like steel, aluminum, or other metal. Under the backplate layer **108** is the lightplate layer **110**.

[0011] The lightplate **270** (i.e., light guide plate or light-guide) of the lightplate layer **110** can employ conventional light-emitting diodes (LEDs) as an illuminant. Typically, the LEDs are mounted on the outer edge of the keyboard assembly **100** and away from the keys **200** themselves. The light from the LEDs is guided to the interior of the keyboard **100** via the light guide plate **270**. Diffusers (e.g., etched dots or patterns) under the keys catch the light and diffuse it under each key. Therefore, in an area with weak or no light, the legends on the keys **200** of the keyboard **100** can be seen by the light emitted from the light guide plate **270**, thereby facilitating to operate.

[0012] Generally, a conventional lightplate layer **110** has a light-generating component (e.g., LEDs) to one or more edges of the keyboard **100** so as that it is not under any actual keys **200**. That light-generating component is thick, because it generally comprises a flexible printed circuit (FPC) that contains conventional LEDs.

[0013] The conventional lightplate layer **110** is designed to diffuse the light of its light guides through diffusers. A diffuser may be a series of unevenly-spaced bumps, etched dots, or some uneven pattern to scatter the light of the light guide **270**. The density of bumps increases further away from the light source according to a diffusion equation. The diffused light then travels to either side of the diffuser. The front of the lightplate **270** faces the actual desired goal, which is the underside of the key. The back of the lightplate **270** has a reflector to reflect otherwise wasted light back toward the underside of the keytop **210**.

[0014] The conventional lightplate layer **110** has three substrates (from top to bottom): a Mylar mask substrate, a light guide substrate, and reflector substrate. The Mylar mask substrate masks the key webs. The light guide substrate is a clear material (e.g., silicon) consisting of light guides (e.g., light paths) and diffusers under keys to diffuse the light on the guides. The reflector substrate reflects the light up towards the keys above. The reflector substrate is sometimes made of aluminum foil, sometimes merely a white-pigmented surface or, as in the 3M Vikuiti ESR, consists of hundreds of polymer layers of alternating low and high refractive index. A conventional lightplate layer **110** is about 0.25-0.5 mm thick.

[0015] FIG. **2** illustrates a side elevation view of a simplified key assembly ("key") **200** of a conventional keyboard **100** of a typical computer system. The components of the

key assembly **200** are not shown to scale. Also, they are not shown with proper relative proportions to the size and thickness of the other components. Rather, the components are shown in the order of the keyboard stack described and with regard to the relationships to each other.

[0016] Stripped down to its essentials, the conventional key assembly **200** includes a keycap **210** (e.g., keytop), a collapsible elastomeric plunger (i.e., "rubber dome") **220**, a scissor-mechanism **230**, a rigid base **240**, a keyswitch sensor **260**, and a lightplate **270**.

[0017] The layers of keyboard assembly **100** correspond to this key assembly **200** in the following manner:

[0018] the key layer **102** includes the keycap **210** (typical thickness is 0.3-0.5 mm);

[0019] the key mechanics layer **104** includes the rubber dome **220** and scissor-mechanism **230** (typical thickness is 1.5-2.5 mm);

[0020] the sensor layer **106** includes the keyswitch sensor **260** (typical thickness is 0.25 mm);

[0021] the backplate layer **108** includes the base **240** (typical thickness is 0.25-0.5 mm);

[0022] the lightplate layer **110** includes the lightplate **270** (typical thickness is 0.25-0.5 mm).

[0023] The rubber dome **220** provides a familiar snap-over feel to a user while she presses the key **200** to engage the keyswitch sensor **260** under the keytop **210**. The primary purpose for the scissor-mechanism **230** is to level the keytop **210** during its keypress.

[0024] Typically, the scissor mechanism **230** includes at least a pair of interlocking rigid (e.g., plastic or metal) blades (**232**, **234**) that connect the keycap **210** to the base **240** and/or body of the keyboard **100**. The interlocking blades **232**, **234** move in a "scissor"-like fashion when the keycap **210** travels along its vertical path, as indicated by Z-direction arrow **250**. The arrangement of the scissor mechanism **230** reduces the wobbling, shaking, or tilting of the keycap **210** while the user is depressing it.

[0025] As can be seen in both assemblies (**100** and **200**), the light from the lightplate **270** (e.g., lightplate layer **110**) must make its way past many obstructions to arrive under the keycap **210** and to ultimately illuminate a transparent or translucent legend (e.g., "A" or "Shift") of a key **210**. The obstructions include the backplate layer **108**, sensor layer **106**, keyboard mechanics layer **104** (such as rubber dome **220** and scissor-mechanism **230**), and other structures under the keycap **210** itself.

[0026] In conventional keyboards **100**, a narrow unobstructed path is designed under each key **210** to aid the under illumination of each key **200**. Holes are punched in the backplate **240**. Clear windows are strategically placed in the sensor layer **106**. Of course, the diffusion etchings in the lightplate **270** are placed under those narrow paths under the keys **200**.

[0027] Of course, these narrow unobstructed paths affect the design and function of the other components of the keyboard stack **100**. Too many holes compromise the rigidity of the backplate layer **108**. Arrangement of the keyboard mechanics **220**, **230** cannot be adjusted too much without compromising its functionality and durability.

[0028] One apparent option to reduce obstruction is to place the lightplate layer **110** higher in the stack **100**, for example, above the backplate layer **108** or above the sensor layer **106**. However, using conventional materials, this cannot be accomplished.

[0029] While not shown, the keyboard assemblies **100** include vertical support structures. To provide structural support to the whole keyboard **100**, the vertical support structures attach to the backplate layer **108**. The backplate layer **108**, in turn, is attached to the housing of the device itself.

[0030] Because of the vertical support structures, the lightplate layer **110** is traditionally placed below the backplate layer **108** rather than above it. When it is below the backplate layer **108**, the lightplate layer **110** can be free of holes or, at least, have a minimum of holes therethrough. Above the backplate layer **108**, the lightplate layer **110** must have several holes through which the vertical supports would pass therethrough.

[0031] In short, functionality of a conventional lightplate **270** is compromised greatly by having holes. The holes would cut or significantly redirect the light guides in the lightplate **270**. Additional holes requires more redirection of light guides and limits the real estate available on the plate **270** for such guides. Every bend in the light guide leaks light.

[0032] Overall, this reduces the amount of light that ultimately arrives at each key **200**. The keys **200** that are distant from the LEDs are most affected. Indeed, the number and placement of holes might result in little or no light arriving at the keys **200** that are particularly distant from the LEDs.

[0033] The background of U.S. Pat. No. 5,746,493 says this about conventional light guides and their issues:

[0034] A light guide or light conductor used to transmit light for illuminating a display and keyboard in a device typically is formed as a planar element of translucent material. A light guide is generally positioned as a layer on one side of the device's display panel and keyboard. Light sources, typically LEDs, are positioned along an edge of the light guide and light transmitted into it is diffused and distributed by the light guide to the display and keyboard.

[0035] A problem in conventional light guides is that light is not distributed uniformly, and the display panel and keys are accordingly not uniformly illuminated. Bright and dark areas thus result in the display and keys, which detracts from the appearance of the device.

[0036] This problem is related in part to the manner in which the light sources are positioned and/or coupled to the light guide. Conventionally, light sources are simply positioned along an edge of the light guide for the display panel and additional lights sources positioned in holes located in the interior of the light guide near the key holes. Light from the sources on the edge of the light guide is not uniformly transmitted across the edge of the light guide.

[0037] The problem is also related to how light exiting the light guides is handled at the edges. Light that strikes the edges is in part lost through the edge and in part reflected back in the light guide in a way that does not provide much useful illumination.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. **1** is a schematic diagram illustrating an example layered keyboard assembly environment in which the techniques in accordance with the present disclosure may be implemented.

[0039] FIG. **2** is a schematic diagram illustrating a profile view of an example key assembly.

[0040] FIG. **3** is an illustration of an example lightplate, showing some detail of multiple groups of light-generating sources, according to an implementation.

[0041] FIG. **4** is an illustration of an example layered keyboard assembly, showing some detail of the multiple layers, according to an implementation.

[0042] FIG. **5** is a schematic diagram illustrating a profile view of an example key assembly with illumination, according to an implementation.

[0043] FIG. **6** is a schematic diagram illustrating a profile view of another example key assembly with illumination, according to another implementation.

[0044] FIG. **7** is a schematic diagram illustrating a profile view of a further example key assembly with illumination, according to a further implementation.

[0045] FIG. **8** is an illustration of an example keyboard with separate key legend illumination, according to an implementation.

[0046] FIG. **9** is an illustration of an example device having a keyboard with separate key illumination, according to an implementation.

[0047] FIGS. **10-13** are flowcharts illustrating example processes in accordance with one or more implementations described herein.

[0048] The Detailed Description references the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same reference number references like features and components throughout the drawings.

DETAILED DESCRIPTION

[0049] Techniques and devices provide backlighting for keys **200** of a keyboard **100** or keypad. The backlighting may be a replacement for existing backlighting in an existing keyboard **100**, or it may be an original backlighting application for the keyboard **100**. In particular, the technology disclosed herein utilizes light-generating sources **312** with new and heretofore unachievable properties. A plurality of light-generating sources **312** positioned substantially underneath a keytop **210**, illuminates the key **200**, **500** from underneath the keytop **210**. For example, in one embodiment, at least two of the light-generating sources **312** of the plurality are located underneath the keytop **210** and within a footprint of the keytop **210**.

[0050] Seemingly, all electronic devices are getting smaller and smaller. Computing devices are getting thinner and thinner. The thinness of laptop computers and other mobile devices with keyboards are constrained by many factors. Often, one of the factors that limit the thinness of such keyboarded devices is the keyboard itself. The thinnest of the conventional keyboard stack has been pushed to the limit of what conventional approaches can allow. A conventional laptop keyboard is about 3 mm to 6 mm thick.

[0051] The technology described herein focuses on one functional aspect of the typical stack of a backlit keyboard **100**. That functional aspect is backlighting. The technology described herein provides the backlighting function in a way that enables the overall keyboard stack to be thinner.

[0052] As discussed in the Background section, the conventional backlighting solution involves a relatively thick lightplate layer **110** (which is typically about 0.25-0.5 mm thick) and an even thicker FPC (with the LEDs) tucked towards one or more edges of the keyboard.

[0053] Unlike the conventional lightplates **270**, the lightplate **300** disclosed herein includes deposits of multiple extraordinarily tiny light-generating sources **312** under each backlit key **200** of a keyboard **100** (i.e., "underkey"). In at least one implementation, this is accomplished by placing the tiny light-generating sources **312** on a single thin lightplate **300** layer **110**. In some implementations, that layer **110** is 0.07 to 0.25 mm thick or perhaps thinner. In some implementations, the layer **110** has a thickness of 0.07 to 0.25 mm. In an implementation, the lightplate **300** layer **110** material may be a polyester film or other suitable material.

[0054] In contrast to simply using one underkey light source, the lightplate **300** disclosed herein uses multiple underkey light-generating sources **312**. Those reasons for doing so include, for example, increased illumination, consistency in illumination, and fault tolerance.

[0055] More light-generating sources produce more light. Also, with so many light sources under the key **200**, the color and intensity of each source averages in with all the others sources. Therefore, source-to-source variation doesn't matter as much. The color and intensity of conventional LEDs can vary. Therefore, conventional LEDs are typically sorted based upon their color and intensity. Furthermore, having more sources helps to tolerate manufacturing faults. One failed source under a particular key **200** does not significantly affect the backlighting of that key **200**.

[0056] Note that the diffusers of conventional lightplates **270** are not light-generating sources. Rather, the diffusers merely reflect the existing light of the light guide towards the underside of a key **200**. The diffusers do not generate light themselves.

Example Lightplate

[0057] Various implementations described herein discuss depositing light-generating sources **312** onto particular components and/or layers of the keyboard assembly **100** to illuminate the keys **200** of the keyboard **100**. However, in some implementations, the light-generating sources **312** are deposited onto a thin film lightplate **300**, which is inserted between various layers of the keyboard assembly **100** to illuminate the keys **200**. In many of the implementations, the lightplate **300** is positioned between the keytop(s) **210** of the keyboard assembly **100** and the backplate **240** of the keyboard assembly **100**. A plurality of light-generating sources **312** is deposited on the lightplate **300** at a position that is substantially underneath the keytop(s) **210**, such that the plurality of light-generating sources **312** illuminates the key(s) **200** from underneath the keytop(s) **210**.

[0058] One implementation involves replacing the conventional lightplate **270** of existing typical keyboard assemblies (like that of FIGS. **1** and **2**) with the new and thinner lightplate **300** of the technology described herein. In other words, the new lightplate **300** can be retrofit into an existing keyboard assembly **100**.

[0059] FIG. **3** shows an example lightplate **300**, according to one embodiment. The lightplate **300** can be connected into an existing LED backlighting controller and power source (not shown) of the keyboard assembly **100**. The lightplate **300** has electrically conductive traces **310** to the light-generating sources **312** on the plate **300**. In some implementations, the traces **310** include conductive inks deposited (e.g., printed, drawn, etc.) on the lightplate **300**.

[0060] The traces **310** may be created using conventional conductive ink or other similar processes. Conductive inks

may be classed as fired high solids systems or PTF polymer thick film systems that allow circuits to be drawn or printed on a variety of substrate materials such as polyester to paper. These types of materials usually contain conductive materials such as powdered or flaked silver and carbon like materials. While conductive inks can be an economical way to lay down a modern conductive traces **310**, traditional industrial standards such as etching of conductive traces **310** may be used on relevant substrates.

[0061] FIG. **3** also shows a close-up image of an underkey portion **320** of the lightplate **300**. Each underkey portion **320** is located on the lightplate **300** so as to be under a keytop **210** of a key **200**—hence the term "underkey." The underkey portion **320**, for example, includes the plurality of light-generating sources **312**.

[0062] As can be seen in FIG. **3**, the plurality of light-generating sources **312** of the underkey portion **320** is divided into multiple distinct groups (e.g. groups **322**, **324**, **326**, and **328**) of multiple light-generating sources **312**. Each group is placed substantially underneath a keytop **210**. Herein, the phrase "substantially underneath a keytop" means that at least one of the light-generating sources **312** of that group is located under (i.e., within) the footprint of the keytop **210**. Of course, in other implementations, all of the light-generating sources **312** of the group may be within the footprint of the keytop **210**.

[0063] In at least one implementation, each group of multiple light-generating sources **312** is printed and/or sprayed onto the lightplate **300** and conductive traces **310** link each group to power. Through these traces, the keyboard **100** can power and control the backlighting of the keys **200**.

[0064] In some implementations, the new lightplate **300** may be a replacement (e.g., retrofit) for the conventional lightplate **270** in the stack-up of a conventional keyboard assembly layers (as shown in assembly **100**). In this way, the new lightplate **300** falls below the backplate just like the conventional lightplate.

[0065] In another implementation, a new lightstrip (like the new lightplate **300**) replaces the conventional edge-mounted and edge-lit LEDs of a conventional lightplate (like lightplate **270**). With such an implementation, an edge-wrapped lightstrip is attached (or otherwise optically adjacent) to and around one or more edges of a conventional lightplate **270**. The light from the lightstrip is directed inward into the conventional lightplate **270** and, more particularly, towards the specific light pipes in the conventional lightplate **270**. Lens or prisms may be used to direct the light coming from the new lightstrip. The light beams directed towards the lightplate emanate from the portions of the new lightstrip that are wrapped around the plate.

[0066] FIG. **4** shows an arrangement that is not a retrofit. As depicted, the keyboard assembly **100** layers may be reordered to use the lightplate **300** above the backplate. For example, in one arrangement as seen in FIG. **4**, the order of the layers of the stack (from top to bottom) may include a key mechanics layer **104**, a sensor layer **106**, a lightplate layer **110** (i.e., lightplate **300**), and a backplate layer **108**. This layer order is described further in the section to follow, with regard to other implementations. In alternate implementations, the order may be changed further, with the lightplate **300** being at higher positions within the stack, as described below.

Other Implementations

[0067] Referring to FIGS. **4** and **5**, since the lightplate **300** uses electrically conductive traces **310** rather than light guides, the lightplate **300** can accommodate holes **402** therethrough. For example, in an implementation, the lightplate **300** includes holes **402** that allow for at least a portion of the key mechanics layer **104** (e.g., scissors) to pass through when the keytop **210** is pressed (e.g., during a keypress of the key **200**). This allows more flexibility in placement of the lightplate **300** within the keyboard stack **100**, while maintaining consistent illumination to the keys **200**. Thus, the lightplate **300** may be located above the backplate layer **108** or above the sensor layer **106**. Also, the lightplate **300** may be part of the key mechanics layer **304** or the sensor layer **106**, or even the key layer **102**. Accordingly, the lightplate **300** may be positioned within the keyboard assembly to illuminate the plurality of keys **200** of the keyboard without increasing a total thickness of the keyboard assembly as without the lightplate **300**. In other words, the addition of the lightplate **300** adds nothing to the thickness of the keyboard assembly **100**.

[0068] In various implementations, the light-generating sources **312** are deposited (e.g., printed, sprayed, etc.) on one or more surfaces and/or layers in the keyboard stack. In the implementations, the electrically conductive traces **310** link the sources **312** to power and control systems. In one alternative implementation, the light-generating sources **312** are deposited on the backplate **240** to illuminate the key **200** and/or the keyboard assembly **100**.

Example Backlighting of the Key Mechanics Layer

[0069] FIG. **5** illustrates a side elevation view of an example simplified key assembly **500** constructed in accordance with the technology described herein. More particularly, the example keyboard assembly **500** depicts implementations of the technology described herein with regard to a modified form of a key assembly **200**, where light-generating sources **312** are above the backplate **240**.

[0070] The components of the example key assembly **500** are not shown to scale. Also, they are not shown with typical or expected relative proportions to the size and thickness of the other components. Rather, the components are shown in an example order of a keyboard stack and with an example relationship to each other.

[0071] Stripped down to its essentials, the example key assembly **500** includes a keycap **210**, a collapsible elastomeric plunger (i.e., "rubber dome") **220**, a scissor-mechanism **230**, a rigid backplate **240**, a lightplate **300**, and a sensor layer **260**. The lightplate **300** includes an implementation of the light-generating sources **312** technology described herein.

[0072] The key mechanics layer **104** includes the rubber dome **220** and the scissor-mechanism **230**. The key mechanics layer **104** also inherently includes portions of the structure under the keycap (i.e., keytop) **210**. Those keycap **210** portions form part of the structures that support, connect, and/or interact with the rubber dome **220** and the scissor-mechanism **230** (or other types of resist-and-return structures and leveling structures). Thus, at least a portion of the keycap **210** may be considered part of the key mechanics layer **104**. As used herein, references to something being integral with or "of" the key mechanics (or key mechanics layer **104**) implies that the something is included with, part

of, and/or directed connected to a resist-and-return structure **220**, a leveling structure **230**, and/or a keycap **210** portion that those structures support, connect, and/or interact therewith.

[0073] The rubber dome **220** provides a familiar snap-over feel to a user as her finger **505** presses the key **500** to engage the keyswitch sensor **260** of the sensor layer **106** under the keycap **210**. The primary purpose for the scissor-mechanism **230** is to level the keycap **210** during the keypress.

[0074] The scissor mechanism **230** (as is typical) includes at least a pair of interlocking rigid (e.g., plastic or metal) blades (**232**, **234**) that connect the keycap **210** to the backplate layer **108**, base **240**, and/or body of the keyboard **100**. The interlocking blades **232**, **234** move in a "scissor"-like fashion when the keycap **210** travels along a vertical path. As mentioned above, in some embodiments, the lightplate **300** may include one or more holes **402**, and the lightplate may be positioned within or below the key mechanics layer **104**. In one implementation, at least a portion of the blades **232**, **234** passes through the holes **402** in the lightplate **300** when the keytop **210** is pressed.

[0075] As depicted in FIG. **5**, in an embodiment, the sensor layer **260** sits on the backplate **240** and below the lightplate **300**. As noted in the Background section, the purpose of the sensor layer **106** is to detect a keypress of a key **500**. To that end, the sensor layer **106** has electronic circuitry to sense the downward pressing of the key **500** by the user's finger **505**. The most common type of sensor **260** utilizes a conductive or contact switch under each key. Other sensing technologies (such as capacitive and electrical resistance) may be employed.

[0076] In this example implementation, the lightplate **300** is shown above the backplate **240** and above the sensor layer **106**. With other implementations, the arrangement of the keyboard stack **100** may vary. For example, the lightplate **300** may be below or integral with the sensor layer **108**.

[0077] As depicted in FIG. **5**, the main body of the lightplate **300** is largely positioned below the key mechanics layer **104** and above the sensor layer **260** and backplate **240**. In an embodiment, a portion of each lightplate **300** is positioned integral with the keyboard mechanics layer **104** (or alternately above the keyboard mechanics layer **104**).

[0078] In an embodiment, as shown in FIG. **5**, the position of the lightplate **300** and the holes **402**, allows at least a portion of the key mechanics **230** to move through the holes **402** during a keypress of the keytop **210**. This allows the lightplate **300** to occupy a space that would otherwise be substantially vacant—and to provide illumination to the keys **500** without adding thickness to the keyboard assembly **100**.

[0079] In one implementation, as shown in FIG. **5**, a portion of the lightplate **300**, referred to herein as a light flap (or tab) **552**, extends from the main lightplate **300** and is positioned just above the moving parts of the key mechanics layer **104** (which are rubber dome **220** and the scissor-mechanism **230** in this example) and at the base of the keycap **210**. In one implementation, the light flap **552** is positioned so that the flap **552** makes contact with the underside surface of the keytop **210**). The light flap **552** includes a plurality of light-generating sources **312**, which is shown in groups **554** and **556**. For illustrative purpose only, the individual light-generating sources **312** are shown as incandescent light bulbs and not to scale. In other places in this document, the actual nature and approximate dimensions of example light-generating sources **312** contemplated for use with the technology are discussed.

[0080] In an implementation, the light flap **552** has a hinge **558** that connects the light flap **552** to the main body of the lightplate **300**. The conductive traces **310** that link the plurality of light-generating sources **312** of the light flap **552** to its controller/power-source extend along the hinge **558** from the main body of the lightplate **300** to the light flap **552**. In an embodiment, the conductive traces **310** are arranged to pass between or around the holes **402** in the lightplate **300**.

[0081] In the example key assembly **500** of FIG. **5**, the plurality of light-generating sources **312** are deposited on the lightplate **300** (between or around the holes **402**) at a position that is substantially underneath an at least partially translucent key legend of the key **500**. That is, at least part of the keytop is at least translucent. Alternatively, part of the keytop may be more than translucent. It may be transparent.

[0082] In this position, the plurality of light-generating sources **312** is configured to consistently illuminate the key legend of the key **500** from underneath the keytop **210**. In one example, as shown in FIG. **5**, the plurality of light-generating sources **312** is deposited on the light flap **552**. The light emanating from the plurality of light-generating sources (such as those of groups **554** and **556**) pass through a translucent or transparent material of a key legend **502** of the keycap **210** effectively backlighting the legend **502**.

[0083] Indeed, this arrangement—of having the backlighting light sources **312** being so close to the key legend **502**—is particularly desirable for allowing little or no light to leak out from around the keys **500**. Also, since there are no obstacles between the light sources **312** and the legend **502**, the lighting is more efficient and presumably less power is needed to accomplish the same lighting quality produced by conventional backlighting approaches.

[0084] In an embodiment, the lightplate **300** may be fabricated with cutouts for the light flaps **552**. The flaps **552** are positioned under each keytop **210**. During assembly of the keyboards **100**, the light flaps **552** are extended from the lightplate **300**, and positioned amongst, within, and/or above the key mechanics layer **104**.

Other Implementations of Key Mechanics Layer

[0085] In various implementations, the techniques and devices described herein may be implemented in ways other than as described above. For example, the lightplate **300** does not include a light flap **552** or hinge **558** in some implementations. In some of those implementations, as shown in FIG. **6**, the light-generating sources **312** are deposited on the main body of the lightplate **300** below the key mechanics layer **104**, instead of on a light flap **552**. In such implementations, as discussed further below, the illumination from the light-generating sources **312** is directed up from the lightplate **300** to the underside of the keytop **210** to illuminate the key **500**.

[0086] Since the discussed light-generating sources **312** are both extraordinarily tiny and capable of being deposited on any non-conductive surface, there are many other options available for placing these light-generating sources **312** in, around, and above the key mechanics layer **104**. With each implementation, there is included a means to electrically couple the contemplated light-generating sources **312** with the power source (e.g., via the conductive traces **310** of the lightplate) and possibly a keyboard controller.

[0087] In one example implementation, the plurality of light-generating sources **312** may be deposited onto the key layer **102**. For example, the plurality of light-generating sources **312** may be deposited on the top surface of the keycap **210**. A clear coat or cover may protect the keycap-housed light-generating sources **312**. Alternatively, the light-generating sources **312** may be deposited on the underside of the keycap **210**. With the undermounted light-generating sources **312**, there is presumptively sufficient light reflecting off the components below the keycap **210** to effectively backlight the key **500**. If there is not, the reflective material may be added to increase the reflection or even to direct it. Alternatively still, the light-generating sources **312** may be in-mold decorated into the keycap **210**.

[0088] In these example implementations, the keycap-housed light-generating sources **312** may be powered and controlled via a conductive connection **310** (e.g. wire or conductive trace) descending from the keycap **210** to the lightplate **300** below. Alternatively still, these keycap-housed light-generating sources **312** may be powered via induction, small battery, a capacitor, or ambient light (e.g., solar cell).

[0089] In another example implementation, the plurality of light-generating sources **312** may be deposited on the outer surface of the rubber dome **220**. Alternatively, the plurality of light-generating sources **312** may be deposited on a surface of the blades **232**, **234** of the scissor mechanism **230** or on other portions of the key mechanics layer **104**.

[0090] In these example implementations, the dome-mounted or blade-mounted light-generating sources **312** may be powered and controlled via a conductive connection **310** (e.g. wire or conductive trace) descending to the lightplate **300** below. Alternatively still, these the dome-mounted or blade-mounted light-generating sources **312** may be powered via induction, small battery, a capacitor, or ambient light (e.g., solar cell).

Consistency of Underkey Illumination

[0091] The placement of the light diffusers for the conventional light guide **270** approach is limited by the diffusing technology and by the light-plate **270** real estate demanded by the light guides themselves. Because the light diffusers cannot be placed precisely enough and they fail to produce enough light, key legends are often lit inconsistently.

[0092] For example, in most keyboards, some of the keys include legends with multiple characters (e.g., "shift," "Ctrl," etc.), forming a multi-letter word (see FIG. **9**, for example), or have multiple symbols or legends (e.g., the "7" key also has an "&" legend). However, with some backlighting techniques, the multi-character legends or multiple legends are backlit inconsistently (e.g., some of the characters are dimmer and some are brighter). When backlit with the techniques and devices described herein (i.e., the plurality of light-generating sources **312** is deposited on the lightplate **300** in multiple groups that are substantially underneath the multiple transparent or translucent key legends **502** of the key), the multiple characters and the multiple symbols or legends are lit consistently across the key **500**. For example, the middle characters of a multi-character legend are equally as well lit as the characters at either end of the legend.

[0093] The backlighting techniques and devices described herein are able to consistently backlight key legends **502** because the placement of the light-generating sources **312** under the keytop **210** can be precise. For example, the light-generating sources **312** can be deposited (e.g., printed) in a group (or in multiple groups) onto the lightplate **300** in a place that would be directly under the location (e.g., footprint) of the key legend **502**.

[0094] In addition, the light-generating sources **312** are spread out over a small area under the key **500**. Therefore, rather than having light coming from just one spot or point under the key **500**, light can emanate from multiple locations under the key **500**. Furthermore, the backlighting technology described herein can be significantly brighter than conventional approaches.

[0095] As used herein, the phrase "substantially underneath the key legend **502** of the key" includes at least one light-generating source **312** directly underneath (i.e., in the footprint) of the key legend **502** of the key **500** once the keyboard stack **100** is assembled.

Diffused Keyboard Backlighting from Underkey Light Sources

[0096] As noted above, the conventional lightplates **270** have diffusers (e.g., etched dots or patterns) under the keys **200** to catch the light of the light guide **270**. The manner in which the diffusers redirect the light of the light guides **270** reflects and scatters the light of the light guide **270**.

[0097] The light redirection and scattering is called diffuse reflection or light diffusion. Herein, it is simply called diffusion. Unlike specular reflection, diffusion is the reflection of light from a surface such that an incident ray is reflected at many angles. In contrast, specular reflection is the mirror-like reflection of light from a surface, in which light from a single incoming light ray is reflected into a single outgoing direction.

[0098] Diffused light is a soft light with neither the intensity nor the glare of direct light. It is scattered and comes from all directions. Thus, it seems to wrap around objects. It is softer and does not cast harsh shadows.

[0099] As its name implies, the light reflected by the diffusers of the conventional lightplate **270** technology is diffused. Thus, the light passing through the underside and around a key **200** is diffused. However, the technology described herein involves point light sources under a key **500**. A typical point light source produces direct light. Because of its harsh nature, direct light is not always as desirable as diffuse light.

[0100] The light-generating sources **312** according to the techniques and devices described herein are extraordinarily small and each individual source **312** may be difficult to differentiate from others. These factors may reduce some of the harshness and glare of the typical direct light. However, there may be a desire to increase the overall diffusion of the light coming from the light-generating sources **312** according to the techniques and devices described herein.

[0101] FIG. **6** illustrates a side elevation view of the simplified key assembly **500**, where the light from the light-generating sources may be diffused while illuminating the key legend **502** of the key **500**. In the example implementation shown, the lightplate **300** is shown above the backplate **240** but below the keyswitch sensor **260**. With other implementations, the arrangement of the keyboard stack **100** may vary. For example, the lightplate **300** may be integral with the keyswitch sensor **260** or above the keyswitch sensor **260**. In other examples, the lightplate **300** may

be integral with the keycap **210**, part of the key mechanism **230**, and/or sandwiched between the keycap **210** and the key mechanism **230**.

[0102] As depicted in FIG. **6**, the plurality of light-generating sources **312** is shown in groups **672**, **674**, and **676** on the lightplate **300**. For illustrative purpose only, the individual light-generating sources are shown as incandescent light bulbs and not to scale. In other places in this document, the actual nature and approximate dimensions of example light-generating sources contemplated for use with the technology are discussed.

[0103] To promote diffusion of the light emanating from the plurality of light-generating sources **312** (which are shown in groups **672**, **674**, and **676**), the plurality of light-generating sources **312** are placed under the infrastructure of the key mechanics **230**. More precisely, the light-generating sources **312** are placed on the lightplate **300** so as to be in the footprint of the collapsible elastomeric plunger **220**, the scissor-mechanism **232**, **234**, or other structures of the key mechanics **230**. That is, the light-generating sources **312** are placed on the lightplate **300** in positions so that they are substantially directly underneath the collapsible elastomeric plunger **220**, the scissor-mechanism **232**, **234**, or other structures of the key mechanics **230**. For this context, "substantially directly underneath" these structures includes over half of the plurality of light-generating sources **312** of a group being actually directly underneath such structures once the keyboard **100** is assembled.

[0104] In alternate implementations, the light-generating sources **312** are deposited onto the structure of the collapsible elastomeric plunger **220**, the scissor-mechanism **232**, **234**, or other structures of the key mechanics **230**.

[0105] As depicted, example light ray **680** emanates from the group **676** of the light-generating sources and towards the underside of the keycap **210**. Since the sources **312** are pointed towards the keycap **210**, little to no light emanates from the sources **312** in a direction other than towards the underside of the keycap **210**.

[0106] As shown, example light ray **680** is reflectively diffused off the blade **632**. The depicted arrows indicate the light scatted off the blade **632**. For the sake of simplicity of explanation, the paths of the scattered light will be understood to exist but will not be explored.

[0107] Following the now diffuse example light ray **680** after its reflection off the blade **632**, it is similarly reflected in a diffused manner off the backplate **240** (or alternatively off the reflector substrate of the lightplate **300**). Following the even more diffuse example light ray **680** after its reflection off backplate **240**, the light ray **680** emerges from a presumably transparent portion of the keycap **210**. Illuminated area **502** of the keycap **210** indicates the diffuse light ray **680** (among others) backlighting the key **500** and/or the key legend **502**.

Integral with Sensor Layer

[0108] In an implementation, as depicted in FIG. **7**, the lightplate **300** and the sensor layer **106** are an integrated layer. For example, the light-generating sources **312** are deposited onto the sensor layer **106**. As shown in FIG. **7**, the sensor/light layer **702** includes a plurality of light-generating sources **312**, which is shown in groups **704** and **706**. For illustrative purpose only, the individual light-generating sources are shown as incandescent light bulbs and not to scale. In other places in this document, the actual nature and approximate dimensions of example light-generating sources contemplated for use with the technology are discussed. In an implementation, the electrically conductive trace(s) **310** providing connectivity from a power source to the light-generating sources **312** are also deposited onto the sensor layer **106**.

[0109] In this example implementation, the lightplate **300** is shown above the backplate **240** and as part of the sensor layer **106** with the sensors **260**, forming a multi-functional layer. In an embodiment, the multi-functional layer integrating the lightplate **300** with the sensor layer **106** can replace the sensor layer **106** of an existing keyboard assembly **100**, providing keypress detection and key illumination to the existing keyboard assembly **100**. With other implementations, the arrangement of the keyboard stack **100** may vary. For example, the lightplate may be above the sensor layer **106**. In other examples, the lightplate **300** may be integral with the keycaps **210**, part of the key mechanisms **220** and **230**, and/or sandwiched between the keycap **210** and the key mechanism **220** and **230**, forming other multi-functional layers. In various implementations, the electrically conductive trace(s) **310** are also deposited onto the multi-functional layer, providing connectivity from a power source to the light-generating sources **312**.

[0110] As noted in the Background section, the purpose of the sensor layer **106** is to detect a keypress. To that end, it has electronic circuitry to sense the downward pressing of the key **500** by the user's finger **505**. The most common type of sensor **260** utilizes a conductive or contact switch under each key **500**. Other sensing technologies (such as capacitive and electrical resistance) may be employed. The sensor layer **106** is also called the "keyswitch" layer or the "sensor membrane" layer.

[0111] A conventional keyboard **100** typically utilizes a sensor membrane layer **106** of at least three substrates and one or more conductive-based switches to detect key **500** depressions. A first substrate and second substrate each have contact switch circuitry. The first and second substrates are separated by a third non-conductive substrate disposed therebetween. The non-conductive substrate between the two conductive substrates has a hole therethrough that allows the underkey contacts of each conductive substrate to trampoline together upon a keypress. This action closes a switch and indicates a keypress.

[0112] In the example key assembly **500**, the plurality of light-generating sources **312** may be deposited on any or all of the three substrates. Regardless of which substrate on which the sources are deposited, the conductive traces that link the sources **312** back to a controller and power source may be on, under, or part of any substrate. That is, the conductive traces may be on the same surface of the same substrate as where the light-generating sources **312** are deposited or alternatively on a completely different substrate—presuming that the circuits to the sources **312** are connected through the substrates.

[0113] The sources **312** may be deposited on the top conductive substrate. In this way, the top substrate is acting in the same way as the lightplate **300** discussed above. Alternatively, the light-generating sources **312** may be deposited on the bottom conductive substrate. Alternatively still, the light-generating sources **312** may be deposited on the middle substrate. In more alternatively, the light-generating sources **312** may be deposited on an additional substrate of the sensor/light layer **702**.

[0114] When the light-generating sources **312** are in or under the sensor/light layer **702**, the substrates above the sources **312** (or at least a portion thereof) are transparent and/or translucent. In this way, light from the sources **312** may travel through the substrates above the sources. In some implementations, the substrates above the sources **312** (or at least a portion thereof) are frosted or etched in a manner to diffuse the light emanating from the sources **312**.

[0115] One of the advantages of a combination of the lightplate **300** and the sensor layer **106** is decreasing the overall thickness of the keyboard assembly **100**. These implementations effectively eliminate the lightplate **300** from the keyboard stack **100**. A conventional laptop keyboard **100** is about 3 mm to 6 mm thick. A conventional lightplate **270** is about 0.25-0.5 mm thick. This can result in reducing the thickness of the keyboard stack **100** to 2.5-5.75 mm. In the world of ever shrinking electronic devices, this can represent a significant improvement in thinness.

Separate Control of Light-Generating Sources

[0116] Conventionally, the light from the lightplate **270** must make its way past many obstructions to arrive under the keycap **210** and to ultimately illuminate a transparent or translucent legend **502** (e.g., "A" or "Shift") of a key **200**. The obstructions include the backplate **240**, sensor layer **106**, keyboard mechanics (such as rubber dome **220** and scissor-mechanism **230**, and other structures under the keycap **210** itself).

[0117] Because the conventional lightplate **270** is placed far back under the key **200**, the lightplate **270** illuminates both the legend **520** of the key **200** and exposed volume around the key **200**. The illumination of the exposed volume causes a "halo" effect around the key **200**. Hence, this is often called halo illumination or simply a halo. With conventional approaches, the legend **520** and halo illumination could not be controlled separately.

[0118] In an implementation, separately addressable groups of light-generating sources **312** may be placed more directly under the area where separately controlled illumination is desired. Indeed, a separately addressable group of light-generating sources **312** may be placed directly under the transparent or translucent legend **502** of a key. In one implementation, the group may be placed with a light dam or light barrier surrounding it so that light from the light-generating sources **312** is limited to illuminating a desired key legend **502** of a desired key **500** and to inhibit the light from leaking to other key legends or to other keys.

[0119] Similarly, another separately addressable group(s) of light-generating sources **312** may be placed around the periphery of the key **500**. The group(s) may be placed on the underside of the keytop **210** (along is periphery) or directly under the periphery of the key **500**. Accordingly, the groups providing illumination of the key legend **502** may be addressed and controlled separately from the groups providing illumination of the halo around the key **500**. For example, the key legend and the halo may be illuminated separately or simultaneously, as desired, by controlling the illumination of the two groups (or two sets of groups) independently.

[0120] Further, as shown in FIG. **8**, some keys **500** on a keyboard **100** have multiple different legends. For example, the "7" key also has the "&." Typically, the alternative function of a key (e.g., "&") is accessed by pressing an additional key **802**, such as the SHIFT key, Ctrl key, or a function or command key. Accordingly, a single group of light-generating sources **312** is separately controlled based on a keypress of one or more predetermined keys or key combinations.

[0121] Because a conventional lightplate **270** is placed far back under the key, the lightplate **270** illuminates both legends of the key. With conventional approaches, the illumination of different legends **502** typically cannot be controlled separately.

[0122] In an implementation, a key **500** includes multiple transparent or translucent key legends **502**, and a plurality of light-generating sources **312** is deposited on the lightplate **300** in multiple groups that are substantially underneath the multiple transparent or translucent key legends **502** of the key **500**. The multiple groups of light-generating sources **312** are separately addressable and separately controlled to illuminate each of the transparent or translucent key legends **502** separately and individually, based on a keypress of one or more predetermined keys or key combinations.

[0123] For example, referring to FIG. **8**, separately addressable groups of light-generating sources **312** may be placed more directly under the area where separately controlled illumination is desired. Indeed, a separately addressable group of light-generating sources **312** may be placed directly under each of the transparent or translucent legends **502** of a key (e.g., "7" and "&"), and the illumination of each legend may be separately controlled. For example, the "7" can be illuminated when the additional key **802** (e.g., SHIFT key) is not pressed and the "&" can be illuminated when the additional key **802** is pressed. Each group of light-generating sources **312** may be placed with a light dam or barrier surrounding it so that little to no light leaks out around the key and to other legends.

[0124] In alternate examples, the "function" keys may be illuminated when the "Alt" or "Fn" key is pressed, alternate legends (either numbers or functions) may be illuminated on the number key pad based on whether the "num lock" key is pressed, and so forth.

[0125] Additionally, a conventional lightplate **270** of a keyboard **100** is either on or off. The illumination of portions of the lightplate **270** is not addressable and not controllable.

[0126] Referring to FIG. **9**, in an implementation, separately addressable light-generating sources **312** may be distributed under the keys **500** of the keyboard **100**, such that individual keys **500** or key legends **502** can be illuminated individually. Consequently, the light under the keyboard **100** might perform various dynamic effects based upon certain triggers.

[0127] For example, such dynamic effects can include: randomly illuminating or flashing a sequence of keys **500** and/or key legends **502**, rolling on or off illumination of a sequence of keys **500** and/or key legends **502** (from bottom to top of keyboard **100** or vice versa or from side to side of the keyboard **100**, or other pattern); flashing or blinking of all or part of the keyboard **100** or sets of keys **500** and/or key legends **502**, dynamically illuminating or flashing a set or a sequence of keys **500** and/or key legends **502** according to audible tones, or the like.

[0128] Additionally, the dynamic effects may include temporarily illuminating one or more individual keys **500** and/or key legends **502**. This might occur, for example, when the user has a limited number of acceptable keystrokes, for example, the group of keys **500** that the user may press may blink, and so forth.

[0129] Some examples of triggers might be with respect to a device including the keyboard assembly **100** or an application running on the device. For example, the triggers may include powering up the device, opening the device, receiving notification of a status of an application of the device, receiving a message or mail at the device, having a limited selection of keystrokes available at the device, and so forth. In an embodiment, a different trigger causes a different dynamic light effect to be performed. In some embodiments, the dynamic light effects may augment or replace audible notifications made by the device to alert a user.

Representative Processes

[0130] FIGS. **10-13** are flow diagrams illustrating example processes (**1000**, **1100**, **1200**, **1300**) for illuminating a keyboard (such as keyboard assembly **100**, for example), according to implementations. The processes are described with reference to FIGS. **1-9**.

[0131] The order in which the processes are described is not intended to be construed as a limitation, and any number of the described process blocks can be combined in any order to implement the processes, or alternate processes. Additionally, individual blocks may be deleted from the processes without departing from the spirit and scope of the subject matter described herein. Furthermore, the processes can be implemented in any suitable materials, or combinations thereof, without departing from the scope of the subject matter described herein.

[0132] According to process **1000**, at block **1002**, the process includes depositing a plurality of light-generating sources (such as light-generating sources **312**, for example) within the keyboard assembly. In an implementation, the keyboard assembly includes at least one key (such as key **200** or **500**, for example) positioned on a keyboard (such as such as key layer **102**, for example), and the plurality of light-generating sources is deposited substantially underneath a keytop (such as keytop **210**, for example) of the key.

[0133] At block **1002**, the process includes linking the plurality of light-generating sources via an electrically conductive (such as conductive trace **310**, for example) trace to a power source. In an implementation, the plurality of light-generating sources illuminate the at least one key from underneath the keytop when the power supply supplies power to the electrically conductive trace.

[0134] In an implementation, the process includes depositing the plurality of light-generating sources underneath the keytop and within a footprint of the keytop. For example, the process may include placing the plurality of light-generating sources into multiple distinct groups of multiple light-generating sources with each group placed substantially underneath the keytop.

[0135] In one embodiment, the process includes printing and/or spraying a liquid or gel into several distinct groups within the keyboard assembly, the liquid or gel having the plurality of light-generating sources suspended therein. In one embodiment the plurality of light-generating sources includes light-emitting semiconductors, such as miniature LEDs.

[0136] In an implementation, the process includes replacing a keyboard illumination source within a keyboard assembly with the plurality of light-generating sources to illuminate the key(s) of the keyboard.

[0137] In another implementation, the process includes depositing the plurality of light-generating sources onto a lightplate (such as such as lightplate **300**, for example) and locating the lightplate within the keyboard assembly to illuminate the at least one key. In an implementation, the lightplate is positioned, such that at least a portion of the plurality of light-generating sources is located underneath the keytop of the at least one key and within the footprint of the keytop.

[0138] According to process **1100**, at block **1102**, the process includes depositing the plurality of light-generating sources on the lightplate within the keyboard assembly, where the keyboard assembly includes a plurality of keytops. At block **1104**, the process includes positioning the lightplate underneath the plurality of keytops and above a backplate (such as backplate **240**, for example) of the keyboard assembly. In an implementation, the plurality of light-generating sources is disposed substantially underneath the plurality of keytops.

[0139] At block **1106**, the process includes linking the plurality of light-generating sources via an electrically conductive trace to a power source, the plurality of light-generating sources illuminating the plurality of keys from underneath the plurality of keys when the power supply supplies power to the electrically conductive trace.

[0140] In an implementation, the process includes positioning the lightplate underneath the plurality of keytops such that a majority portion of the plurality of light-generating sources is disposed within a footprint of the plurality of keytops.

[0141] In one embodiment, the process includes printing and/or spraying a liquid or gel onto the lightplate, where the liquid or gel has the plurality of light-generating sources suspended therein.

[0142] In an implementation, the process includes replacing a pre-existing keyboard illumination source within the keyboard assembly with the lightplate to illuminate the plurality of keys of the keyboard.

[0143] In various implementations, the process includes positioning the lightplate within the keyboard assembly to illuminate the plurality of keys of the keyboard without increasing a total thickness of the keyboard assembly as without the lightplate. For example, the addition of the lightplate does not add to the thickness dimension of the keyboard assembly.

[0144] In one example, the plurality of light-generating sources includes light-emitting semiconductors that have a diameter between about 20 to 50 microns and a height between about 5 to 20 microns.

[0145] According to process **1200**, at block **1202**, the process includes depositing the plurality of light-generating sources on a key layer (such as key layer **102**, for example), a key mechanics layer (such as key mechanics layer **104**, for example), or a sensor layer (such as sensor layer **106**, for example) of the keyboard assembly, or a combination thereof. In the process, the keyboard assembly includes a plurality of keytops.

[0146] At block **1204**, the process includes positioning the plurality of light-generating sources substantially underneath the plurality of keytops. At block **1206**, the process includes linking the plurality of light-generating sources via an electrically conductive trace to a power source, where the plurality of light-generating sources illuminate the plurality of keys from underneath the plurality of keytops when the power supply supplies power to the electrically conductive trace.

[0147] In an implementation, the process includes depositing at least a portion of the plurality of light-generating sources onto the backplate of the keyboard assembly to illuminate the plurality of keys and/or the keyboard assembly.

[0148] In one implementation, the process includes depositing the plurality of light-generating sources onto a topside and/or an underside of one or more of the plurality of keytops to illuminate the plurality of keys.

[0149] In another implementation, the process includes depositing the plurality of light-generating sources onto a keypress mechanism (such as keypress mechanism **220** or **230**, for example) of the key mechanics layer to illuminate the plurality of keys. For example, in an embodiment, the process includes depositing the plurality of light-generating sources such that the plurality of light-generating sources illuminates the plurality of keys via light emanating from the plurality of light-generating sources and reflectively diffused by the keypress mechanism.

[0150] In an implementation, the process includes depositing the plurality of light-generating sources and the electrically conductive trace onto the sensor layer to illuminate the plurality of keys. In an embodiment, the depositing includes printing or spraying a liquid or gel onto the at least one of the key layer, the key mechanics layer, the sensor layer, or a combination thereof, where the liquid or gel has the plurality of light-generating sources suspended therein.

[0151] According to process **1300**, at block **1302**, the process includes depositing a plurality of light-generating sources onto the lightplate within the keyboard assembly, the keyboard assembly including a key. At block **1304**, the process includes positioning the lightplate underneath a keytop of the key, the plurality of light-generating sources disposed substantially underneath an at least partially translucent key legend of the key

[0152] At block **1306**, the process includes linking the plurality of light-generating sources via an electrically conductive trace to a power source, where the plurality of light-generating sources illuminate the key legend of the key from underneath the keytop when the power supply supplies power to the electrically conductive trace.

[0153] In an implementation, the process includes spraying and/or printing a liquid or gel onto the lightplate, the liquid or gel having the plurality of light-generating sources suspended therein.

[0154] In an embodiment, the process includes positioning the lightplate so that the lightplate makes contact with an underside surface of the keytop.

[0155] In another embodiment, the process includes positioning the lightplate so that the key legend is illuminated by a first group of light-generating sources and the periphery of the key is illuminated by a second group of light-generating sources, either separately or simultaneously. In an implementation, the process further includes controlling the illumination of the first group and the second group independently.

[0156] In one implementation, the process includes confining illumination of the plurality of light-generating sources to the key legend of the key and shielding the illumination of the plurality of light-generating sources from illuminating other legends and/or other keys.

[0157] In alternate implementations, other techniques may be included in the processes **1000**, **1100**, **1200**, and **1300** in various combinations, and remain within the scope of the disclosure.

Light-Generating Sources

[0158] Conventionally, the smallest produced surface-mount LEDs are about 1.0 mm long by 0.8 mm wide and 0.2 mm thick. An example of a light-generating component **312** that is contemplated to be used with the technology described herein is described in U.S. Pat. No. 8,415,879, which is titled "Diode for a Printable Composition." These semi-conductor light-generating sources **312** are called "printable light-emitting diodes" or pLEDs herein.

[0159] Each printable light-emitting diode has a cross-section with a maximum length of 3 to 50 microns. Indeed, in some implementations, the light-generating component **312** has a cross-section with a maximum length of 15 to 20 microns. This is about thirty to fifty times smaller than the smallest conventional surface-mount LEDs available.

[0160] Using the pLEDs, each group of light-generating sources **312** (e.g., group **322**) contains about two-thousand sources **312** in some implementations. In other implementations, a group may contain as much as five-thousand sources **312**.

[0161] Of course, other implementations may use different technology for the light-generating sources **312** that may be deposited on a thin layer of material (e.g., 0.07 to 0.25 mm thick) underneath the keytops **210** and in an electrically conductive manner. For example, a hybrid of organic light-emitting diodes (OLEDs) with inorganic quantum dots may be an effective light-generating source **312** for the technology described herein.

[0162] Of course, other suitable light-generating sources may be used with implementations discussed herein and otherwise contemplated. In some implementations, a suitable light-generating source is smaller than 1.0 mm long by 0.8 mm wide and 0.2 mm thick and is larger than includes light-emitting semiconductors that each has a cross-section with a maximum length of 3 to 50 microns.

[0163] For external factors—such as existing contracts, particular illumination requirements, etc.—a keyboard **100** may be constructed that is backlit using a combination of conventional backlighting technologies (e.g., light guides, conventional LEDs, etc.) that is not printed or sprayed onto the lightplate (e.g., surface mount components, etc.) and the deposited light-generated sources **312** discussed herein. The conventional LEDs may be, for example, standard or surface mount LEDs, or the like.

Deposition of Light-Generating Sources

[0164] Implementations of the technology described herein that use the printable light-emitting diodes involve a disposition (e.g., printing, spraying, etc.) of printable light-emitting diodes that are suspended in a liquid or gel (e.g., ink).

[0165] The process of placing the light-generating sources **312** that are suspended in a liquid or gel on the lightplate is called "liquid deposition" herein. The liquid deposition may be accomplished by printing, spraying, or other such application processes. Indeed, the liquid deposition may be accomplished on a conventional printing press, screen press, ink jet printing, or other printing technology.

[0166] Deposition, as used herein, of light-generating sources involves the placement of such sources on a surface and in such a manner so that it is or can be linked electronically to a power source. Disposition does not include surface mounting as is accomplished with conventional LEDs. Rather, deposition herein includes, for example, liquid deposition, printing, spraying, lithography, electrophotography, ejection, squirting, shooting, electrophoresis, electroplating, and the like onto a surface.

[0167] Of course, other implementations may use different technology for the light-generating sources **312** that may be deposited on a thin layer of material (e.g., 0.07 to 0.25 mm thick), such as a thin film, underneath the keys and in an electrically conductive manner.

Additional and Alternative Implementation Notes

[0168] The discussion herein refers to keys and keytops as though each one was a separate unit from the other such items. Alternative implementations are contemplated where the individual keys (and thus keytops) are part of a integrated or contiguous material that covers the keyboard assembly.

[0169] In the above description of exemplary implementations, for purposes of explanation, specific numbers, materials configurations, and other details are set forth in order to better explain the present invention, as claimed. However, it will be apparent to one skilled in the art that the claimed invention may be practiced using different details than the exemplary ones described herein. In other instances, well-known features are omitted or simplified to clarify the description of the exemplary implementations.

[0170] The inventor intends the described exemplary implementations to be primarily examples. The inventor does not intend these exemplary implementations to limit the scope of the appended claims. Rather, the inventor has contemplated that the claimed invention might also be embodied and implemented in other ways, in conjunction with other present or future technologies.

[0171] Moreover, the word "exemplary" is used herein to mean serving as an example, instance, or illustration. Any aspect or design described herein as exemplary is not necessarily to be construed as preferred or advantageous over other aspects or designs. Rather, use of the word "exemplary" is intended to present concepts and techniques in a concrete fashion. The term "technology," for instance, may refer to one or more devices, apparatuses, systems, methods, articles of manufacture, and/or computer-readable instructions as indicated by the context described herein.

[0172] As used in this application, the term "or" is intended to mean an inclusive "or" rather than an exclusive "or." That is, unless specified otherwise or clear from context, "X employs A or B" is intended to mean any of the natural inclusive permutations. That is, if X employs A; X employs B; or X employs both A and B, then "X employs A or B" is satisfied under any of the foregoing instances. In addition, the articles "a" and "an" as used in this application and the appended claims should generally be construed to mean "one or more," unless specified otherwise or clear from context to be directed to a singular form.

[0173] The techniques described with respect to the various devices disclosed may be implemented as one or more methods or processes for backlighting a key **500** and/or a key legend **502**. These processes can be considered as a collection of steps in a logical flow, which represents a sequence of operations that can be implemented in mechanics alone or a combination with hardware, software, and/or firmware. In the context of software/firmware, the execution of the instructions on the medium may cause performance of the operations described herein. For example, one or more computer-readable media with processor-executable instructions stored thereon which when executed by one or more processors may cause performance of operations described herein.

[0174] Note that the order in which the processes are described is not intended to be construed as a limitation, and any number of the described process steps can be combined in any order to implement the processes or an alternate process. Additionally, individual steps may be deleted from the processes without departing from the spirit and scope of the subject matter described herein.

Other Ways of the Describing Implementations

[0175] Below is a listing of different ways to describe the implementations introduced herein:

[0176] The subject matter of Example 1 can optionally include an apparatus comprising at least one key positioned on the apparatus; and a plurality of light-generating sources positioned substantially underneath a keytop of the at least one key and configured to illuminate the at least one key from underneath the keytop, at least two of the light-generating sources of the plurality of light-generating sources being within a footprint of the keytop.

[0177] The subject matter of any one of the above examples, starting with an including Example 1 can optionally include the plurality of light-generating sources includes light-emitting semiconductors.

[0178] The subject matter of any one of the above examples, starting with and including Example 1, can optionally include the plurality of light-generating sources includes light-emitting components that each has a cross-section with a maximum length of 15 to 20 microns.

[0179] The subject matter of any of the above examples, starting with and including Example [00166], can optionally include the plurality of light-generating sources includes light-emitting components that each has a cross-section with a maximum length of 3 to 50 microns.

[0180] The subject matter of any of the above examples, starting with and including Example [00166], can optionally include the plurality of light-generating sources is arranged into multiple distinct groups of multiple light-generating sources, each group disposed substantially underneath the keytop.

[0181] The subject matter of any of the above examples, starting with and including Example [00166], can optionally include the plurality of light-generating sources is deposited onto a lightplate located within the apparatus, underneath the at least one key.

[0182] The subject matter of any of the above examples, starting with and including Example [00166], can optionally include the plurality of light-generating sources is printed and/or sprayed onto the lightplate.

[0183] The subject matter of Example 2 can optionally include depositing a plurality of light-generating sources within a keyboard assembly, the keyboard assembly including at least one key positioned on a keyboard, and the plurality of light-generating sources deposited substantially underneath a keytop of the at least one key; and linking the plurality of light-generating sources via an electrically con-

ductive trace to a power source, wherein the plurality of light-generating sources illuminate the at least one key from underneath the keytop when the power supply supplies power to the electrically conductive trace.

[0184] The subject matter of any of the above examples, starting with and including Example 2, can optionally include further comprising depositing the plurality of light-generating sources underneath the keytop and within a footprint of the keytop.

[0185] The subject matter of any of the above examples, starting with and including Example 2, can optionally include placing the plurality of light-generating sources into multiple distinct groups of multiple light-generating sources with each group placed substantially underneath the keytop.

[0186] The subject matter of any of the above examples, starting with and including Example 2, can optionally include printing and/or spraying a liquid or gel into several distinct groups within the keyboard assembly, the liquid or gel having the plurality of light-generating sources suspended therein.

[0187] The subject matter of any of the above examples, starting with and including Example 2, can optionally include replacing a keyboard illumination source within a keyboard assembly with the plurality of light-generating sources to illuminate the at least one key of the keyboard.

[0188] The subject matter of any of the above examples, starting with and including Example 2, can optionally include depositing the plurality of light-generating sources onto a lightplate; and locating the lightplate within the keyboard assembly to illuminate the at least one key, such that at least a portion of the plurality of light-generating sources is located underneath the keytop of the at least one key and within the footprint of the keytop.

[0189] The subject matter of any of the above examples, starting with and including Example 2, can optionally include the plurality of light-generating sources includes light-emitting semiconductors.

[0190] The subject matter of Example 3 can optionally include a backlighting apparatus comprising a lightplate comprised of a thin film and located within a keyboard assembly; a plurality of light-generating sources deposited on the lightplate at a position that is substantially underneath a keytop of a key of the keyboard assembly, the plurality of light-generating sources being configured to illuminate the key from underneath the keytop.

[0191] The subject matter of any one of the above examples, starting with and including Example 3, can optionally include a conductive trace deposited on the lightplate; and a power source, the conductive trace electrically linking the plurality of light-generating sources to the power source.

[0192] The subject matter of any one of the above examples, starting with an including Example 3, can optionally include at least two of the light-generating sources are underneath the keytop and are within a footprint of the keytop.

[0193] The subject matter of any one of the above examples, starting with and including Example 3, can optionally include the plurality of light-generating sources includes light-emitting semiconductors printed and/or sprayed onto the lightplate, while suspended in a liquid or gel medium.

[0194] The subject matter of any one of the above examples, starting with and including Example 3, can optionally include at least one other light-generating source deposited onto the lightplate that is not printed or sprayed onto the lightplate.

[0195] The subject matter of any one of the above examples, starting with and including Example 3, can optionally include the plurality of light-generating sources includes light-emitting semiconductors that each has a cross-section with a maximum length of 15 to 20 microns.

[0196] The subject matter of any one of the above examples, starting with and including Example 3, can optionally include the plurality of light-generating sources is deposited on the lightplate at a position that is substantially underneath a translucent key legend of the key, the plurality of light-generating sources configured to consistently illuminate the key legend of the key from underneath the keytop.

[0197] The subject matter of any one of the above examples, starting with and including Example 3, can optionally include the lightplate is positioned substantially underneath a key mechanism of the keyboard assembly, the key mechanism positioned underneath the keytop and configured to mechanically interact with the keytop, the plurality of light-generating sources being configured to illuminate the underside of the keytop.

[0198] The subject matter of Example 4 can optionally include a backlighting apparatus comprising a lightplate located within a keyboard assembly, the lightplate positioned underneath a keytop of a key of the keyboard assembly and above a backplate of the keyboard assembly; and a plurality of light-generating sources deposited on the lightplate at a position that is substantially underneath the keytop, the plurality of light-generating sources configured to consistently illuminate the key from underneath the keytop.

[0199] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include a conductive trace deposited on the lightplate; and a power source, the conductive trace electrically linking the plurality of light-generating sources to the power source.

[0200] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the keyboard assembly comprises a plurality of keys, and wherein the plurality of light-generating sources are deposited on the lightplate at a plurality of positions that are substantially underneath a plurality of keytops of the plurality of keys and are configured to consistently illuminate the plurality of keys from underneath the plurality of keytops.

[0201] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the lightplate is positioned underneath a sensor layer of the keyboard assembly and above the backplate of the keyboard assembly.

[0202] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the lightplate is positioned underneath one or more keytops of the keyboard assembly and above a sensor layer of the keyboard assembly.

[0203] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the lightplate is positioned underneath one or more keytops of the keyboard assembly and above or within a key mechanics layer of the keyboard assembly.

[0204] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the lightplate is positioned within or underneath a key mechanics layer of the keyboard assembly and above the backplate of the keyboard assembly.

[0205] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the plurality of light-generating sources is deposited into multiple distinct groups of multiple light-generating sources and each group is placed substantially underneath the keytop.

[0206] The subject matter of any one of the above examples, starting with and including Example 4, can optionally include the plurality of light-generating sources includes light-emitting semiconductors that each has a cross-section with a maximum length of 15 to 20 microns.

[0207] The subject matter of Example 5 can optionally include depositing a plurality of light-generating sources on a lightplate within a keyboard assembly, the keyboard assembly including a plurality of keytops; positioning the lightplate underneath the plurality of keytops and above a backplate of the keyboard assembly, the plurality of light-generating sources disposed substantially underneath the plurality of keytops; and linking the plurality of light-generating sources via an electrically conductive trace to a power source, wherein the plurality of light-generating sources illuminate the plurality of keys from underneath the plurality of keys when the power supply supplies power to the electrically conductive trace.

[0208] The subject matter of any one of the above examples, starting with and including Example 5, can optionally include positioning the lightplate underneath the plurality of keytops such that a majority portion of the plurality of light-generating sources is disposed within a footprint of the plurality of keytops.

[0209] The subject matter of any one of the above examples, starting with and including Example 5, can optionally include printing and/or spraying a liquid or gel onto the lightplate, the liquid or gel having the plurality of light-generating sources suspended therein.

[0210] The subject matter of any one of the above examples, starting with and including Example 5, can optionally include replacing a pre-existing keyboard illumination source within the keyboard assembly with the lightplate to illuminate the plurality of keys of the keyboard.

[0211] The subject matter of any one of the above examples, starting with and including Example 5, can optionally include positioning the lightplate within the keyboard assembly to illuminate the plurality of keys of the keyboard without increasing a total thickness of the keyboard assembly as without the lightplate.

[0212] The subject matter of any one of the above examples, starting with and including Example 5, can optionally include the plurality of light-generating sources includes light-emitting semiconductors that each has a cross-section with a maximum length of 15 to 20 microns.

[0213] The subject matter of Example 6 can optionally include a keyboard assembly comprising: at least one key positioned on the keyboard assembly; a key mechanism positioned underneath a keytop of the key and configured to mechanically interact with the keytop, the key mechanism configured to provide a keypress function of the key; and a plurality of light-generating sources positioned substantially within or underneath the key mechanism, the plurality of light-generating sources being configured to illuminate the underside of the keytop with light emanating from the plurality of light-generating sources.

[0214] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include a lightplate disposed substantially within or underneath the key mechanism, the plurality of light-generating sources printed and/or sprayed onto the lightplate.

[0215] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include a conductive trace deposited onto the lightplate; and a power source, the conductive trace electrically linking the plurality of light-generating sources to the power source.

[0216] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include a lightplate having one or more conductive traces electrically linking the plurality of light-generating sources to a power source, the lightplate having a light flap positioned on or within the key mechanism, the light flap having the plurality of light-generating sources thereon.

[0217] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include the plurality of light-generating sources illuminates the underside of the keytop via light reflectively diffused by the key mechanism.

[0218] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include the key mechanism comprises at least one of a resist-and-return structure and a key leveling structure.

[0219] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include the plurality of light-generating sources includes a portion of light-generating sources comprising printed light-emitting semiconductors and includes at least one other light-generating source that is not a printed light-emitting semiconductor.

[0220] The subject matter of any one of the above examples, starting with and including Example 6, can optionally include at least two of the light-generating sources is underneath the keytop and within a footprint of the keytop.

[0221] The subject matter of Example 7 can optionally include a keyboard assembly comprising: a key positioned on the keyboard assembly; a key mechanism positioned underneath a keytop of the key and configured to mechanically interact with the keytop, the key mechanism configured to provide a keypress function of the key when the keytop is pressed; a lightplate positioned substantially within or underneath the key mechanism and above a backplate of the keyboard assembly, the lightplate including holes therein that allow for at least a portion of the key mechanism to pass therethrough when the keytop is pressed; and a plurality of light-generating sources deposited on the lightplate at a position that is substantially underneath the keytop, the plurality of light-generating sources configured to consistently illuminate the key from underneath the keytop.

[0222] The subject matter of any one of the above examples, starting with and including Example 7, can optionally include the key mechanism includes a key leveling structure comprising one or more rigid blades, and

wherein at least a portion of the rigid blades passes through a hole in the lightplate when the keytop is pressed.

[0223] The subject matter of any one of the above examples, starting with and including Example 7, can optionally include the lightplate includes one or more conductive traces electrically linking the plurality of light-generating sources to a power source, the one or more conductive traces arranged between the holes of the lightplate.

[0224] The subject matter of any one of the above examples, starting with and including Example 7, can optionally include the lightplate includes a light flap positioned on or within the key mechanism, the light flap having the plurality of light-generating sources and/or one or more conductive traces thereon.

[0225] The subject matter of any one of the above examples, starting with and including Example 7, can optionally include the plurality of light-generating sources is deposited on the lightplate at positions between the holes that are substantially underneath a translucent key legend of the key, the plurality of light-generating sources configured to consistently illuminate the key legend of the key from underneath the keytop.

[0226] The subject matter of any one of the above examples, starting with and including Example 7, can optionally include the lightplate is positioned above a sensor layer of the keyboard assembly.

[0227] The subject matter of any one of the above examples, starting with and including Example 7, can optionally include the lightplate is positioned between a sensor layer of the keyboard assembly and the backplate.

[0228] The subject matter of Example 8 can optionally include a keyboard assembly comprising: a key layer including a key; a key mechanics layer including a keypress mechanism configured to mechanically interact with a keytop of the key and to provide a keypress of the key; a sensor layer including a sensor configured to detect the keypress of the key and to indicate the keypress to a keyboard controller; and a plurality of light-generating sources deposited on the key layer, the key mechanics layer, the sensor layer, or a combination thereof, and positioned substantially underneath the keytop, the plurality of light-generating sources being configured to illuminate the key from underneath the keytop.

[0229] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include a conductive trace deposited on the key layer, the key mechanics layer, the sensor layer, or a backplate of the keyboard assembly, or a combination thereof; and a power source, the conductive trace electrically linking the plurality of light-generating sources to the power source.

[0230] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include a backplate, and wherein at least a portion of the plurality of light-generating sources is deposited onto the backplate to illuminate the key and/or the keyboard assembly.

[0231] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include the plurality of light-generating sources is deposited onto a topside and/or an underside of the keytop to illuminate the key.

[0232] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include the plurality of light-generating sources is deposited onto the keypress mechanism to illuminate the key.

[0233] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include the keypress mechanism comprises a resist-and-return structure and/or a leveling structure, and at least a portion of the plurality of light-generating sources is deposited onto the resist-and-return structure and/or the leveling structure to illuminate the key.

[0234] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include the plurality of light-generating sources illuminates the key via light reflectively diffused by the keypress mechanism.

[0235] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include the plurality of light-generating sources is printed and/or sprayed onto the sensor layer.

[0236] The subject matter of any one of the above examples, starting with and including Example 8, can optionally include the plurality of light-generating sources includes light-emitting semiconductors that each has a cross-section with a maximum length of 15 to 20 microns.

[0237] The subject matter of Example 9 can optionally include a method comprising: depositing a plurality of light-generating sources on a key layer, a key mechanics layer, or a sensor layer of a keyboard assembly, or a combination thereof, the keyboard assembly including a plurality of keytops; positioning the plurality of light-generating sources substantially underneath the plurality of keytops; and linking the plurality of light-generating sources via an electrically conductive trace to a power source, wherein the plurality of light-generating sources illuminate the plurality of keys from underneath the plurality of keytops when the power supply supplies power to the electrically conductive trace.

[0238] The subject matter of any one of the above examples, starting with and including Example 9, can optionally include depositing at least a portion of the plurality of light-generating sources onto a backplate of the keyboard assembly to illuminate the plurality of keys and/or the keyboard assembly.

[0239] The subject matter of any one of the above examples, starting with and including Example 9, can optionally include depositing the plurality of light-generating sources onto a topside and/or an underside of one or more of the plurality of keytops to illuminate the plurality of keys.

[0240] The subject matter of any one of the above examples, starting with and including Example 9, can optionally include depositing the plurality of light-generating sources onto the keypress mechanism to illuminate the plurality of keys.

[0241] The subject matter of any one of the above examples, starting with and including Example 9, can optionally include depositing the plurality of light-generating sources such that the plurality of light-generating sources illuminates the plurality of keys via light emanating from the plurality of light-generating sources and reflectively diffused by the keypress mechanism.

[0242] The subject matter of any one of the above examples, starting with and including Example 9, can optionally include depositing the plurality of light-generat-

ing sources and the electrically conductive trace onto the sensor layer to illuminate the plurality of keys.

[0243] The subject matter of any one of the above examples, starting with and including Example 9, can optionally include the depositing includes printing or spraying a liquid or gel onto the at least one of the key layer, the key mechanics layer, the sensor layer, or a combination thereof, the liquid or gel having the plurality of light-generating sources suspended therein.

[0244] The subject matter of Example 10 can optionally include a backlighting apparatus comprising: a multi-functional layer of a keyboard assembly; and a plurality of light-generating sources deposited onto or within the multi-functional layer of the keyboard assembly, the plurality of light-generating sources disposed substantially underneath a plurality of keytops of a plurality of keys of the keyboard assembly, and configured to consistently illuminate the plurality of keys from underneath the plurality of keytops.

[0245] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer includes one or more of a plurality of keytops, a plurality of keypress mechanisms, or a plurality of keypress sensors.

[0246] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer is positioned within the keyboard assembly above a backplate configured to support the keyboard assembly and to which one or more layers of the keyboard assembly is attached.

[0247] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include one or more conductive traces disposed on the multi-functional layer and electrically linking the plurality of light-generating sources to a power source.

[0248] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer comprises a key layer and includes the plurality of keytops, the plurality of light-generating sources being deposited onto an underside of the keytops to illuminate the plurality of keys.

[0249] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer comprises a key mechanics layer and includes the plurality of keypress mechanisms, the keypress mechanisms each configured to mechanically interact with a keytop of the plurality of keytops and to provide a keypress action of the keytop.

[0250] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer comprises a key mechanics layer and includes a plurality of resist-and-return structures and leveling structures configured to mechanically interact with the plurality of keytops and to provide a keypress action for the plurality of keytops, the plurality of light-generating sources deposited onto or within the resist-and-return structures and/or the leveling structures.

[0251] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer comprises a sensor layer and includes a plurality of keypress sensors, the keypress sensors each configured to detect a keypress of a key of the plurality of keys and to indicate the keypress to a keyboard controller, the keypress sensors including at least one of a conductive keyswitch sensor, a capacitive sensor, or an electrically resistive sensor.

[0252] The subject matter of any one of the above examples, starting with and including Example 10, can optionally include the multi-functional layer is configured to replace a sensor layer of an existing keyboard assembly and to provide keypress detection and key illumination to the existing keyboard assembly.

[0253] The subject matter of Example 11 can optionally include a backlighting apparatus comprising: a lightplate comprised of a thin film; a plurality of light-generating sources deposited on the lightplate at a position that is substantially underneath an at least partially translucent key legend of a key of an assembled keyboard, the plurality of light-generating sources being configured to consistently illuminate the key legend of the key from underneath a keytop of the key.

[0254] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include a conductive trace deposited on the lightplate; and

[0255] a power source, the conductive trace electrically linking the plurality of light-generating sources to the power source.

[0256] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include the key legend includes a multi-letter word.

[0257] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include the key legend has multiple symbols and the illumination of each symbol of the key legend by the plurality of light-generating sources is consistent in relationship with the illumination of the other symbols of the key legend.

[0258] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include the key includes multiple translucent key legends, and wherein the plurality of light-generating sources is deposited on the lightplate in multiple groups that are substantially underneath the multiple translucent key legends of the key, the plurality of light-generating sources being configured to consistently illuminate the multiple translucent key legends of the key from underneath the keytop.

[0259] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include a single group of the multiple groups of light-generating sources is separately addressable and separately controlled to illuminate a single translucent key legend of the multiple translucent key legends separately and individually.

[0260] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include the single group of light-generating sources is separately controlled based on a keypress of one or more predetermined keys or key combinations.

[0261] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include a light barrier surrounding a group of light-generating sources, the light barrier arranged to limit light from the group to illuminating a desired key legend of a desired key and to inhibit the light from leaking to other key legends or to other keys.

[0262] The subject matter of any one of the above examples, starting with and including Example 11, can optionally include the plurality of light-generating sources includes light-emitting semiconductors that includes light-emitting semiconductors that each has a cross-section with a maximum length of 15 to 20 microns.

[0263] The subject matter of Example 12 can optionally include a method comprising: depositing a plurality of light-generating sources on a lightplate within a keyboard assembly, the keyboard assembly including a key; positioning the lightplate underneath a keytop of the key, the plurality of light-generating sources disposed substantially underneath an at least partially translucent key legend of the key; and linking the plurality of light-generating sources via an electrically conductive trace to a power source, wherein the plurality of light-generating sources illuminate the key legend of the key from underneath the keytop when the power supply supplies power to the electrically conductive trace.

[0264] The subject matter of any one of the above examples, starting with and including Example 12, can optionally include spraying and/or printing a liquid or gel onto the lightplate, the liquid or gel having the plurality of light-generating sources suspended therein.

[0265] The subject matter of any one of the above examples, starting with and including Example 12, can optionally include positioning the lightplate so that the lightplate makes contact with an underside surface of the keytop.

[0266] The subject matter of any one of the above examples, starting with and including Example 12, can optionally include positioning the lightplate so that the key legend is illuminated by a first group of light-generating sources and the periphery of the key is illuminated by a second group of light-generating sources, either separately or simultaneously; and

[0267] controlling the illumination of the first group and the second group independently.

[0268] The subject matter of any one of the above examples, starting with and including Example 12, can optionally include confining illumination of the plurality of light-generating sources to the key legend of the key and shielding the illumination of the plurality of light-generating sources from illuminating other legends and/or other keys.

[0269] The subject matter of Example 13 can optionally include a keyboard assembly comprising: a key layer including a key having a keytop; a lightplate located within the keyboard assembly, the lightplate positioned underneath the keytop and above a backplate of the keyboard assembly; a plurality of light-generating sources deposited on the lightplate at a position that is substantially underneath the keytop, the plurality of light-generating sources configured to consistently illuminate the key and/or the key legend from underneath the keytop; and one or more conductive traces disposed on the lightplate and electrically linking the plurality of light-generating sources to a power source.

[0270] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include the lightplate includes a light flap positioned on, within, or underneath the keytop, the light flap having at least a portion of the plurality of light-generating sources thereon and a hinge physically connecting the light flap to the lightplate, the hinge extending one or more of the conductive traces of the lightplate to the plurality of light-generating sources of the flap so as to electrically couple the plurality of light-generating sources to a power source.

[0271] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include multiple translucent key legends, and wherein the plurality of light-generating sources is deposited on the lightplate in multiple groups that are substantially underneath the multiple translucent key legends of the key, the multiple groups of light-generating sources being separately addressable and separately controlled to illuminate each of the translucent key legends of the multiple translucent key legends separately and individually based on a keypress of one or more predetermined keys or key combinations.

[0272] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include a plurality of keys with translucent key legends, at least a portion of the keys having multiple translucent key legends, and wherein the light-generating sources are arranged to illuminate each of the plurality of keys and each of the translucent key legends, and are separately addressable and separately controlled to illuminate a single key and/or a single key legend.

[0273] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include the separately addressable and separately controlled light-generating sources illuminate at least a portion of the plurality of keys and/or at least a portion of the translucent key legends according to a predetermined pattern, based on one or more preset triggers.

[0274] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include the one or more triggers, with respect to a device including the keyboard assembly, includes: powering up the device, opening the device, receiving notification of a status of an application of the device, receiving a message or mail at the device, and having a limited selection of keystrokes available at the device.

[0275] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include randomly illuminating or flashing a sequence of keys and/or key legends, rolling illumination of a sequence of adjacent keys and/or key legends, flashing a set of keys and/or key legends, dynamically illuminating or flashing a set or a sequence of keys and/or key legends according to audible tones, or temporarily illuminating one or more individual keys and/or key legends.

[0276] The subject matter of any one of the above examples, starting with and including Example 13, can optionally include the separately addressable and separately controlled light-generating sources illuminate a portion of the keys and/or the key legends when the portion represents a limited selection of acceptable keystrokes available to a user.

1-99. (canceled)

100: An apparatus comprising:

at least one key positioned on the apparatus; and

a plurality of light-generating sources positioned substantially underneath a keytop of the at least one key and configured to illuminate the at least one key from underneath the keytop, at least two of the light-generating sources of the plurality of light-generating sources being within a footprint of the keytop.

101: The apparatus of claim **100**, wherein the plurality of light-generating sources includes light-emitting semiconductors.

102: The apparatus of claim **100**, wherein the plurality of light-generating sources includes light-emitting components that each has a cross-section with a maximum length of 15 to 20 microns.

103: The apparatus of claim **100**, wherein the plurality of light-generating sources includes light-emitting components that each has a cross-section with a maximum length of 3 to 50 microns.

104: The apparatus of claim **100**, wherein the plurality of light-generating sources is arranged into multiple distinct groups of multiple light-generating sources, each group disposed substantially underneath the keytop.

105: The apparatus of claim **100**, wherein the plurality of light-generating sources is deposited onto a lightplate located within the apparatus, underneath the at least one key.

106: The apparatus of claim **105**, wherein the plurality of light-generating sources is printed and/or sprayed onto the lightplate.

107: A method comprising:

depositing a plurality of light-generating sources within a keyboard assembly, the keyboard assembly including at least one key positioned on a keyboard, and the plurality of light-generating sources deposited substantially underneath a keytop of the at least one key; and

linking the plurality of light-generating sources via an electrically conductive trace to a power source, wherein the plurality of light-generating sources illuminate the at least one key from underneath the keytop when the power supply supplies power to the electrically conductive trace.

108: The method of claim **107**, further comprising depositing the plurality of light-generating sources underneath the keytop and within a footprint of the keytop.

109: The method of claim **107**, wherein the depositing includes placing the plurality of light-generating sources into multiple distinct groups of multiple light-generating sources with each group placed substantially underneath the keytop.

110: The method of claim **107**, wherein the depositing includes printing and/or spraying a liquid or gel into several distinct groups within the keyboard assembly, the liquid or gel having the plurality of light-generating sources suspended therein.

111: The method of claim **107**, further comprising replacing a keyboard illumination source within a keyboard assembly with the plurality of light-generating sources to illuminate the at least one key of the keyboard.

112: The method of claim **107**, further comprising depositing the plurality of light-generating sources onto a lightplate; and

locating the lightplate within the keyboard assembly to illuminate the at least one key, such that at least a portion of the plurality of light-generating sources is located underneath the keytop of the at least one key and within the footprint of the keytop.

113: The method of claim **107**, wherein the plurality of light-generating sources includes light-emitting semiconductors.

114: A backlighting apparatus comprising:

a lightplate comprised of a thin film and located within a keyboard assembly;

a plurality of light-generating sources deposited on the lightplate at a position that is substantially underneath a keytop of a key of the keyboard assembly, the plurality of light-generating sources being configured to illuminate the key from underneath the keytop.

115: The backlighting apparatus of claim **114**, further comprising:

a conductive trace deposited on the lightplate; and

a power source,

the conductive trace electrically linking the plurality of light-generating sources to the power source.

116: The backlighting apparatus of claim **114**, wherein at least two of the light-generating sources are underneath the keytop and are within a footprint of the keytop.

117: The backlighting apparatus of claim **114**, wherein the plurality of light-generating sources includes light-emitting semiconductors printed and/or sprayed onto the lightplate, while suspended in a liquid or gel medium.

118: The backlighting apparatus of claim **117**, further comprising at least one other light-generating source deposited onto the lightplate that is not printed or sprayed onto the lightplate.

119: The backlighting apparatus of claim **114**, wherein the plurality of light-generating sources includes light-emitting semiconductors that each has a cross-section with a maximum length of 15 to 20 microns.

120: The backlighting apparatus of claim **114**, wherein the plurality of light-generating sources is deposited on the lightplate at a position that is substantially underneath a translucent key legend of the key, the plurality of light-generating sources configured to consistently illuminate the key legend of the key from underneath the keytop.

121: The backlighting apparatus of claim **114**, wherein the lightplate is positioned substantially underneath a key mechanism of the keyboard assembly, the key mechanism positioned underneath the keytop and configured to mechanically interact with the keytop, the plurality of light-generating sources being configured to illuminate the underside of the keytop.

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