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TECHNICAL LED INTELLECTUAL PROPERTY, LLC

UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF CALIFORNIA

TECHNICAL LED INTELLECTUAL PROPERTY, LLC, a Delaware limited liability company, Plaintiff, v. HOME CONTROLS, INC., a California corporation, Defendant.	Case No. '19CV0144 LAB KSC **COMPLAINT FOR PATENT INFRINGEMENT (U.S. PATENT NO. RE41,685)** **DEMAND FOR JURY TRIAL**

This is an action for patent infringement in which Technical LED Intellectual Property, LLC ("Technical LED" or "Plaintiff") makes the following allegations against Home Controls Inc. ("Home Controls" or "Defendant"):

PARTIES

1. Plaintiff Technical LED is a Delaware limited liability company, with its principal place of business located at 251 Little Falls Dr., Wilmington, DE 19808.

2. On information and belief, Defendant Home Controls has a principal place of business at 8525 Redwood Creek Rd., San Diego, CA 92126.

JURISDICTION AND VENUE

3. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

4. Venue is proper in this district under 28 U.S.C. §§ 1391(c) and 1400(b). On information and belief, Defendant has transacted business in this district, and has committed and/or induced acts of patent infringement in this district.

5. On information and belief, Defendant is subject to this Court's specific and general personal jurisdiction pursuant to due process and/or California's Long Arm Statue, due at least to its substantial business in this forum, including: (i) at least a portion of the infringements alleged herein; (ii) regularly doing or soliciting business, engaging in other persistent courses of conduct, and/or deriving substantial revenue from goods and services provided to individuals in California and in this Judicial District; and having a regular and established place of business in this Judicial District.

FIRST CAUSE OF ACTION

Infringement of U.S. Patent No. RE41,685

6. Plaintiff is the owner by assignment of United States Patent No. RE41,685 ("the '685 Patent") titled "Light Source with Non-White and Phosphor-Based White LED Devices and LCD Assembly." The '685 Patent reissued on September 14, 2010. A true and correct copy of the '685 Patent is attached as **Exhibit A**.

7. Upon information and belief, Defendant directly or through intermediaries has been and is now infringing the '685 Patent in the State of California, in this judicial district, and elsewhere in the United States, by, making, using, providing, supplying, distributing, selling, and/or offering for sale products (including at least its website at www.homecontrols.com) further including smart led lights, RGBW led lights and similar type assemblies, comprising a light source that infringes one or more claims of the '685 Patent and particularly, e.g., claims 10 through 14 of the '685 Patent. The '685 Patent reads on Home Control's, Zipato Z-wave RGBW led light bulb as set forth in the exemplary claims chart, attached as **Exhibit B**.

8. Upon information and belief and in view of the foregoing, Defendant has been and is continuing to directly infringe, literally infringe, and/or infringe the '685 Patent under the doctrine of equivalents. Defendant is thus liable for infringement of the '685 Patent pursuant to 35 U.S.C. § 271.

9. As a result of Defendant's infringement of the '685 Patent, Plaintiff has suffered monetary damages and is entitled to a money judgment in an amount adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the court, and Plaintiff will continue to suffer damages in the future unless Defendant's infringing activities are enjoined by this Court. Unless a permanent injunction is issued enjoining Defendant and its agents, servants, employees, representatives, affiliates, and all others acting on in active concert therewith from infringing the '685 Patent, Plaintiff will be greatly and irreparably harmed.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that this Court enter:

1. A judgment in favor of Plaintiff that Defendant has willfully infringed and is willfully infringing the '685 Patent, and has induced infringement and is inducing infringement of the '685 Patent;;

2. A permanent injunction enjoining Defendant and its officers, directors, agents servants, affiliates, employees, divisions, branches, subsidiaries, parents, and all others acting in active concert therewith from infringement, inducing the infringement of, or contributing to the infringement of '685 Patent, or such other equitable relief the Court determines is just and proper;

3. A judgment and order requiring Defendant pay to Plaintiff its damages, attorneys fees, costs, expenses, and prejudgment and post-judgment interest for Defendant's infringement and willful infringement of the '685 Patent as provided under 35 U.S.C. § 284, and an accounting of ongoing post-judgment infringement; and

4. Any and all other relief, at law or equity, to which Plaintiff may show itself to be entitled.

DATED: January 22, 2019

FERNALD LAW GROUP APC

By: _____
Brandon C. Fernald

Attorneys for Plaintiff

TECHNICAL LED INTELLECTUAL PROPERTY, LLC

DEMAND FOR JURY TRIAL

Technical LED, pursuant to Rule 38 of the Federal Rules of Civil Procedure and Local Rule 38-1, hereby requests a trial by jury of any issues so triable by right.

DATED: January 22, 2019

FERNALD LAW GROUP APC

By: _____
Brandon C. Fernald

Attorneys for Plaintiff
TECHNICAL LED INTELLECTUAL PROPERTY, LLC

EXHIBIT A

US00RE41685E

(19) **United States**

(12) **Reissued Patent**

Feldman et al.

(10) **Patent Number: US RE41,685 E**

(45) **Date of Reissued Patent: Sep. 14, 2010**

(54) **LIGHT SOURCE WITH NON-WHITE AND PHOSPHOR-BASED WHITE LED DEVICES, AND LCD ASSEMBLY**

(75) Inventors: **Alan Stuart Feldman**, Phoenix, AZ (US); **Brian David Cull**, Massillon, OH (US); **Dennis Michael Davey**, Glendale, AZ (US)

(73) Assignee: **Honeywell International, Inc.**, Morristown, NJ (US)

(21) Appl. No.: **11/788,399**

(22) Filed: **Apr. 19, 2007**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **6,666,567**
Issued: **Dec. 23, 2003**
Appl. No.: **09/473,301**
Filed: **Dec. 28, 1999**

(51) **Int. Cl.**
G09F 13/04 (2006.01)
F21V 9/00 (2006.01)
F21S 4/00 (2006.01)

(52) **U.S. Cl.** **362/237**; 362/97.3; 362/231; 362/236; 362/249.02; 349/69; 349/70

(58) **Field of Classification Search** 362/97, 362/228, 230, 231, 237, 249, 800, 240, 236, 362/249.02, 97.3; 349/69, 70
See application file for complete search history.

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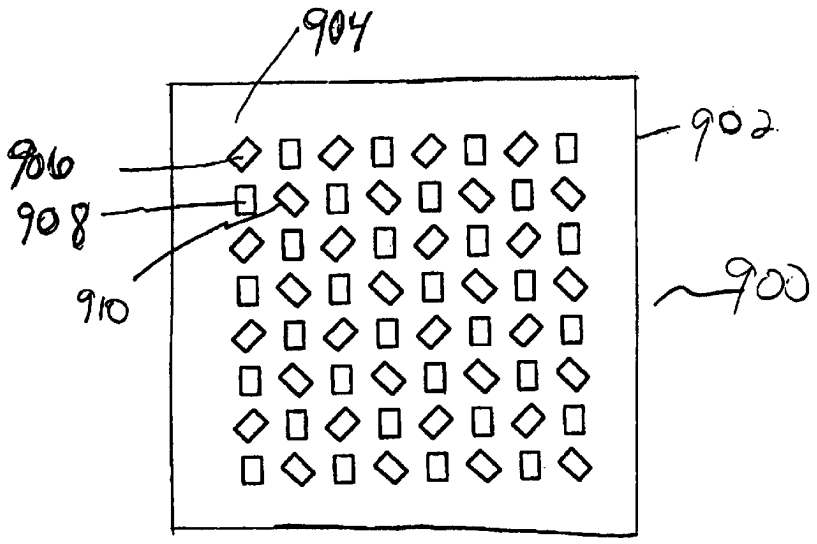
Primary Examiner—Ismael Negron

(74) *Attorney, Agent, or Firm*—Alston & Bird LLP

(57) **ABSTRACT**

A light source incorporates *phosphor-based white* light emitting diodes (LEDs). The LEDs may be raised off the floor of the optical cavity to permit light to be emitted from the base of the LED. Additionally, a reflective protrusion may be placed beneath the raised LED to aid in redirecting light forward. The LEDs may be skewed in relation to adjacent LEDs to reduce interference. Non-white LEDs may be incorporated into the light source to permit for selective color tuning. Fluorescent lamps may also be implemented in combination with the LEDs to form a hybrid light source. *The light source may be used as a backlight for a liquid crystal display assembly.*

16 Claims, 10 Drawing Sheets



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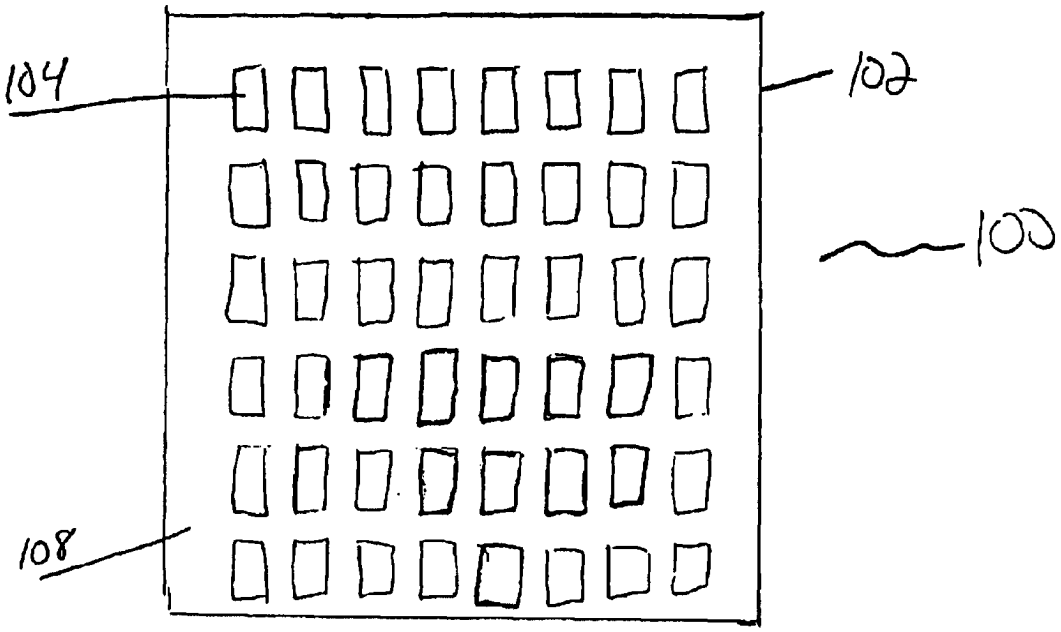


FIGURE 1
(Prior Art)

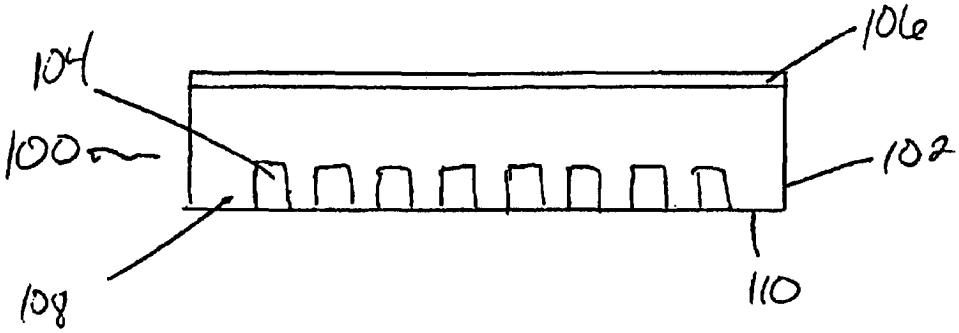


FIGURE 2
(Prior Art)

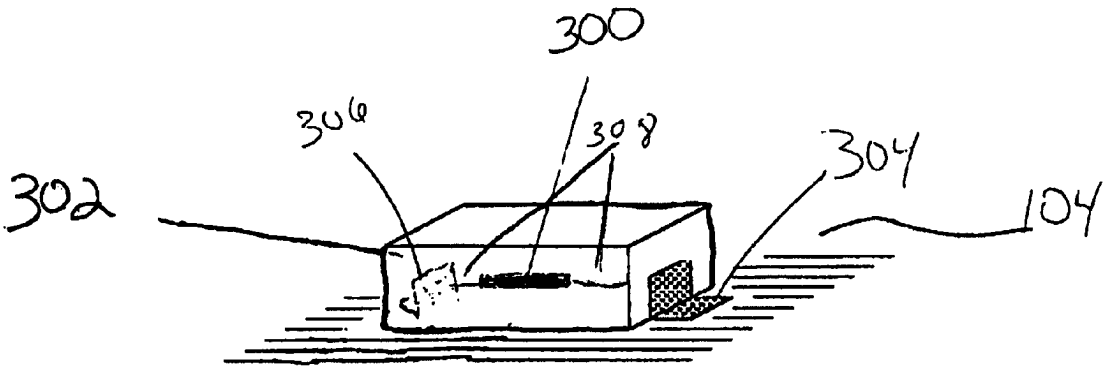


FIGURE 3

(PRIOR ART)

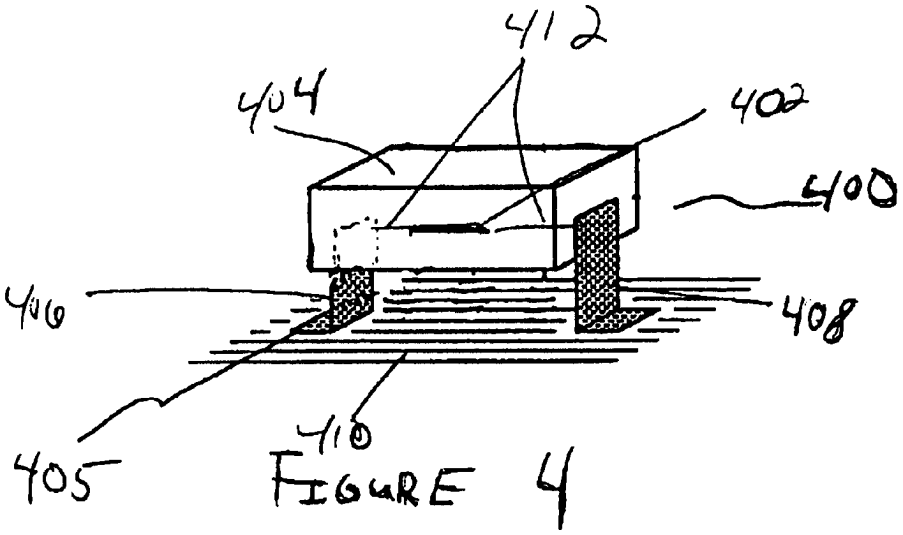


FIGURE 4

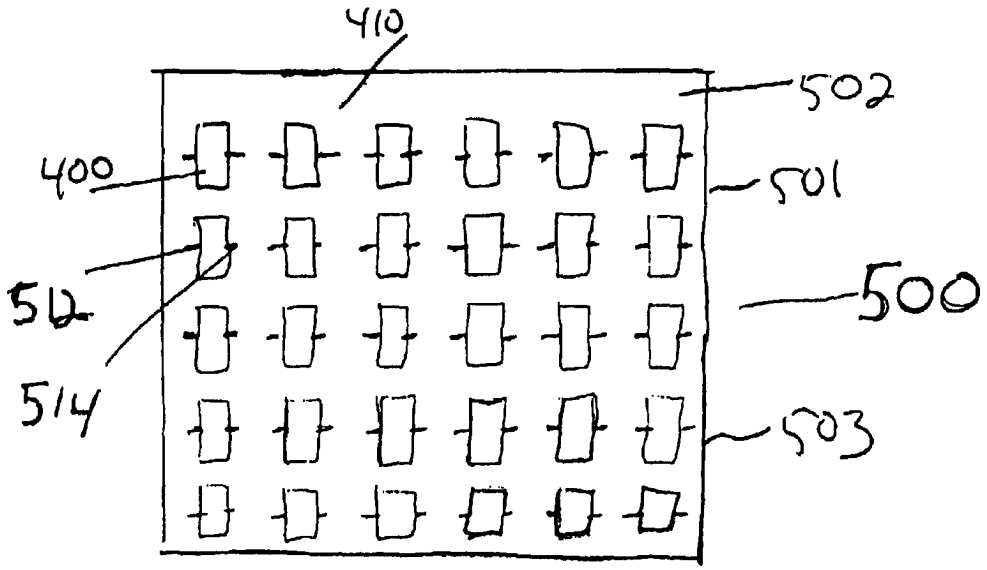


FIGURE 5

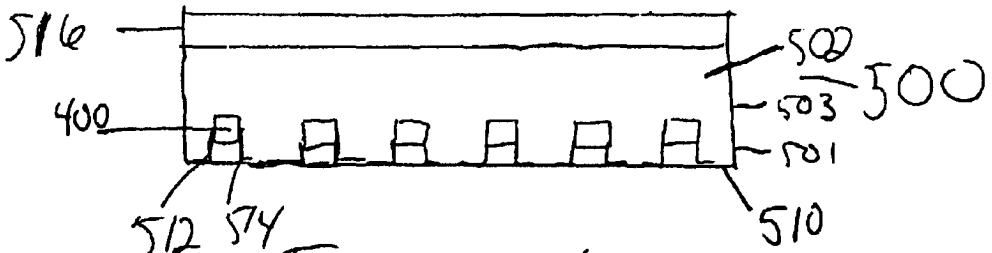


FIGURE 6

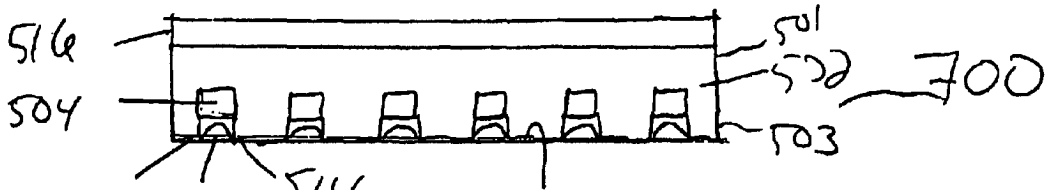


FIGURE 7

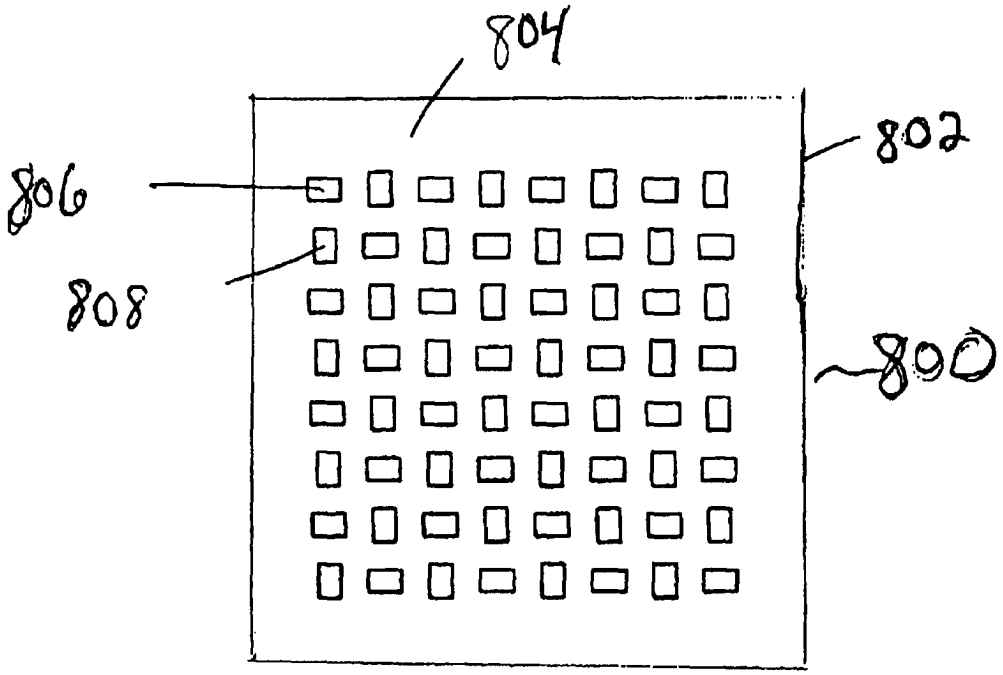


FIGURE 8

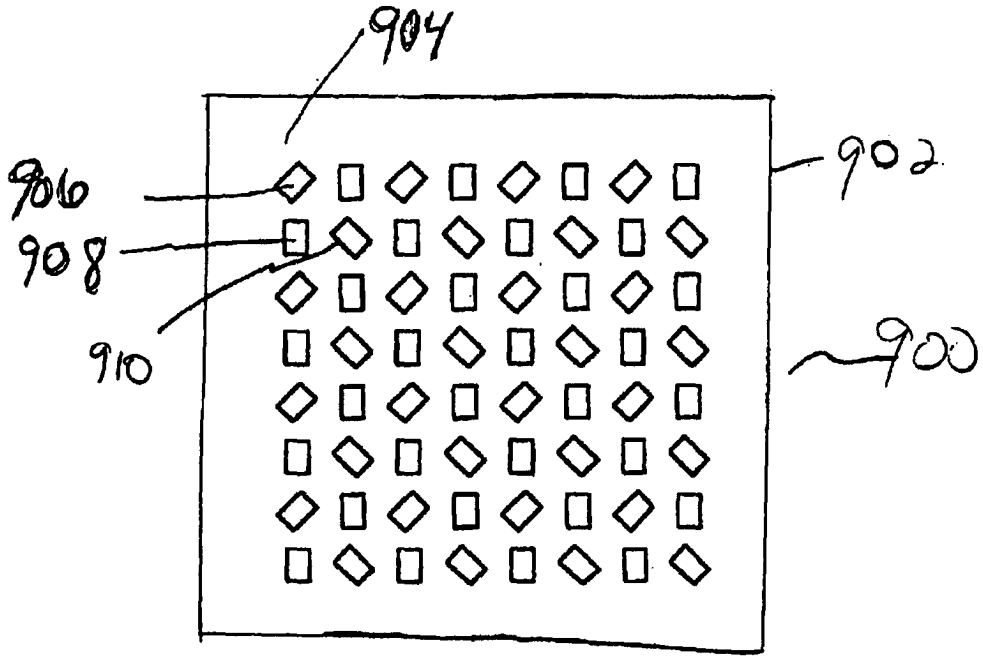
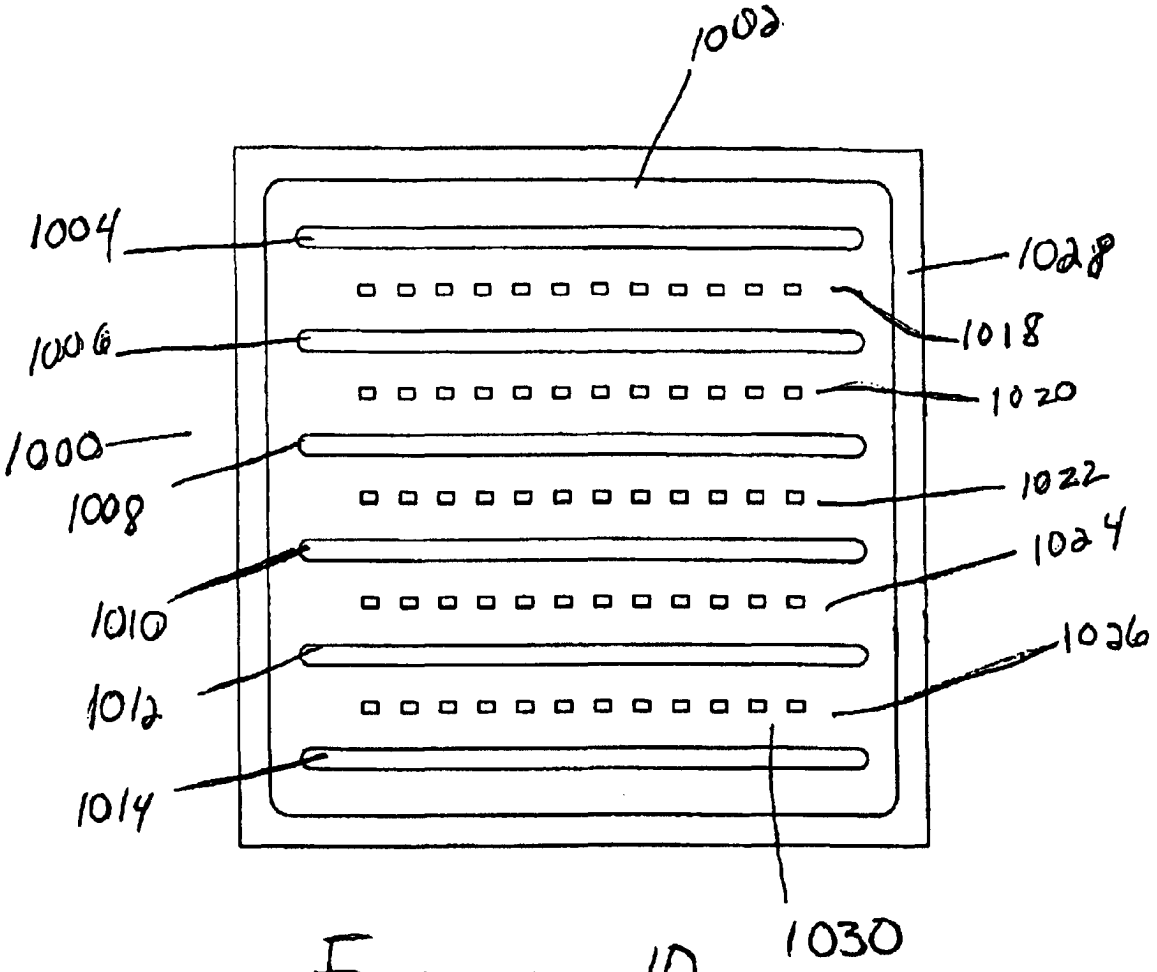


FIGURE 9


1002
1004
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1020
1000
1022
1008
1024
1010
1026
1012
1014
1030

FIGURE 10

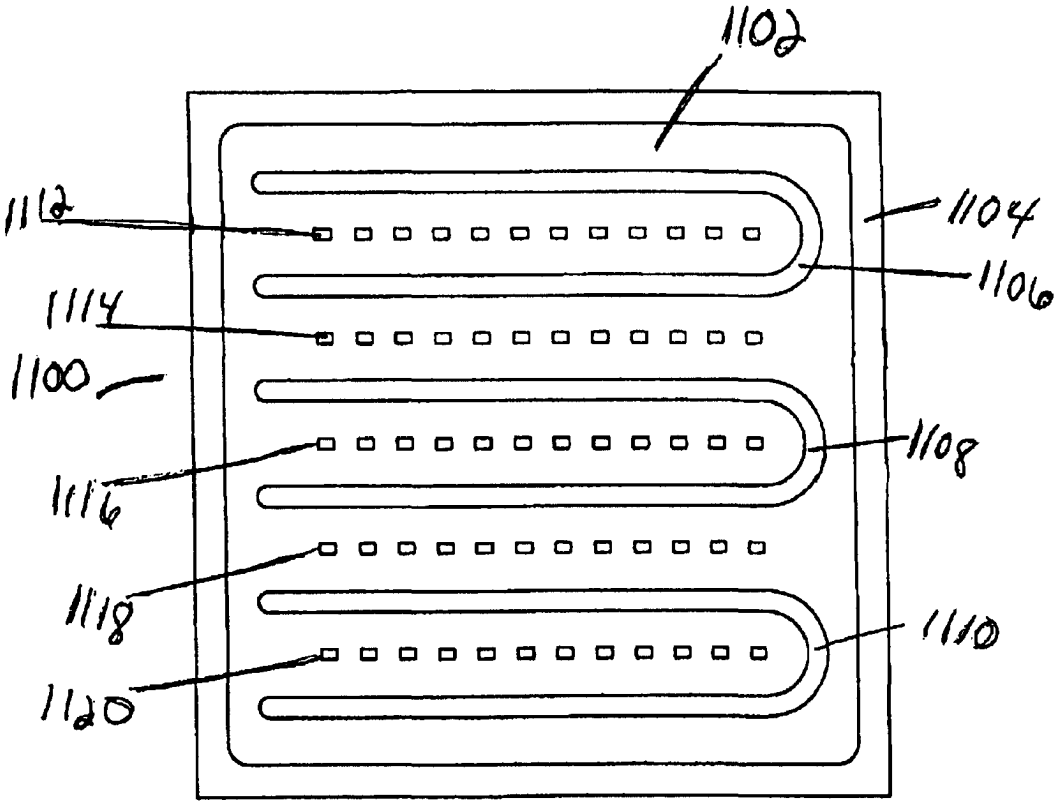


FIGURE 11

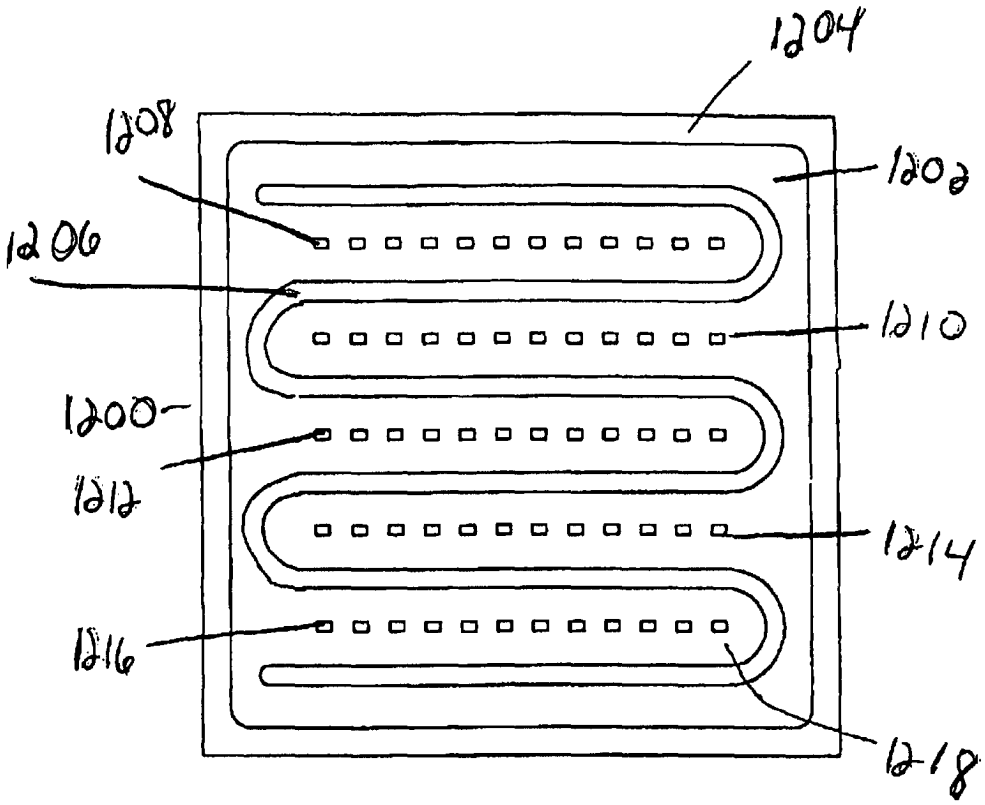


FIGURE 12

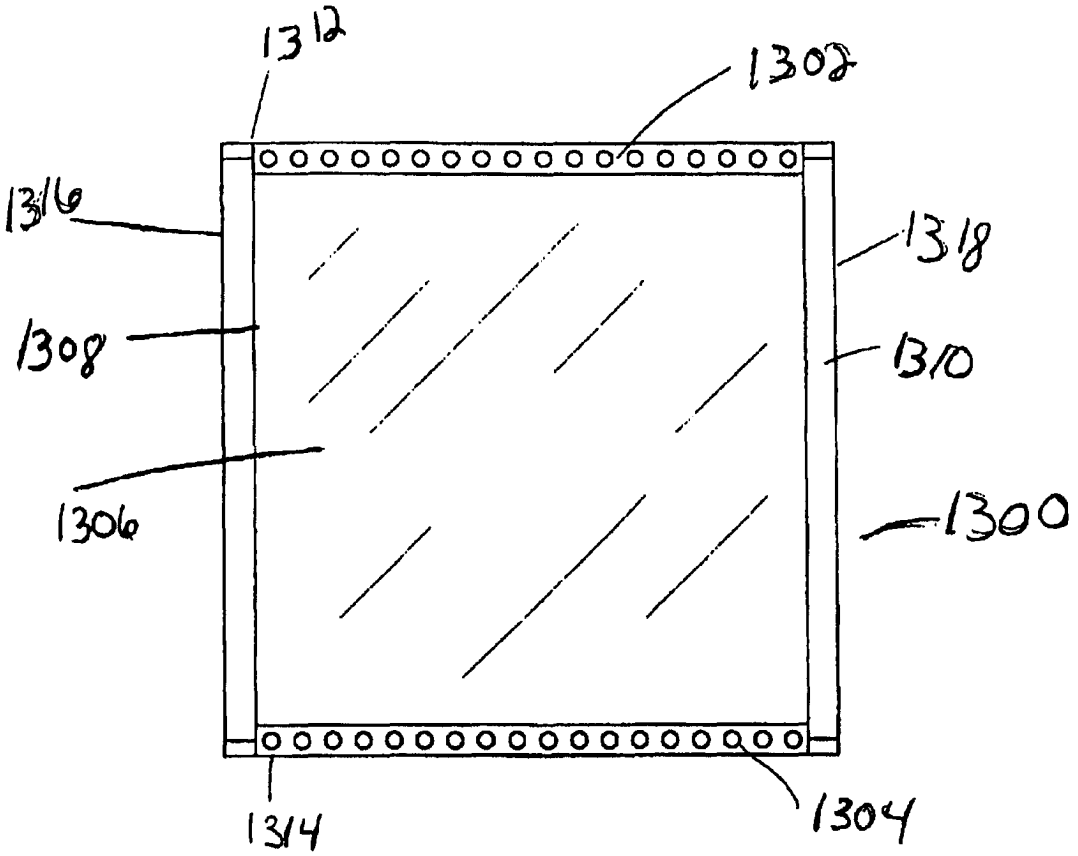


FIGURE 13

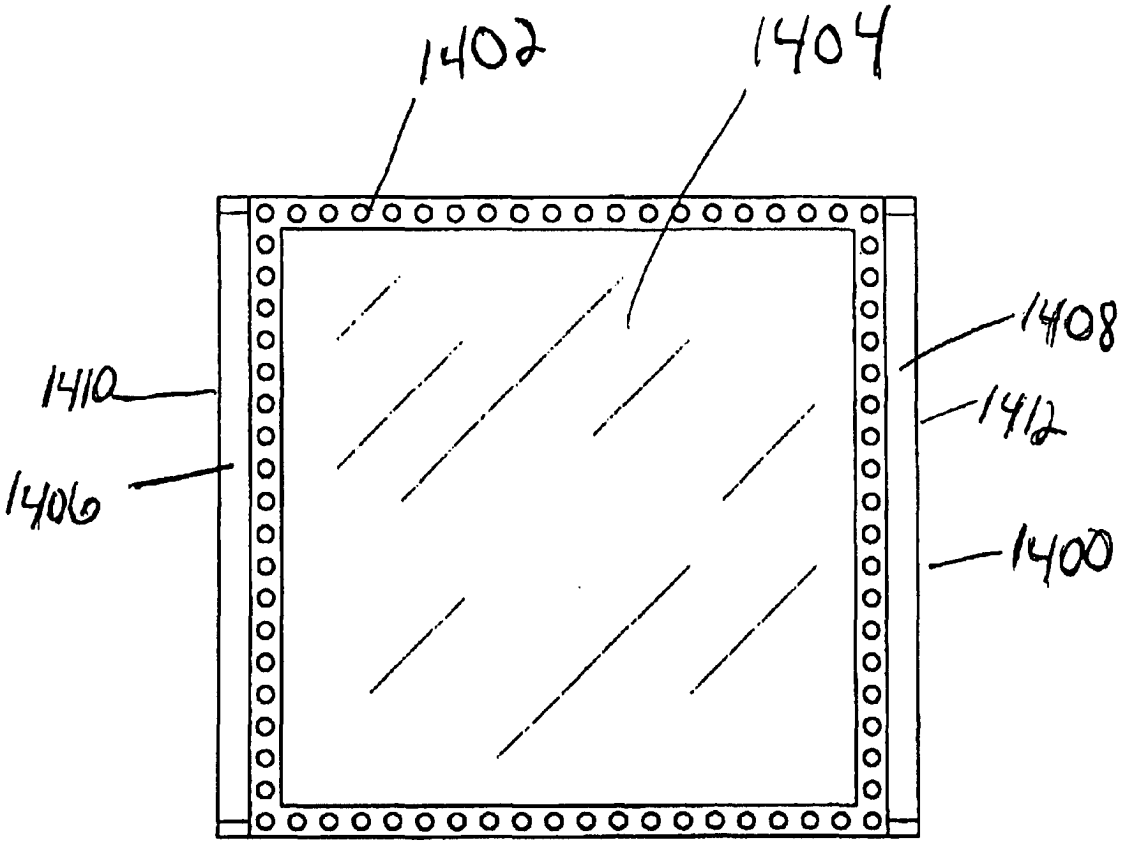


FIGURE 14

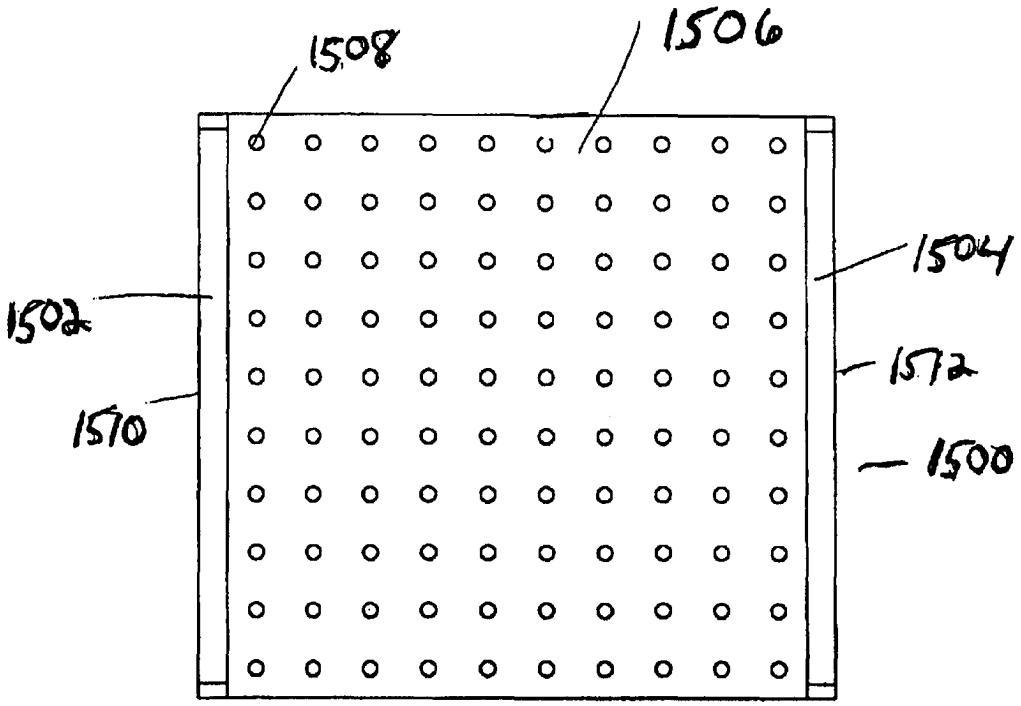


FIGURE 15

LIGHT SOURCE WITH NON-WHITE AND PHOSPHOR-BASED WHITE LED DEVICES, AND LCD ASSEMBLY

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

Notice: More than one reissue application has been filed for the reissue of U.S. Pat. No. 6,666,567. The reissue applications are application Ser. No. 11/788,399 (the present application), Ser. No. 11/788,398 (filed concurrently herewith), and Ser. No. 11/316,597, all of which are divisional reissues of U.S. Pat. No. 6,666,567.

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention generally relates to lighting systems, and more particularly, to light sources implementing light emitting diodes (LEDs).

2. Background

Many industries and applications need backlighting to illuminate an information source. In particular, transmissive liquid crystal displays (LCDs) have become very popular in many electronic media. LCDs are useful in applications such as, but not limited to, displays in avionics, laptop computers, video cameras, and automatic teller machine displays. However, many LCDs require backlighting to illuminate the information being displayed.

Many systems perform the backlighting function in conventional displays. For example, one way to backlight an information source employs an array of conventional straight tubular fluorescent lamps. While these conventional lamps are inexpensive and do not require complex electronic controls, they are sometimes inadequate for particular applications. For instance, in avionics applications, the poor color quality of the phosphors and the short lamp life of these conventional lamps, among other shortcomings, limit their usefulness.

To avoid the various problems with conventional lamps, many manufacturers employ customized lamps, such as tubular serpentine lamps. Unlike conventional fluorescent lamp arrays, custom-made serpentine lamps commonly provide good color characteristics, light luminance uniformity, and long lamp life. These lamps are typically hand made, and consequently, are comparatively costly. Moreover, these lamps. are extremely fragile and difficult to install. Therefore, while custom-made tubular serpentine lamps may meet certain standards for the backlighting function, the high cost and fragility associated with these lamps detract from the advantages they offer.

A third alternative for backlighting information sources is flat fluorescent lamps. An exemplary flat fluorescent lamp, described in U.S. Pat. No. 5,343,116, issued Aug. 30, 1994, to Winsor, comprises a substrate fritted to a transparent cover lid, forming an enclosure. Diffuse channels are formed into the substrate in the interior of the enclosure. Standard phosphors are added to the interior of the enclosure which is further flushed with a material for emitting energy, such as argon or mercury. Energy is emitted in the form of visible light when an electric potential is introduced to the lamp by two electrodes, with one electrode placed at each end of the diffuse channel. Such lamps potentially offer greater ruggedness and lower manufacturing costs than serpentine tubular lamp alternatives. However, these lamps are still costly to manufacture and are difficult to repair.

Yet another alternative for backlighting information sources implements LEDs. The use of LEDs as light sources can be advantageous for several reasons. LEDs have a long life, which reduces the frequency for replacing non-functioning diodes. Further, when it is time to replace an LED, replacement is easier and more cost effective than when replacing a fluorescent light source. Additionally, LEDs are mechanically robust, i.e., they can typically withstand greater shocks and vibration than conventional fluorescent lights. Referring now to FIGS. **1** and **2**, a conventional light source **100** incorporating LEDs comprises an optical cavity **102**, multiple LEDs **104**, a power source (not shown), and a diffuser **106** (FIG. **2**). Optical cavity **102** has a floor **108** in the interior portion of light source **100** and an exterior surface **110**.

As shown in FIG. **2**, in conventional LED light systems, the LEDs **104** are attached directly to the floor **108** of the optical cavity **102**. Referring to FIG. **3**, LED **104** typically comprises a surface mount device constructed by encasing a diode **300** near the center of a small translucent rectangular block **302**. Electrical contacts **304** and **306** at the ends of block **302** connect to the diode via a small lead frame **308**.

Conventional LED lighting systems, however, fail to perform adequately for many backlighting applications, such as avionics, in which strict display performance requirements restrict their use. For example, LEDs typically use power less efficiently than conventional fluorescent lamps to produce comparable light intensity. Further, a conventional fluorescent lamp relies on phosphors which have narrowly defined spectral emission peaks that must be carefully controlled to provide repeatable color output. Control of the phosphor mixture to produce production-quality lamps requires significant investment of time and effort to maintain a uniform mixture, produce an acceptable color point, and ensure color purity based on phosphor chemistry. Moreover, in conventional white LEDs, the spectral emission is dominated by the blue spectral emission, and thus, the resulting "white" light is heavily shifted toward the blue spectrum. This shift limits the usefulness of LED light sources in backlighting applications.

SUMMARY OF THE INVENTION

A light source according to various aspects of the present invention comprises LEDs raised above the floor of the optical cavity. The raised LEDs may optionally have a protrusion under the LED for assisting in redirecting light. In another embodiment, adjacent LEDs may be skewed relative to one another to reduce absorption and reflection among the LEDs. In a further embodiment, non-white LEDs may be incorporated into the light source to permit selective color tuning. In an alternative embodiment, a hybrid light source may be created when fluorescent lamps are augmented with LEDs. These LEDs, which may optionally be raised above the floor of the optical cavity, may also optionally have a protrusion beneath. the raised LED.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter of the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, may best be understood by reference to the following description taken in conjunction with the claims and the accompanying drawings, in which like parts may be referred to by like numerals:

FIG. **1** is plan view of a prior art light source incorporating LED technology;

FIG. **2** is a side cross-sectional view of the light source of FIG. **1**;

FIG. **3** is a perspective view of a conventional diode;

FIG. **4**. is a perspective view of an elevated diode in accordance with an exemplary embodiment of the present invention;

FIG. **5** is plan view of a light source implementing LEDs in accordance with an exemplary embodiment of the present invention;

FIG. **6** is a side cross-sectional view of the light source of FIG. **5**;

FIG. **7** is a side cross-sectional view of the light source of FIG. **5** having protrusions beneath the raised LEDs in accordance with a further embodiment of the present invention;

FIG. **8** is a plan view of a light source configuring LEDs in an orthogonal arrangement in accordance with an exemplary embodiment of the present invention;

FIG. **9** is a plan view of a light source configuring LEDs in an oblique arrangement in accordance with an exemplary embodiment of the present invention;

FIG. **10** is a plan view of a hybrid light source incorporating LEDs and tubular fluorescent lamps in accordance with an exemplary embodiment of the present invention;

FIG. **11** is a plan view of a hybrid light source incorporating LEDs and U-shaped fluorescent lamps in accordance with an exemplary embodiment of the present invention;

FIG. **12** is a plan view of a hybrid light source incorporating LEDs and a serpentine fluorescent lamp in accordance with an exemplary embodiment of the present invention; and

FIGS. **13**–**15** are plan views of further embodiments of hybrid light source configurations in accordance with various aspects of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

The ensuing descriptions are preferred exemplary embodiments only, and are not intended to limit the scope, applicability, or configuration of the invention in any way. Rather, the ensuing descriptions provide a convenient description for implementing various exemplary embodiments of light sources according to various aspects of the present invention, it being understood that various changes may be made in the function and arrangement of elements described in the preferred embodiments without departing from the spirit and scope of the invention as set forth in the appended claims.

Referring now to FIGS. **4**–**6**, a light source **500** in accordance with various aspects of the present invention implements an LED that is not flush with floor of the optical cavity. Raising LEDs **504** above the surface tends to capture rear-emitted light that is otherwise absorbed or otherwise lost, enabling the light source to emit more light without additional power. In the present embodiment, the light source **500** comprises: a housing **501** having a floor **410** and an exterior wall **503** forming an optical cavity **502**; multiple LEDs **400**; and a power source (not shown). The light source may further include a diffuser **516** (FIG. **6**). Housing **501** may be constructed of any suitable material according to the criteria of the application, such as heat exposure, mechanical shock resistance, or cost. In the present embodiment, the housing **501** comprises aluminum, steel, glass, or ceramics, and defines the optical cavity **502**. The optical cavity comprises any cavity defined in the housing in which light is to be dispersed. The floor **410** and or wall **503** may optionally be coated with a reflective material, for example, Duraflect™, expanded polytetrafluoroethylene, or any diffuse white paint such as a polyurethane paint. The floor **410** comprises any suitable base or surface for supporting the LEDs **400** or other relevant components.

The power source provides appropriate power supply and control to operate the lamp. The power source may provide power in any appropriate form, such as AC electrical current, and may control the power in any suitable manner, for example in conjunction with a voltage source with current limiting resistance, a constant current source, or a pulse width modulated current source,

LED **400** may be any LED suitable for the application, such as a phosphor-based white LED sold by Nichia Corp, Tokushima, Japan. The color, type, configuration, performance, and other characteristics may be selected according to any appropriate criteria. In the present embodiment, LED **400** includes a diode **402** encased in a translucent rectangular package **404**. The LED **400** is raised by a support system **405** such that the base of LED **400** is elevated above the floor **410** of optical cavity **502**. For example, the support system **405** suitably comprises a pair of L-brackets **406** and **408** attached to either side of the LED **400** to support the LED **400** above the floor **410**. L-brackets **406** and **408** may be affixed to floor **410** according to any suitable technique, such as by an adhesive, fastener or solder. Any support system **405** that raises the LED **400** above floor **410**, for example, by using raised, a support matrix, or the like, may be used to support the LED **400**.

The support system **405** may further connect the LED **400** to the power source. For example, in the present embodiment, the L-brackets **406** and **408** may be constructed of a suitable electrically conductive material that supports the, LED above the surface of the floor **410**, such as copper or beryllium. A lead frame **412** electrically connects the diode **402** with L-brackets **406** and **408**. L-brackets **406** and **408** are suitably connected to a printed circuit board which is connected to the power source, for example through control electronics.

In configurations where LEDs **400** are raised above floor **410**, as in FIGS. **5** and **6**, the light output of the light source may be further accomplished by providing a reflective protrusion beneath the raised LEDs **504**, further optimizing the recapture of emitted light. By placing the protrusions under the raised LEDs **504**, a greater amount of light may be redirected forward, causing a greater light output without requiring a corresponding increase in power. Referring to the exemplary embodiment of FIG. **7**, light source **700** has an optical cavity **502** above which LEDs **504** are mounted, suitably by L-brackets **512** and **514**. Protrusions **518** are located approximately below LEDs **504**. Protrusions **518** may be prepared in any suitable manner and shape, such as according to the desired application. For example, protrusions **518** may be prepared by stamping the floor **410** of the optical cavity **502** such that protrusions **518** form in the surface of the floor **410**. Alternatively, protrusions **518** may be constructed by adding materials onto floor **410**, for example, by placing droplets of an epoxy material onto floor **410** and then covering the surface of the epoxy with a reflective material. Protrusions **518** suitably have an approximately parabolic or semi-spherical shape that is convex relative to the floor **410** of optical cavity **502**. Further, protrusions **518** may alternatively be shaped to direct in a predetermined direction. This configuration may be useful in applications having a narrow range of desired viewing angles for an associated display.

In accordance with various aspects of the present invention, the light emitted by the light source may be further enhanced by arranging the LEDs in an array that reduces any absorptive or reflective effects of adjacent LEDs. For example, referring to FIG. **8**, in accordance with a further embodiment of the present invention, a light source **800** has an optical cavity **802** with a floor **804**. The longitudinal axes of a first set of LEDs are oriented in a first direction, such as horizontally **806**, and those of a second set of LEDs are oriented in a second direction, such as vertically **808**, such that they are perpendicular to one another. This orthogonal arrangement of adjacent LEDs, due to the relative placement of neighboring LEDs, tends to reduce the absorptive or reflective effect that adjacent LEDs may have on each other, permitting a greater light output without requiring an additional power input. Further, any or all of the LEDs may be mounted either directly onto floor **804**, or alternatively, may be mounted above floor **804** as described above. Additionally, protrusions, as described above in accordance with FIG. **7**, may be added to further enhance the recapture of rear-emitted light. Therefore, by skewing orientation of the LEDs relative to one another, the intensity of the light provided by the light source tends to increase without requiring a corresponding increase in power. Light output may be further enhanced by raising the LEDs above the optical cavity floor.

Several variations in the orientation of the LEDs may be implemented to enhance light output. For example, referring now to FIG. **9**, in accordance with yet another embodiment of the present invention, light source **900** has an optical cavity **902** with a floor **904**. Three sets of LEDs are oriented in three different directions, such as vertically **908** and at approximately 45° from the vertical **906**, **910**. Due to the relative placement of neighboring LEDs, this oblique configuration also tends to reduce the absorptive or reflective effects of adjacent LEDs, yielding improved output without requiring additional power. Further, in accordance with other aspects of the present invention, any or all of the LEDs may be mounted either directly onto floor **904**, or alternatively, may be mounted above floor **904** as described above. Additionally, protrusions, as described in accordance with FIG. **7**, may be added to further enhance the recapture of rear-emitted light.

A light source according to various aspects of the invention may further be configured to exhibit improved spectral characteristics. In accordance with a further embodiment of the present invention, non-white LEDs, preferably, red, green, and blue LEDs, and more preferably red and green LEDs, may be incorporated into the light source as described and constructed in FIGS. **4**–**15** to enable it to have a tunable color output. Non-white LEDs, in particular red, green and blue LEDs may be any commercially available non-white LED.

The non-white LEDs may be configured in the light source in a variety of manners, including, but not limited to, clustering the different LED types together, and by laying down each color in separate rows. Further, non-white LEDs may be randomly dispersed throughout the light source with white LEDs, and may also be used in combination with fluorescent lamps as described below. The non-white LEDs may be mounted directly on the floor of the optical cavity, or as described in detail above, or they may be elevated above the optical cavity floor, and further, they may optionally be elevated above reflective protrusions as described above.

By incorporating non-white LEDs, multiple-wavelength LED light sources are introduced into a diffuse optical cavity to allow color mixing, with the purpose of increasing the color saturation of an LED-based backlight to increase its usefulness in lighting an LCD panel. These emission spectra allow tuning of the color balance of the backlight by actively driving the LEDs or selectively enhancing particular colors to achieve a desired balance. This tunability allows one LED backlight to be used with a wide variety of LCD panels possessing different combinations of color filters. It also allows active tuning of the color balance of an LED-based light source across the color spectrum, limited only by the saturation of the individual color elements comprising the backlight.

To exploit the advantages of both LEDs and fluorescent light sources, a hybrid light source may incorporate both LEDs and fluorescent lights. Referring to FIG. **10**, in accordance with an exemplary embodiment according to various aspects of the present invention, a light source **1000** has an optical cavity **1002** containing alternating rows of tubular fluorescent lamps and LEDs. An optional reflective cavity **1028** may be added to the light source to further enhance light output. In accordance with this exemplary embodiment, six tubular fluorescent lamps **1004**, **1006**, **1008**, **1010**, **1012**, and **1014** are arranged in a parallel configuration within the optical cavity **1002**. The fluorescent lamps may be mounted in any suitable manner, for example, by using a support to mount the fluorescent lamp in optical cavity **1002**. Fluorescent lamps **1004**, **1006**, **1008**, **1010**, **1012**, and **1014** may be any commercially available tubular fluorescent lamp. These lamps may be either hot cathode or cold cathode lamps and may have a variety of shapes, including, but not limited to, straight, U-shaped (e.g., as elements **1106**, **1108**, and **1110** are illustrated in the exemplary embodiment shown in FIG. **11**), and serpentine fluorescent lamps (e.g., as element **1206** is illustrated in the exemplary embodiment shown in FIG. **12**).

LEDs may be interspersed among the fluorescent lamps in a variety of configurations in the hybrid light source. As seen in FIG. **10**, rows of LEDs **1018**, **1020**, **1022**, **1024**, and **1026** are alternated in between the fluorescent lamps **1004**, **1006**, **1008**, **1010**, **1012**, and **1014**. LEDs may be white LEDs, non-white LEDs, or may be a mixture of both white and non-white LEDs as described above. Further, the LEDs may be mounted directly to the floor **1030** of the optical cavity **1002**, or may be mounted above the optical cavity **1002** as shown in FIG. **4**, and may further be mounted over reflective protrusions as described above. Further, the LEDs may be mounted in skewed directions relative to adjacent LEDs as described in FIGS. **8** and **9**.

It should be appreciated that the present invention is not limited to the configurations described above. For example, referring to FIGS. **13**–**15**, various alternative embodiments may include an edge-lit configuration, i.e., light floods the cavity from the sides and is randomly reflected. In the edge-lit configurations, the LEDs suitably face into the cavity, and not toward the view.

Referring now to FIGS. **13** and **14**, these figures illustrate light source embodiments having the illumination sources around the perimeter of the lamp. In FIG. **13**, light source **1300** has LED rows **1302** and **1304** on opposite sides **1312** and **1314** of optical cavity **1306**. Fluorescent lamps **1308** and **1310** are also located on opposite sides **1316** and **1318** of optical cavity **1308**. In FIG. **14**, light source **1400** has LEDs **1402** around the perimeter of optical cavity **1404**. Fluorescent lamps **1406** and **1408** are on opposite side **1410** and **1412** of optical cavity **1404** The LEDs **1302**, **1304** and **1402** of FIGS. **13** and **14** may be in a variety of orientations,

including skewed relative to one another, raised from the optical cavity surface, and having a protrusion under the elevated LED. Further, a variety of LED color combinations may be implemented to permit selective color tuning

Referring now to FIGS. **13** and **14**, these figures illustrate light source embodiments having the illumination sources around the perimeter of the lamp. In FIG. **13**, light source **1300** has LED rows **1302** and **1304** on opposite sides **1312** and **1314** of optical cavity **1306**. Fluorescent lamps **1308** and **1310** are also located on opposite sides **1316** and **1318** of optical cavity **1306**. In FIG. **14**, light source **1400** has LEDs **1402** around the perimeter of optical cavity **1404**. Fluorescent lamps **1406** and **1408** are on opposite side **1410** and **1412** of optical cavity **1404**. The LEDs **1302**, **1304** and **1402** of FIGS. **13** aid **14** may be in a variety of orientations, including skewed relative to one another, raised from the optical cavity surface, and having a protrusion under the elevated LED. Further, a variety of LED color combinations may be implemented to permit selective color tuning.

It should be appreciated that in all embodiments of the present invention any number of LEDs and fluorescent lamps may be used according to the particular application or design criteria of the backlight or the display. As such, the drawing figures and the present description are only meant to illustrate exemplary embodiments in accordance with the present invention and are not intended to limit the invention to the configurations illustrated herein.

Thus, a light source incorporating LEDs and fluorescent lamps according to various aspects of the present invention provides several features and advantages, such as light output uniformity. In addition, the above descriptions are preferred exemplary embodiments only, and are not intended to be limiting in any way. Various modifications, substitutions, and other applications of the present embodiments may be made without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A light source, comprising:

an optical cavity having a floor;

at least one light emitting diode (LED) having a top and a bottom coupled to said floor such that said bottom of said at least one light emitting diode is elevated above said floor of said optical cavity; and

a reflective protrusion located below said at least one LED.

2. A light source comprising:

an optical cavity having a floor;

at least one fluorescent lamp coupled to said optical cavity; and

at least two LEDs coupled to said optical cavity, wherein adjacent said at least two LEDs are skewed at approximately 45° relative to one another.

3. A light source comprising:

an optical cavity having a floor;

at least one fluorescent lamp coupled to said optical cavity; and

at least two LEDs coupled to said optical cavity, wherein adjacent said at least two LEDs are perpendicular to one another.

4. A light source comprising:

an optical cavity having a floor;

at least one fluorescent lamp coupled to said optical cavity; and

at least one LED coupled to said optical cavity, wherein said at least one LED is coupled with said optical cavity such that said LED is elevated from said floor of said optical cavity.

5. A light source according to claim **4** further comprising a protrusion on said floor positioned beneath said elevated LED.

6. A light source comprising:

an optical cavity having a floor;

at least two fluorescent lamps coupled to said optical cavity; and

at least one LED coupled to said optical cavity, wherein two of said fluorescent lamps are located at opposing sides of said optical cavity, and said LEDs are located at intervals around substantially the perimeter of said optical cavity.

7. A method of manufacturing a light source comprising the steps of:

providing an optical cavity having a floor;

mounting at least one LED having a top and bottom in said optical cavity such that said bottom of said LED is elevated above said floor of said optical cavity; and

providing a protrusion below said at least at one LED.

8. A method of manufacturing a light source comprising the steps of:

providing an optical cavity having a floor;

mounting at least one LED having a top and bottom in said optical cavity such that said bottom of said LED is elevated above said floor of said optical cavity; and

mounting at least one fluorescent lamp in said optical cavity.

9. A light source comprising:

an optical cavity having a floor;

a plurality of fluorescent lamps coupled to said optical cavity substantially parallel to one other; and

a plurality of LEDs coupled to said optical cavity interspersed among said fluorescent lamps, wherein said plurality of LEDs are coupled to said optical cavity, said plurality of LEDs having tops and bottoms and being coupled to said optical cavity such that said bottoms of said LEDs are elevated above said floor.

10. A light source comprising:

an optical cavity;

a plurality of first light-emitting diodes each of which is a phosphor light-emitting diode that emits white light, each first light-emitting diode comprising a diode encased in a light-transmitting package;

a plurality of second light-emitting diodes each of which emits non-white light, each second light-emitting diode comprising a diode encased in a light-transmitting package;

wherein the first and second light-emitting diodes are arranged to emit light into the optical cavity such that mixing of spectral outputs from the first and second light-emitting diodes occurs in the optical cavity.

11. A light source of claim 10, further comprising at least one third light-emitting diode having a spectral output different from those of the first and second light-emitting diodes.

12. A light source of claim 11, wherein the spectral output of the second light-emitting diodes is a red output.

13. A light source of claim 11, wherein the spectral output of the third light-emitting diode is a green output.

14. A light source of claim 13, further comprising at least one fourth light-emitting diode having a blue output.

15. A liquid crystal display assembly comprising:

a backlight including:

an optical cavity;

a plurality of first light-emitting diodes each of which is a phosphor light-emitting diode that emits white light, each first light-emitting diode comprising a diode encased in a light-transmitting package;

a plurality of second light-emitting diodes each of which emits non-white light, each second light-emitting diode comprising a diode encased in a light-transmitting package;

wherein spectral outputs of the first and second light-emitting diodes are operative to tune a color balance of the backlight;

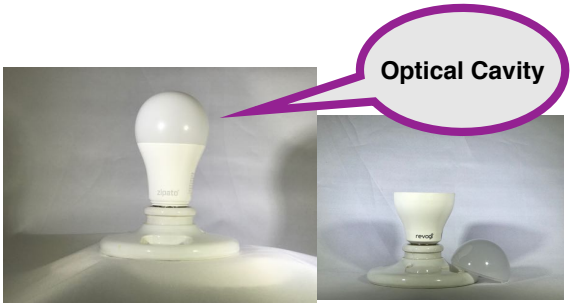
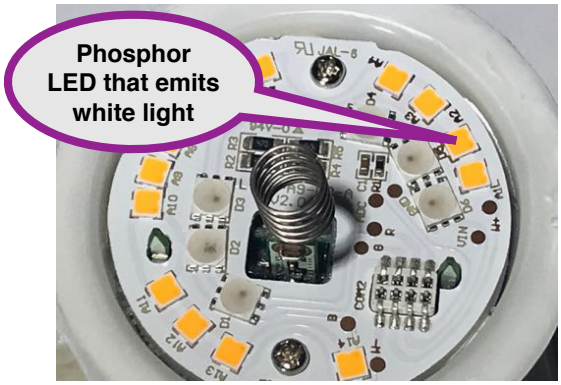
wherein the first and second light-emitting diodes are arranged to emit light into the optical cavity such that mixing of the spectral outputs from the first and second light-emitting diodes occurs in the optical cavity; and

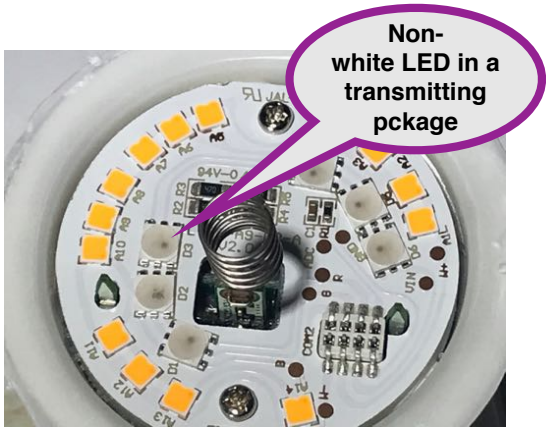
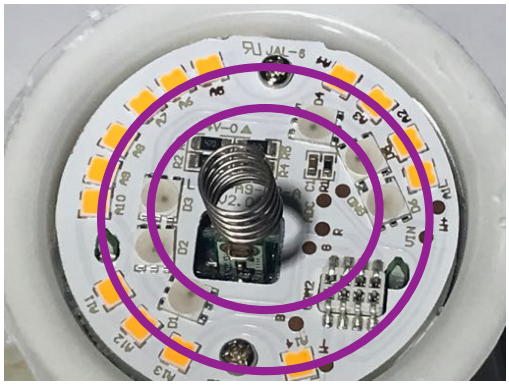
a liquid crystal display panel positioned adjacent to the backlight so as to be illuminated by the backlight.

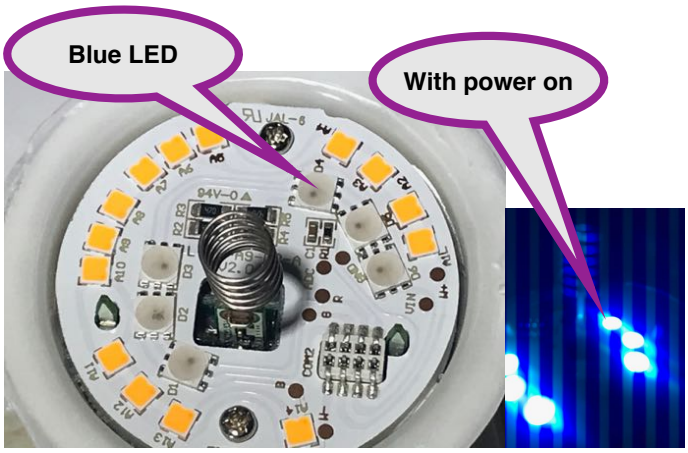
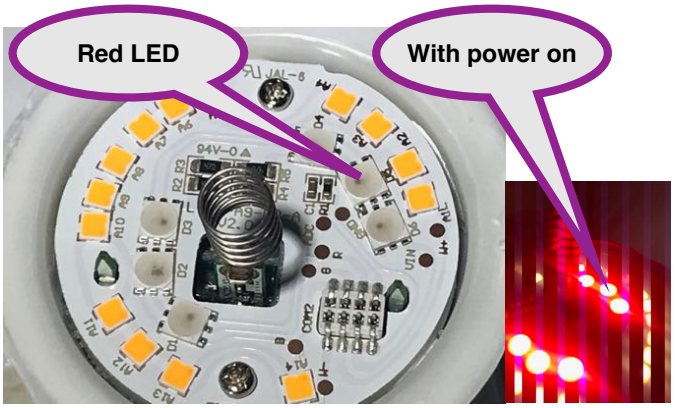
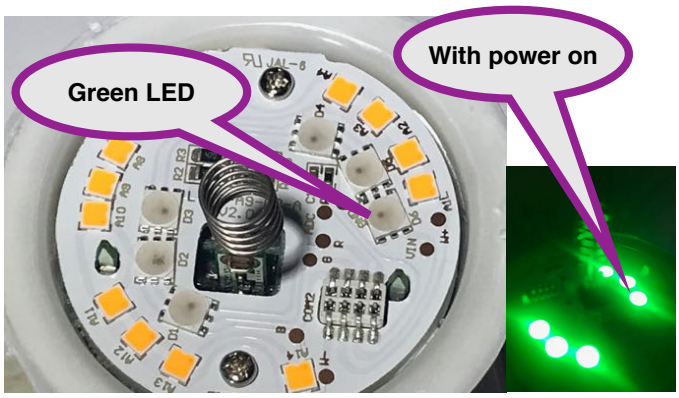
16. A liquid crystal display assembly of claim 15, further comprising at least one filter that is configured to be used with the liquid crystal display panel and the backlight.

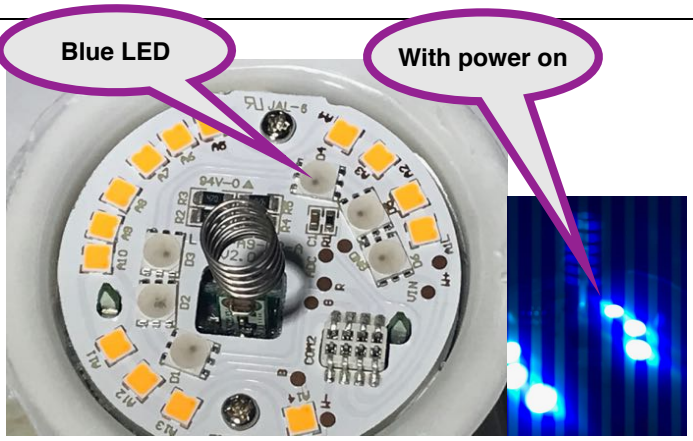
* * * * *

EXHIBIT B

US Patent US RE41,685		Zipato Z-Wave RGBW LED Light Bulb
10. A light source		The Zipato Z-Wave RGBW LED Light Bulb 2 Light Bulb is a light source.
comprising: an optical cavity;		The opaque plastic dome creates an optical cavity.
a plurality of first light-emitting diodes each of which is a phosphor light-emitting diode that emits white light,		The bulb has 14 white LEDs. Each white LED is a phosphor LED that emits white light.

each first light-emitting diode comprising a diode encased in a light-transmitting package;		Each first LED is encased in a light trasmittig package.
a plurality of second light-emitting diodes each of which emits non-white light, each second light-emitting diode comprising a diode encased in a light-transmitting package;		Each bulb has 6 non-white LEDs. Each non-white LED is encased in a light transmitting package.
wherein the first and second light-emitting diodes are arranged to emit light into the optical cavity such that mixing of spectral outputs from the first and second light-emitting diodes occurs in the optical cavity.		The white, red, green, and blue LEDs are arranged geometrically to mix the light spectral outputs within the optical cavity.

11. A light source of claim 10, further comprising at least one third light-emitting diode having a spectral output different from those of the first and second light-emitting diodes.		Each bulb has a third LED (blue) that has a specteral output different than the first (white) and second (red) LED's.
12. A light source of claim 11, wherein the spectral output of the second light-emitting diodes is a red output.		Each bulb second non-white (red) LED encased in a light transmitting package.
13. A light source of claim 11, wherein the spectral output 65 of the third light-emitting diode is a green output.		Each bulb has a third (green) LED encased in a light transmitting package.

14. A light source of claim 13, further comprising at least one fourth light-emitting diode having a blue output.		Each bulb has a fourth (blue) LED encased in a light transmitting package.

JS 44 (Rev. 06/17)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. *(SEE INSTRUCTIONS ON NEXT PAGE OF THIS FORM.)*

I. (a) PLAINTIFFS
TECHNICAL LED INTELLECTUAL PROPERTY, LLC

DEFENDANTS
HOME CONTROLS INC.

(b) County of Residence of First Listed Plaintiff New Castle County
(EXCEPT IN U.S. PLAINTIFF CASES)

County of Residence of First Listed Defendant San Diego County
(IN U.S. PLAINTIFF CASES ONLY)
NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE TRACT OF LAND INVOLVED.

(c) Attorneys *(Firm Name, Address, and Telephone Number)*
Brandon C. Fernald,
FERNALD LAW GROUP APC
510 W. 6th Street, Suite 700, Los Angeles, CA 90014, (323) 410-0300

Attorneys *(If Known)*
'19CV0144 LAB KSC

II. BASIS OF JURISDICTION *(Place an "X" in One Box Only)*

- ❒ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question *(U.S. Government Not a Party)*
- ❒ 2 U.S. Government Defendant
- ❒ 4 Diversity *(Indicate Citizenship of Parties in Item III)*

III. CITIZENSHIP OF PRINCIPAL PARTIES *(Place an "X" in One Box for Plaintiff and One Box for Defendant)*
(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	❒ 1	❒ 1	Incorporated *or* Principal Place of Business In This State	❒ 4	❒ 4
Citizen of Another State	❒ 2	❒ 2	Incorporated *and* Principal Place of Business In Another State	❒ 5	❒ 5
Citizen or Subject of a Foreign Country	❒ 3	❒ 3	Foreign Nation	❒ 6	❒ 6

IV. NATURE OF SUIT *(Place an "X" in One Box Only)*
Click here for: Nature of Suit Code Descriptions.

CONTRACT
- ❒ 110 Insurance
- ❒ 120 Marine
- ❒ 130 Miller Act
- ❒ 140 Negotiable Instrument
- ❒ 150 Recovery of Overpayment & Enforcement of Judgment
- ❒ 151 Medicare Act
- ❒ 152 Recovery of Defaulted Student Loans (Excludes Veterans)
- ❒ 153 Recovery of Overpayment of Veteran's Benefits
- ❒ 160 Stockholders' Suits
- ❒ 190 Other Contract
- ❒ 195 Contract Product Liability
- ❒ 196 Franchise

REAL PROPERTY
- ❒ 210 Land Condemnation
- ❒ 220 Foreclosure
- ❒ 230 Rent Lease & Ejectment
- ❒ 240 Torts to Land
- ❒ 245 Tort Product Liability
- ❒ 290 All Other Real Property

TORTS

PERSONAL INJURY
- ❒ 310 Airplane
- ❒ 315 Airplane Product Liability
- ❒ 320 Assault, Libel & Slander
- ❒ 330 Federal Employers' Liability
- ❒ 340 Marine
- ❒ 345 Marine Product Liability
- ❒ 350 Motor Vehicle
- ❒ 355 Motor Vehicle Product Liability
- ❒ 360 Other Personal Injury
- ❒ 362 Personal Injury - Medical Malpractice

PERSONAL INJURY
- ❒ 365 Personal Injury - Product Liability
- ❒ 367 Health Care/ Pharmaceutical Personal Injury Product Liability
- ❒ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- ❒ 370 Other Fraud
- ❒ 371 Truth in Lending
- ❒ 380 Other Personal Property Damage
- ❒ 385 Property Damage Product Liability

CIVIL RIGHTS
- ❒ 440 Other Civil Rights
- ❒ 441 Voting
- ❒ 442 Employment
- ❒ 443 Housing/ Accommodations
- ❒ 445 Amer. w/Disabilities - Employment
- ❒ 446 Amer. w/Disabilities - Other
- ❒ 448 Education

PRISONER PETITIONS

Habeas Corpus:
- ❒ 463 Alien Detainee
- ❒ 510 Motions to Vacate Sentence
- ❒ 530 General
- ❒ 535 Death Penalty

Other:
- ❒ 540 Mandamus & Other
- ❒ 550 Civil Rights
- ❒ 555 Prison Condition
- ❒ 560 Civil Detainee - Conditions of Confinement

FORFEITURE/PENALTY
- ❒ 625 Drug Related Seizure of Property 21 USC 881
- ❒ 690 Other

LABOR
- ❒ 710 Fair Labor Standards Act
- ❒ 720 Labor/Management Relations
- ❒ 740 Railway Labor Act
- ❒ 751 Family and Medical Leave Act
- ❒ 790 Other Labor Litigation
- ❒ 791 Employee Retirement Income Security Act

IMMIGRATION
- ❒ 462 Naturalization Application
- ❒ 465 Other Immigration Actions

BANKRUPTCY
- ❒ 422 Appeal 28 USC 158
- ❒ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
- ❒ 820 Copyrights
- ☒ 830 Patent
- ❒ 835 Patent - Abbreviated New Drug Application
- ❒ 840 Trademark

SOCIAL SECURITY
- ❒ 861 HIA (1395ff)
- ❒ 862 Black Lung (923)
- ❒ 863 DIWC/DIWW (405(g))
- ❒ 864 SSID Title XVI
- ❒ 865 RSI (405(g))

FEDERAL TAX SUITS
- ❒ 870 Taxes (U.S. Plaintiff or Defendant)
- ❒ 871 IRS—Third Party 26 USC 7609

OTHER STATUTES
- ❒ 375 False Claims Act
- ❒ 376 Qui Tam (31 USC 3729(a))
- ❒ 400 State Reapportionment
- ❒ 410 Antitrust
- ❒ 430 Banks and Banking
- ❒ 450 Commerce
- ❒ 460 Deportation
- ❒ 470 Racketeer Influenced and Corrupt Organizations
- ❒ 480 Consumer Credit
- ❒ 490 Cable/Sat TV
- ❒ 850 Securities/Commodities/ Exchange
- ❒ 890 Other Statutory Actions
- ❒ 891 Agricultural Acts
- ❒ 893 Environmental Matters
- ❒ 895 Freedom of Information Act
- ❒ 896 Arbitration
- ❒ 899 Administrative Procedure Act/Review or Appeal of Agency Decision
- ❒ 950 Constitutionality of State Statutes

V. ORIGIN *(Place an "X" in One Box Only)*

☒ 1 Original Proceeding ❒ 2 Removed from State Court ❒ 3 Remanded from Appellate Court ❒ 4 Reinstated or Reopened ❒ 5 Transferred from Another District *(specify)* ❒ 6 Multidistrict Litigation - Transfer ❒ 8 Multidistrict Litigation - Direct File

VI. CAUSE OF ACTION
Cite the U.S. Civil Statute under which you are filing ***(Do not cite jurisdictional statutes unless diversity)***:
35 U.S.C. § 271
Brief description of cause:
Infringement of U.S. Patent No. RE41,685

VII. REQUESTED IN COMPLAINT:
❒ CHECK IF THIS IS A **CLASS ACTION** UNDER RULE 23, F.R.Cv.P.
DEMAND $
CHECK YES only if demanded in complaint:
JURY DEMAND: ☒ Yes ❒ No

VIII. RELATED CASE(S) IF ANY *(See instructions)*:
JUDGE _____ DOCKET NUMBER _____

DATE
01/22/2019

SIGNATURE OF ATTORNEY OF RECORD
/s/ BCF

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RECEIPT # _____ AMOUNT _____ APPLYING IFP _____ JUDGE _____ MAG. JUDGE _____

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INSTRUCTIONS FOR ATTORNEYS COMPLETING CIVIL COVER SHEET FORM JS 44

Authority For Civil Cover Sheet

The JS 44 civil cover sheet and the information contained herein neither replaces nor supplements the filings and service of pleading or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. Consequently, a civil cover sheet is submitted to the Clerk of Court for each civil complaint filed. The attorney filing a case should complete the form as follows:

I.(a) **Plaintiffs-Defendants.** Enter names (last, first, middle initial) of plaintiff and defendant. If the plaintiff or defendant is a government agency, use only the full name or standard abbreviations. If the plaintiff or defendant is an official within a government agency, identify first the agency and then the official, giving both name and title.

(b) **County of Residence.** For each civil case filed, except U.S. plaintiff cases, enter the name of the county where the first listed plaintiff resides at the time of filing. In U.S. plaintiff cases, enter the name of the county in which the first listed defendant resides at the time of filing. (NOTE: In land condemnation cases, the county of residence of the "defendant" is the location of the tract of land involved.)

(c) **Attorneys.** Enter the firm name, address, telephone number, and attorney of record. If there are several attorneys, list them on an attachment, noting in this section "(see attachment)".

II. **Jurisdiction.** The basis of jurisdiction is set forth under Rule 8(a), F.R.Cv.P., which requires that jurisdictions be shown in pleadings. Place an "X" in one of the boxes. If there is more than one basis of jurisdiction, precedence is given in the order shown below.
United States plaintiff. (1) Jurisdiction based on 28 U.S.C. 1345 and 1348. Suits by agencies and officers of the United States are included here.
United States defendant. (2) When the plaintiff is suing the United States, its officers or agencies, place an "X" in this box.
Federal question. (3) This refers to suits under 28 U.S.C. 1331, where jurisdiction arises under the Constitution of the United States, an amendment to the Constitution, an act of Congress or a treaty of the United States. In cases where the U.S. is a party, the U.S. plaintiff or defendant code takes precedence, and box 1 or 2 should be marked.
Diversity of citizenship. (4) This refers to suits under 28 U.S.C. 1332, where parties are citizens of different states. When Box 4 is checked, the citizenship of the different parties must be checked. (See Section III below**; NOTE: federal question actions take precedence over diversity cases.**)

III. **Residence (citizenship) of Principal Parties.** This section of the JS 44 is to be completed if diversity of citizenship was indicated above. Mark this section for each principal party.

IV. **Nature of Suit.** Place an "X" in the appropriate box. If there are multiple nature of suit codes associated with the case, pick the nature of suit code that is most applicable. Click here for: Nature of Suit Code Descriptions.

V. **Origin.** Place an "X" in one of the seven boxes.
Original Proceedings. (1) Cases which originate in the United States district courts.
Removed from State Court. (2) Proceedings initiated in state courts may be removed to the district courts under Title 28 U.S.C., Section 1441. When the petition for removal is granted, check this box.
Remanded from Appellate Court. (3) Check this box for cases remanded to the district court for further action. Use the date of remand as the filing date.
Reinstated or Reopened. (4) Check this box for cases reinstated or reopened in the district court. Use the reopening date as the filing date.
Transferred from Another District. (5) For cases transferred under Title 28 U.S.C. Section 1404(a). Do not use this for within district transfers or multidistrict litigation transfers.
Multidistrict Litigation – Transfer. (6) Check this box when a multidistrict case is transferred into the district under authority of Title 28 U.S.C. Section 1407.
Multidistrict Litigation – Direct File. (8) Check this box when a multidistrict case is filed in the same district as the Master MDL docket.
PLEASE NOTE THAT THERE IS NOT AN ORIGIN CODE 7. Origin Code 7 was used for historical records and is no longer relevant due to changes in statue.

VI. **Cause of Action.** Report the civil statute directly related to the cause of action and give a brief description of the cause. **Do not cite jurisdictional statutes unless diversity.** Example: U.S. Civil Statute: 47 USC 553 Brief Description: Unauthorized reception of cable service

VII. **Requested in Complaint.** Class Action. Place an "X" in this box if you are filing a class action under Rule 23, F.R.Cv.P.
Demand. In this space enter the actual dollar amount being demanded or indicate other demand, such as a preliminary injunction.
Jury Demand. Check the appropriate box to indicate whether or not a jury is being demanded.

VIII. **Related Cases.** This section of the JS 44 is used to reference related pending cases, if any. If there are related pending cases, insert the docket numbers and the corresponding judge names for such cases.

Date and Attorney Signature. Date and sign the civil cover sheet.