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(54) **REMOTELY DISTRIBUTED POWER NETWORK FOR AN LED LIGHTING SYSTEM**

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CPC ***H05B 37/02*** (2013.01)

(58) **Field of Classification Search**
CPC H05B 37/02; H05B 37/034; H05B 39/04; H05B 39/086; H05B 41/26; H05B 41/036
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See application file for complete search history.

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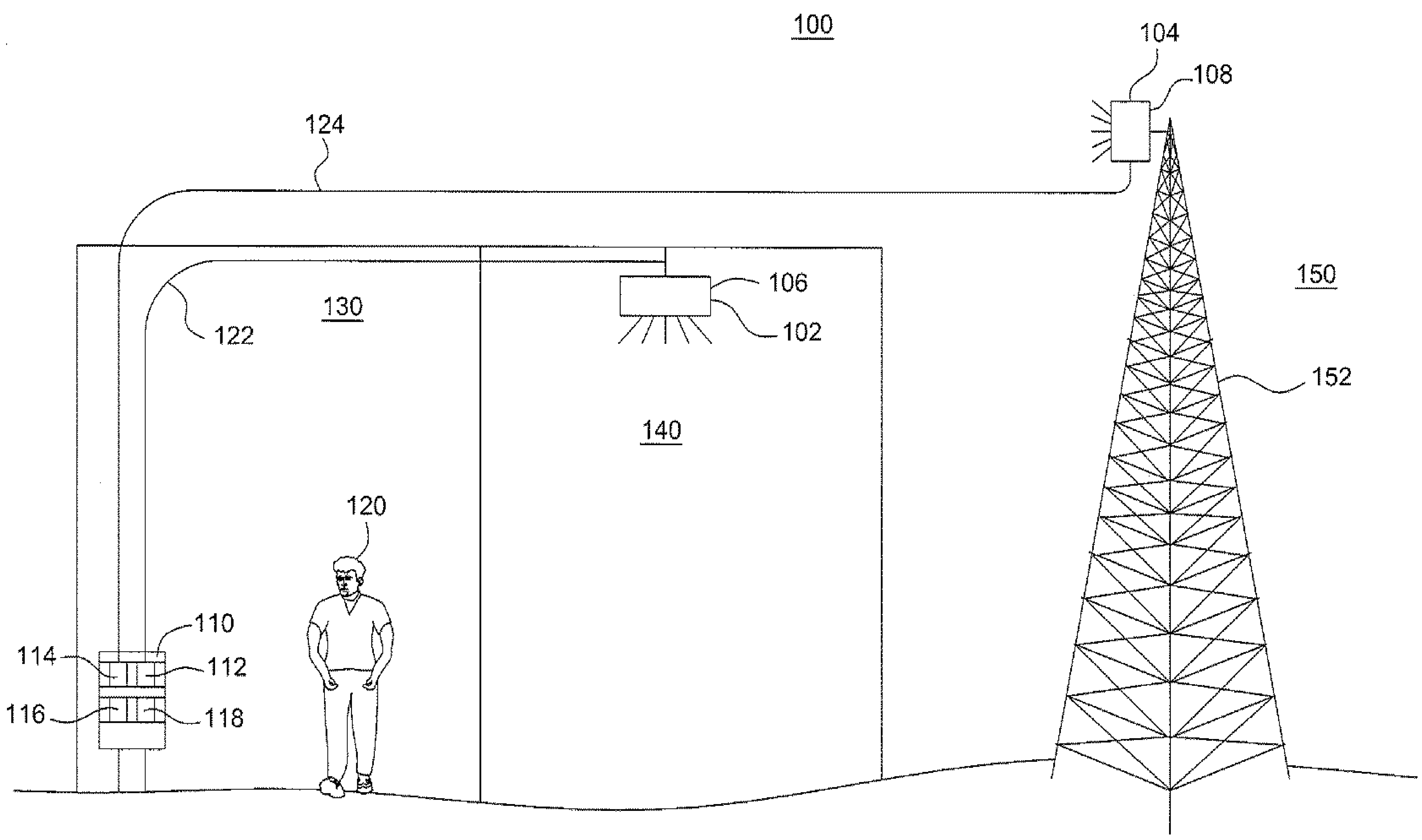
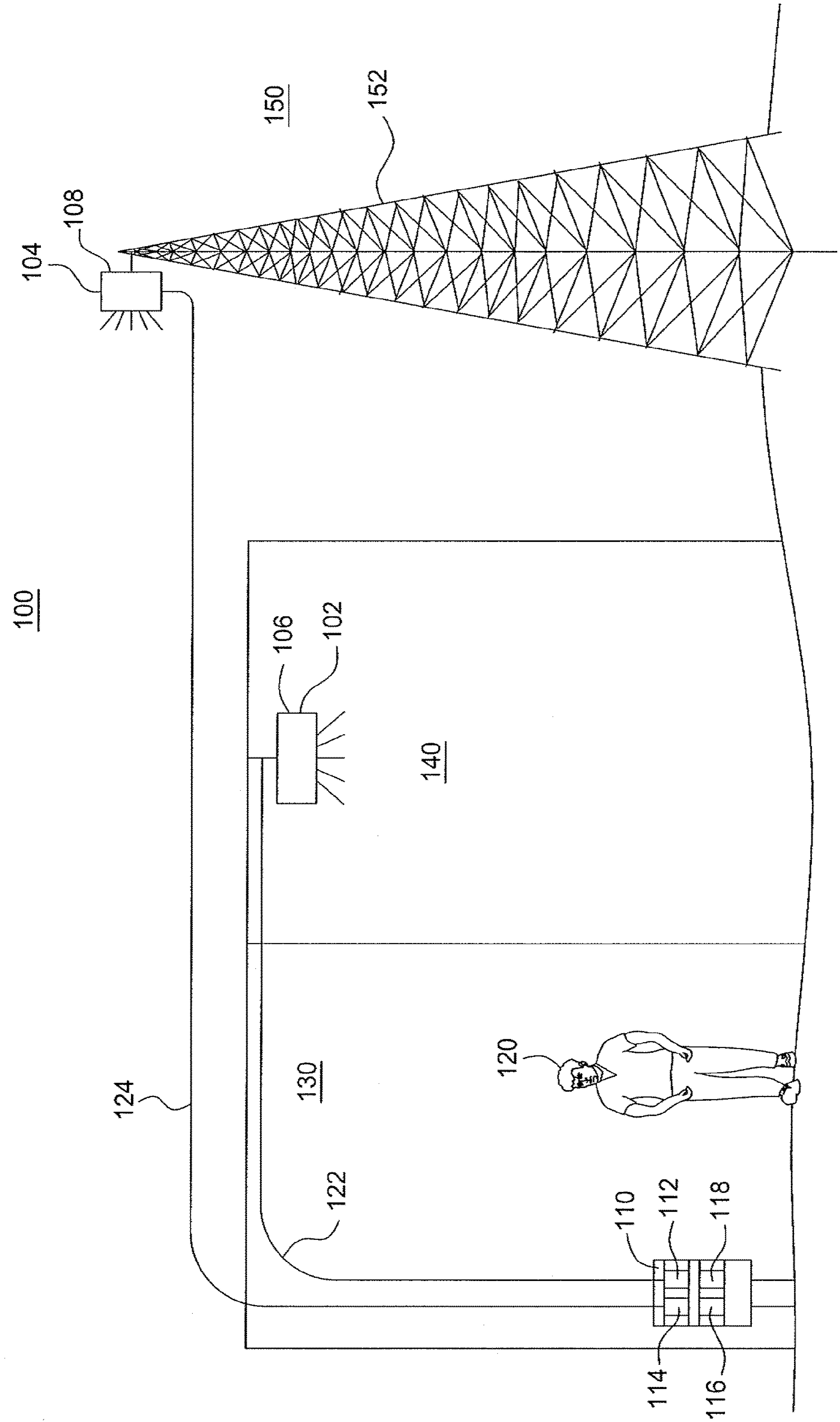
(57) **ABSTRACT**

The present disclosure is directed to a light emitting diode (LED) lighting system. In one embodiment, the LED lighting system includes an LED light source deployed in a first location and a power supply for powering the LED light source, wherein the power supply is remotely located from the LED light source in a second location and designed to power the LED light source to minimize a power loss along a length of an electrical connection coupled between the LED light source and the power supply.

9 Claims, 1 Drawing Sheet

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REMOTELY DISTRIBUTED POWER NETWORK FOR AN LED LIGHTING SYSTEM

BACKGROUND

A typical light fixture has a power supply located within the same housing as the light fixture's optics. However, with newer light fixture technologies, the light source may have a longer life span than the power supply. The power supply may need to be replaced several times over the course of the light fixture's life span.

The maintenance required for the light fixture becomes a problem when they are located in hazardous environments or in hard to reach locations such as, for example, towers or high poles. Each time a light fixture must be replaced requires the cost of multiple people and equipment, such as a service lift. In addition, further costs are incurred if production must be halted near the area where the power supply in the light fixture is being replaced.

SUMMARY

In one embodiment, the present disclosure provides an LED lighting system. In one embodiment, the LED lighting system includes an LED light source deployed in a first location and a power supply for powering the LED light source, wherein the power supply is remotely located from the LED light source in a second location and designed to power the LED light source to minimize a power loss along a length of an electrical connection coupled between the LED light source and the power supply.

In one embodiment, the present disclosure provides another embodiment of an LED lighting system. In one embodiment, the LED lighting system includes a plurality of independently controlled LED light sources deployed in one or more locations and a plurality of power supplies, wherein each one of the plurality of power supplies is for powering one of the plurality of independently controlled LED light sources, wherein the plurality of power supplies are remotely located from the plurality of independently controlled LED light sources in a different location than the one or more locations and designed to power the plurality of independently controlled LED light sources to minimize a power loss along a length of an electrical connection coupled between a respective one of the independently controlled LED light sources and a corresponding one of the plurality of power supplies.

In one embodiment, the present disclosure provides a distributed power network for an LED lighting system. In one embodiment, the distributed power network for an LED lighting system includes a power rack located on a ground level at a first location, one or more power supplies coupled to the power rack via one or more respective electrical connections in the power rack and at least one LED light source located remotely from the power rack in a second location and coupled to the one or more respective electrical connections.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this disclosure and are therefore not to be considered limiting of its scope, for the disclosure may admit to other equally effective embodiments.

FIG. **1** depicts a high level block diagram of a remotely distributed power network for an LED lighting system.

DETAILED DESCRIPTION

As discussed above, a typical light fixture has a power supply located within the same housing as the light fixture's optics. However, with newer light emitting diode (LED) light source technologies, the LED light source may have a longer life span than the power supply. The power supply may fail multiple times over the life span of the light fixture before the LED light source fails.

The maintenance required for the light fixture becomes a problem when they are located in hazardous environments or in hard to reach locations such as, for example, towers or high poles. Each time a light fixture must be replaced requires the cost of multiple people and equipment such as a service lift or a scaffolding.

Further costs are incurred if production must be halted near the area where the power supply is being replaced. For example, the area must be shut down such that maintenance personal may work on the light fixture with the failed power supply.

In addition, each time a housing of the light fixture is opened there is a potential for damaging other components within the light fixture. In addition, if the light fixture is in a hazardous or industrial environment, opening the light fixture may also lead to possible exposure of sparks or ignition in the hazardous environment.

Therefore, in one embodiment of the disclosure, an LED light system is disclosed that has a remotely located power supply. FIG. **1** illustrates a high level block diagram of a remotely distributed power network for an LED lighting system **100**. The remotely distributed power network for an LED lighting system **100** may include different locations **130**, **140** and **150**. Although three different locations are illustrated by example, the remotely distributed power network for an LED lighting system **100** may have any number of different locations.

In one embodiment, one of the locations, for example, location **130** may include a power supply rack **110** that is located on a ground level of the location **130**. The power supply rack **110** may include one or more power supplies **112**, **114**, **116** and **118**. Although four power supplies are illustrated in FIG. **1**, it should be noted that the power supply rack **110** may be any size to accommodate any number of power supplies as required by an application or deployment of the remotely distributed power network for an LED lighting system **100**.

In one embodiment, the one or more power supplies **112**, **114**, **116** and **118** may each be a plug and play power supply. In other words, the one or more power supplies **112**, **114**, **116** and **118** may be "hot-swappable" during operation of an LED light source. The one or more power supplies **112**, **114**, **116** and **118** may each be electrically connected to the power supply rack **110** via any connection suitable for a plug-and-play connection, e.g., a pin connector of any number of pins.

In one embodiment, the power supply rack **110** may be located on a ground level such that a maintenance personnel **120** may easily remove and insert the one or more power supplies **112**, **114**, **116** and **118** into the power supply rack **110**. In other words, to replace a power supply in a light fixture, the maintenance personnel **120** is no longer required to shut down part of the manufacturing floor, use equipment (e.g., a lift), or require multiple maintenance personnel **120**. Rather, the maintenance personnel **120** may simply go to the power supply rack **110** on the ground level at location **130** to remove the failed power supply and replace it with a functioning power supply.

In one embodiment, the one or more power supplies **112**, **114**, **116** and **118** may be electrically connected to one or more LED light sources **102** and **104** located in locations **140** and **150**, respectively, via electrical connections **122** and **124**, respectively. In one embodiment, the electrical connections **122** and **124** may be made via a electric cable or electric wire. In one embodiment, the location **140** may be an indoor environment such as a manufacturing plant, a warehouse, a mine, and the like. In one embodiment, the location **150** may be an outdoor environment such as a tower or an antennae located outside.

In one embodiment, the LED light sources **102** and **104** may include various electrical components that are not shown, for example, resistors, capacitors, printed circuit boards, optics, reflectors, LED chips or die, and the like. Although FIG. **1** illustrates each location **140** and **150** only having one LED light source **102** and **104**, respectively, it should be noted that each location **140** and **150** may have any number of LED light sources.

The one or more power supplies **112**, **114**, **116** and **118** may provide direct current (DC) to the one or more LED light sources **102** and **104**. In one embodiment, the power may be a low voltage DC. For example, the power supply may provide less than 150 Watts (W) of power. The low voltage DC also provides a safer operating environment for the maintenance personnel **120**.

In one embodiment, each one of the LED light sources **102** and **104** may be associated with one power supply, e.g., the power supply **112** for the LED light source **102** and the power supply **114** for the LED light source **104**. As a result, each one of the LED light sources **102** and **104** may be independently controlled via a respective one of the one or more power supplies **112**, **114**, **116** and **118**. Alternatively, a group of LED light sources may be powered by a single power supply **112**, **114**, **116** or **118**.

Notably, the one or more power supplies **112**, **114**, **116** and **118** are each located remotely from the LED light sources **102** and **104**. In other words, the LED light sources **102** and **104** each have a housing **106** and **108**, respectively, that completely encloses an LED die of the LED light sources **102** and **104**. The one or more power supplies **112**, **114**, **116** and **118** are located external to the housing **106** and **108** of the LED light sources **102** and **104**. This advantageously allows the power supply to be replaced without having to open the housing **106** and **108**. Thus, possible damage to electronics of the LED light sources **102** and **104** inside of the housing **106** and **108**, respectively, is minimized.

In one embodiment, the locations **140** and **150** are at different locations than the location **130**. Notably, the one or more power supplies **112**, **114**, **116** and **118** are located at the same location **130** on the ground level. The LED light sources **102** and **104** are located in different remote locations at a level higher than or lower than the ground level. For example, the LED light source **102** may be located above ground on a high warehouse ceiling of location **140** or below ground in a mine that is not easily accessible. The LED light source **104** may be located outdoors on a tower **152** hundreds of feet above ground level.

If a power supply were to be located within the housing **106** and **108** of the LED light sources **102** and **104**, respectively, and fail, the maintenance personnel **120** would be required to go out to the location **140** and **150** and use special equipment to replace the power supply. However, using the embodiments of the present disclosure, the maintenance personnel **120** may replace the power supplies (e.g., the power supplies **112** and **114**) for the LED light sources **102** and **104** in a single power supply rack **110** at the location **130**. In other words, a single maintenance personnel **120** may replace power supplies for two remotely located LED light sources **102** and **104** without having to leave the location **130**. As a result, substantial costs savings may be achieved by reducing the number of needed maintenance personnel, costs associated with sending personnel out to locations **140** and **150** and using equipment needed to reach the LED light sources **102** and **104** that are at a level above the ground.

Another advantage of having the one or more power supplies **112**, **114**, **116** and **118** remotely located from the LED light sources **102** and **104** is that the overall heat load is significantly reduced. In other words, the power supplies **112**, **114**, **116** and **118** will operate cooler due to being removed away from heat generated by the LED light sources **102** and **104** that directly affects the longevity of the power supplies **112**, **114**, **116** and **118**. As a result, the life span of the LED light sources **102** and **104** is also increased. For example, the life span of the LED light sources **102** and **104** may be increased by 30%-50%.

One possible drawback of having the one or more power supplies **112**, **114**, **116** and **118** remotely located form the LED light sources **102** and **104** is that there may be a loss of power over a distance of the electrical connections **122** and **124**. However, to resolve this issue, the one or more power supplies **112**, **114**, **116** and **118** may be designed specifically for the LED light sources **102** and **104** such that there is no loss or minimal loss (e.g., less than 10% loss of power) along the distance of the electrical connections **122** and **124**. Said another way, the power supplies of the present disclosure are designed to power the LED light sources **102** and **104** at a same voltage as an LED light source having a co-located power supply. For example, the power supply may be designed to be more efficient than a typical off the shelf power supply to ensure that the same voltage is delivered to the LED light sources **102** and **104**. A typical off the shelf power supply may have an 80% efficiency, but the power supplies **112**, **114**, **116** and **118** may have an efficiency of greater than 90%. In addition, the one or more power supplies **112**, **114**, **116** and **118** are designed to operate at a constant current to further minimize potential voltage drops along the distance of the electrical connections **122** and **124**. The design of the one or more power supplies **112**, **114**, **116** and **118** may be configured to be a function of the distance of the electrical connections **122** and **124** and specific operating parameters of the LED light sources **102** and **104**.

In other words, any off-the-shelf power supply cannot be used with the remotely located LED light sources **102** and **104** to maintain a similar voltage requirement as those LED light sources having a power supply inside of the housing. For example, off-the-shelf power supplies may operate at 85% efficiency and require the output voltage to increase from 150 Volts (V) to 200 V to compensate for the power loss along a length of an electrical connection. Thus, the value proposition may be lost due to the significant increase in the voltage requirement needed to drive the LED light source.

As a result, the remotely distributed power network for an LED lighting system **100** provides a more efficient way to operate LED light sources. By improving the ease to which failed power supplies may be replaced, the overall costs associated with maintaining and operating the LED light sources is significantly reduced.

While various embodiments have been described above, it should be understood that they have been presented by way of example only, and not limitation. Thus, the breadth and scope of a preferred embodiment should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

The invention claimed is:

1. A light emitting diode (LED) lighting system, comprising:

a first LED light source deployed in a first location in an indoor environment;

a second LED light source deployed in a second location, wherein the first location is different from the second location in an outdoor environment;

a first plug and play power supply for powering the first LED light source; and

a second plug and play power supply for powering the second LED light source, wherein the first plug and play power supply and the second plug and play power supply are located together in a power supply rack at a third location that is remotely located from the first LED light source and the second LED light source, wherein the first plug and play power supply and the second plug and play power supply are each designed to power the respective LED light source to minimize a power loss along a length of an electrical connection coupled to a respective LED light source and to provide a low voltage direct current (DC).

2. The LED lighting system of claim **1**, wherein the first plug and play power supply and the second plug and play power supply operate at a constant current.

3. The LED lighting system of claim **1**, wherein the first plug and play power supply is external to a first housing enclosing the first LED light source and the second plug and play power supply is external to a second housing enclosing the second LED light source.

4. The LED lighting system of claim **1**, wherein the third location comprises a ground level and the first location and the second location comprise a level higher than the ground level.

5. The LED lighting system of claim **1**, wherein the third location comprises a ground level and the second location comprises a level lower than the ground level.

6. A light emitting diode (LED) lighting system, comprising:

a plurality of independently controlled LED light sources deployed in two different locations, wherein a first one of the two different locations comprises an indoor environment and a second one of the two different locations comprises an outdoor environment;

a plurality of plug and play power supplies, wherein each one of the plurality of plug and play power supplies is for powering one of the plurality of independently controlled LED light sources, wherein the plurality of plug and play power supplies is located together in a single power supply rack located remotely from the plurality of independently controlled LED light sources in a different location than the two different locations and designed to power the plurality of independently controlled LED light sources to minimize a power loss along a length of an electrical connection coupled between a respective one of the independently controlled LED light sources and a corresponding one of the plurality of plug and play power supplies and to provide a low voltage direct current (DC).

7. The LED lighting system of claim **6**, wherein the different location comprises a ground level and the two different locations comprise a level higher than the ground level.

8. The LED lighting system of claim **6**, wherein the different location comprises a ground level and the second one of the two different locations comprise a level lower than the ground level.

9. The LED lighting system of claim **6**, wherein each one of the one or more plug and play power supplies is external to a housing of each one of the plurality of independently controlled LED light sources.

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