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(54) **HEAT DISSIPATION DEVICE FOR LED CHIPS**

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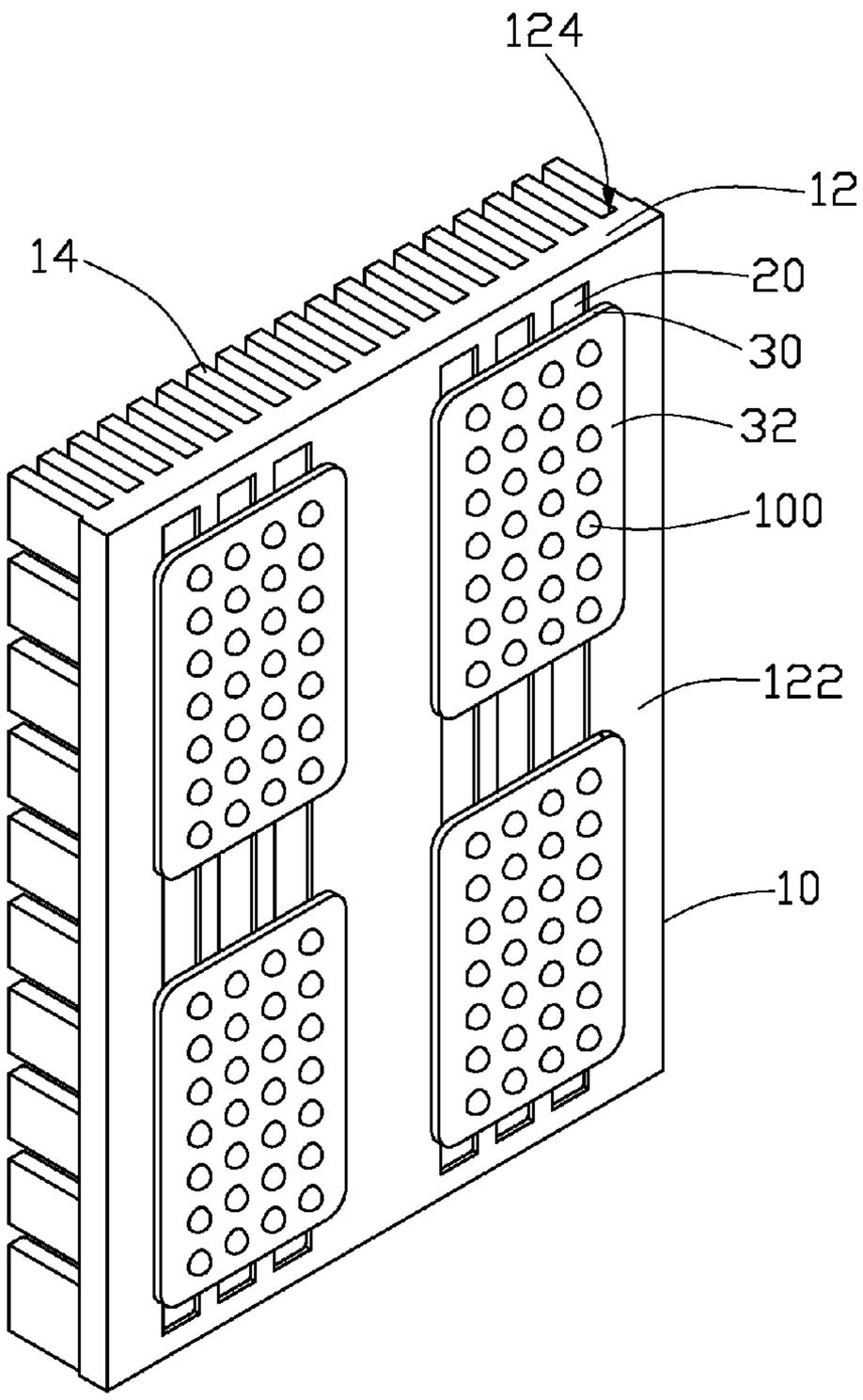
(57) **ABSTRACT**

A heat dissipation device for removing heat from LED chips includes a finned heat sink, a plurality of heat pipes and a plurality of heat conductive substrates. The heat sink comprises a base plate and a plurality of fins formed on the base plate. The heat pipes which transfer heat in a unidirectional manner are embedded in the base plate. Each of the heat pipes defines a first wall and a second wall coupled to the heat sink. The heat pipes only transfer heat from the first walls to the second walls and restrict a heat transfer in a reversed direction. The substrates are in contact with first walls of the heat pipes. The LED chips are mounted on the substrates. When the LED chips generate heat, the heat is transferred to the fins via the unidirectional heat pipes to lower the temperature of the LED chips.



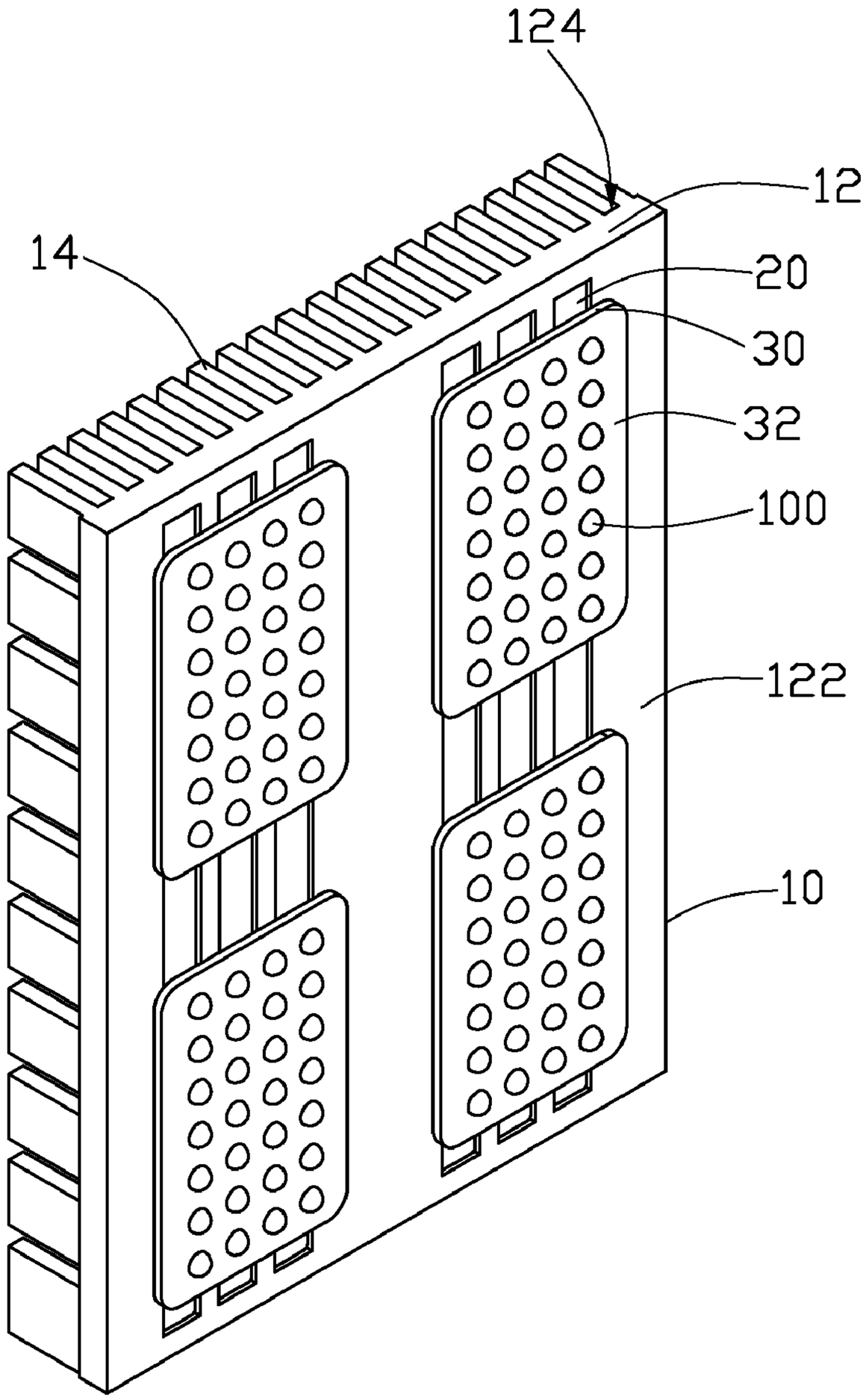


FIG. 1

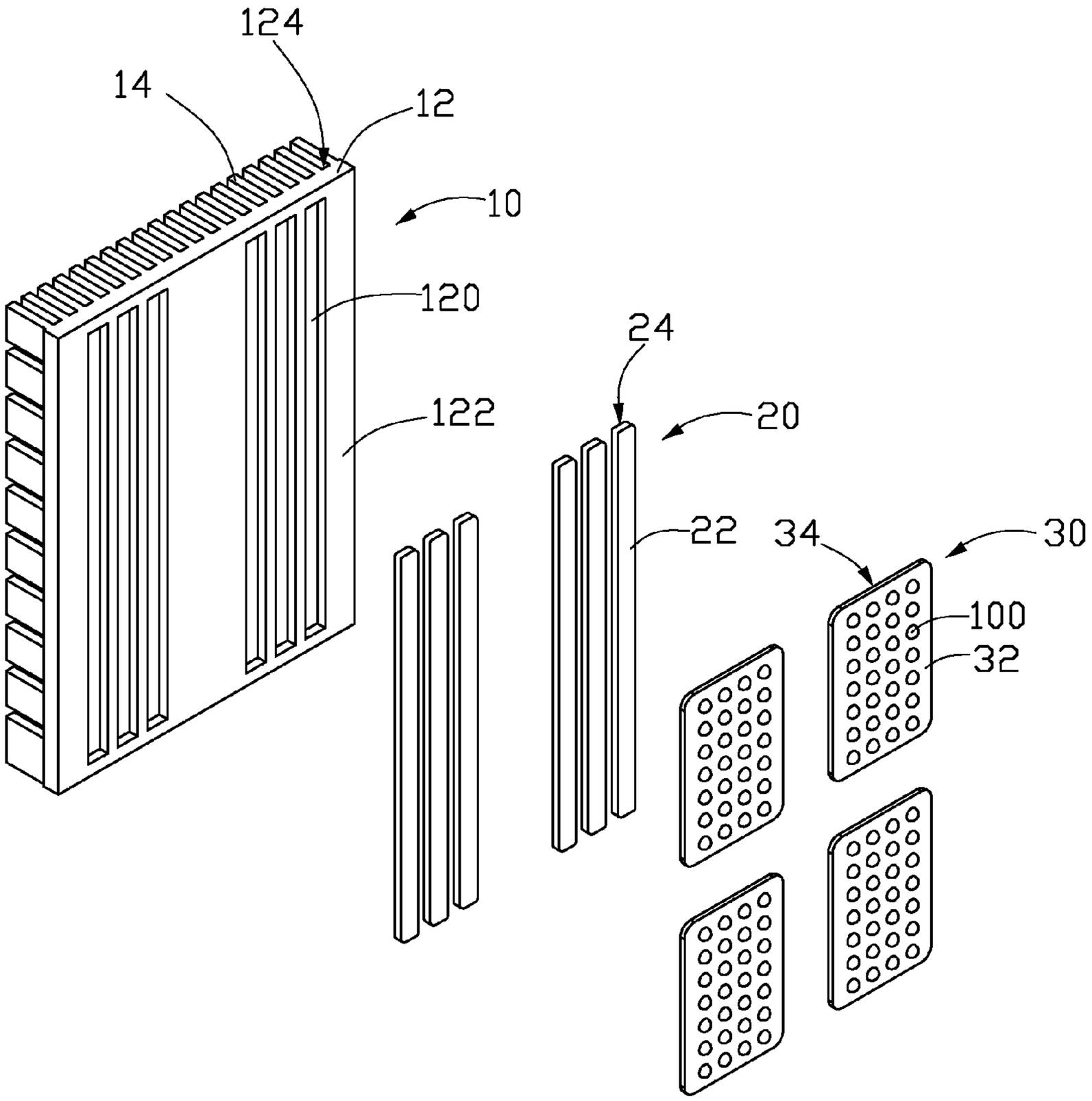


FIG. 2

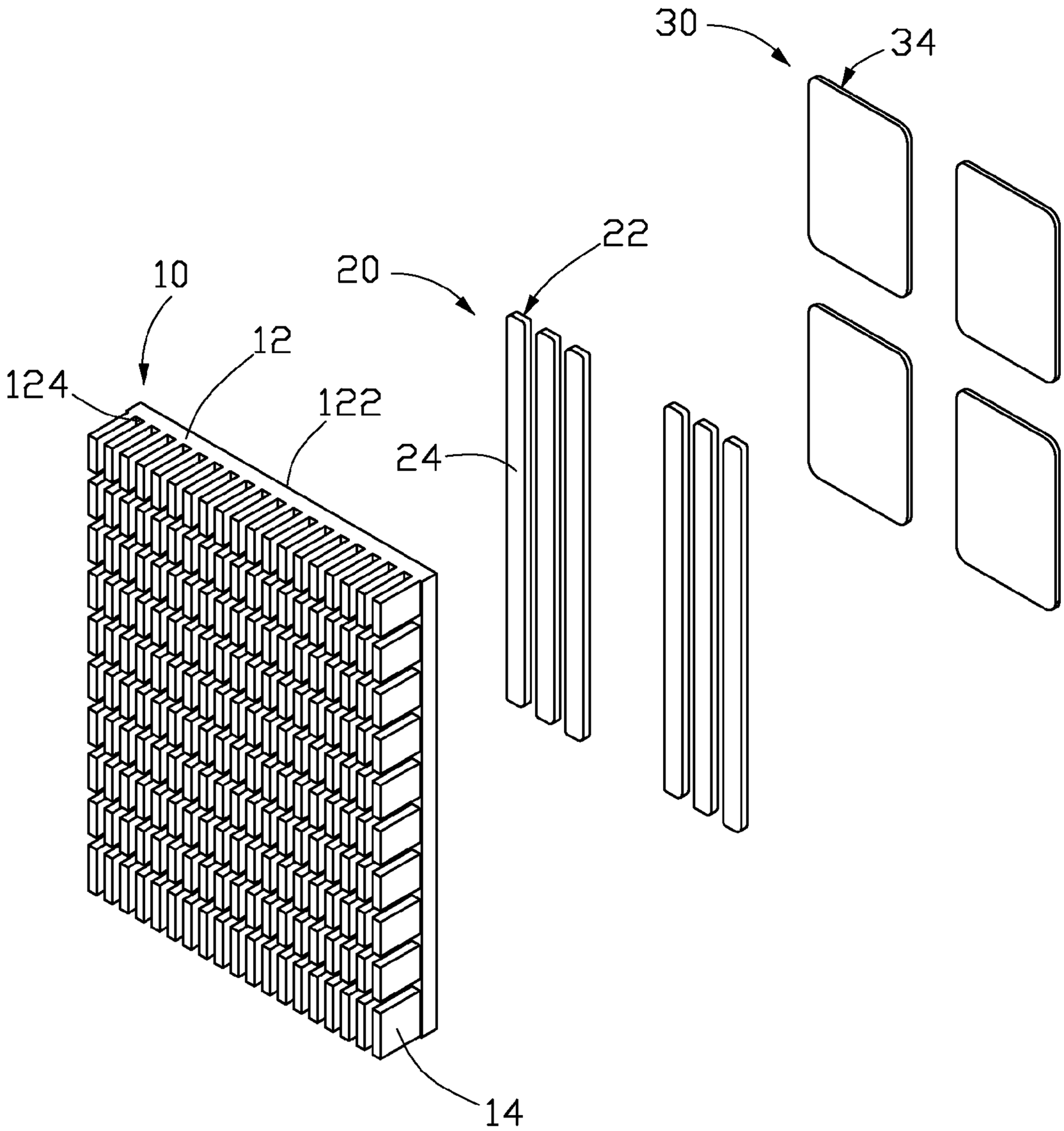


FIG. 3

HEAT DISSIPATION DEVICE FOR LED CHIPS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a heat dissipation device and particularly to a heat dissipation device for removing heat from LED chips.

[0003] 2. Description of Related Art

[0004] An LED lamp is a type of solid state lighting that utilizes light-emitting diodes (LEDs) as a source of illumination. An LED is a device for transferring electricity to light by using a theory that, if a current is made to flow in a forward direction in a junction comprising two different semiconductors, electrons and holes are coupled at the junction region to generate a light beam. The LED has an advantage in that it is resistant to shock, and has an almost eternal lifetime under a specific condition; thus, the LED lamp is intended to be a cost-effective yet high quality replacement for incandescent and fluorescent lamps.

[0005] A high-powered LED light device produces considerable amount of heat, which may cause performance degrade or even damage of the device if the heat is not removed from LED chips of the device efficiently. In an LED light device, the LED chips which are mounted on a substrate are the core for generating light and heat. A transparent cover may be used to cover the LED chips for protecting the LED chips from foreign articles. Although there are many different designs, the major heat dissipation route for the heat produced by the LED chips is usually managed through the substrate to which the LED chips are mounted and a metal heat sink thermally connecting with the substrate.

[0006] When the LED light device is used as an outdoor LED lamp, it usually requires a waterproof sealing for the LED chips to protect the LED chips from rain. The LED lamp comprises a heat sink for dissipating heat generated by the LED chips. In a sunny day, the heat sink is exposed directly to the sunlight and heated by sunlight. The heat absorbed by the heat sink from the sunlight is transferred to the LED chips which are in contact with the heat sink. Therefore, the temperature of the LED chips raises enormously, which affects the life-span of the LED chips.

[0007] What is needed, therefore, is a heat dissipation device for an LED light device which has an improved structure and overcomes the abovementioned disadvantage.

SUMMARY OF THE INVENTION

[0008] A heat dissipation device for removing heat from LED chips includes a finned heat sink, a plurality of heat pipes and a plurality of heat conductive substrates. The heat sink comprises a base plate which defines a first surface and a second surface opposite to the first surface. A plurality of fins are formed on the second surface of the base plate. The heat pipes of unidirectional heat transfer are embedded in the first surface of the heat sink. Each of the heat pipes defines a first wall and a second wall coupled to the heat sink. The heat pipes only transfer heat from the first walls to the second walls and restrict a heat transfer in a reversed direction. The substrates are in contact with first walls of the heat pipes. The LED chips are mounted on the substrates. When the LED chips generate heat, the heat is transferred to the fins of the heat sink via the substrates and the unidirectional heat pipes to lower the temperature of the LED chips.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Many aspects of the present embodiments can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present embodiment. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0010] FIG. **1** is an isometric, assembled view of a heat dissipation device in accordance with a preferred embodiment of the present invention;

[0011] FIG. **2** is an explored view of the heat dissipation device of FIG. **1**; and

[0012] FIG. **3** is a view similar to FIG. **2**, but from an opposite direction.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Referring to FIGS. **1-3**, a heat dissipation device is used for removing heat from LED chips **100** housed in an outdoor LED lamp (not shown). The heat dissipation device comprises a heat sink **10**, a plurality of heat pipes **20** embedded in the heat sink **10** and multiple substrates **30** in contact with both the heat pipes **20** and the heat sink **10**. The LED chips **100** are mounted on the substrates **30** and arranged in matrixes.

[0014] The heat sink **10** is integrally formed by aluminum extrusion. The heat sink **10** comprises a rectangular base plate **12** and a plurality of fins **14** formed on the base plate **12**. The base plate **12** defines a first surface **122** facing the substrates **30** and a second surface **124** opposite to the first surface **122**. A plurality of receiving grooves **120** complementary to the heat pipes **20** is defined in the first surface **122**. The receiving grooves **120** can be various shapes such as L-shaped, U-shaped and S-shaped etc., in accordance with the configurations of the heat pipes **20**. In this embodiment, the receiving grooves **120** and the heat pipes **20** are straight in shape. The receiving grooves **120** are divided into two groups each comprising three elongated, straight grooves **120** juxtaposed closely to each other. The grooves **120** are parallel to two opposite lateral sides of the base plate **12**. The fins **14** extend from the second surface **124** of the base plate **12** and can be constructed in various configurations to maximize heat-exchanging area of the heat sink **10**.

[0015] The heat pipes **20** are divided into two groups, each comprising three heat pipes **20**. Each of the heat pipes **20** is elongated, straight and flat and comprises a casing (not labeled). The casing defines a first wall **22** facing the substrates **30** and a second wall **24** parallel to the first wall **22** and facing the heat sink **10**. Each of the heat pipes **20** is designed to be a unidirectional heat transfer device, which means that the heat pipe **20** can only transfer heat in a direction from the first wall **22** to the second wall **24** and inhibits the heat transfer in a reversed direction, when the first wall **22** faces downwardly. Each of the heat pipes **20** is provided with a capillary wick (not shown) in the casing thereof for achieving the unidirectional heat transfer. The capillary wick may be a plurality of fine grooves defined in a lengthwise direction of the casing, a fine-mesh wick, or a layer of sintered metal/ceramic powders only formed on an inner side of the first wall

22 distant from the second wall **24**. The casing is half filled with working liquid (not shown) which acts as a heat carrier for carrying thermal energy from the first wall **22** to the second wall **24** and the working liquid is just enough to submerge the capillary wick adjacent to the first wall **22** when the first wall **22** faces downwardly toward the ground. The first surface **122** of the heat sink **10** is coplanar with outer surfaces of the first walls **22** when the heat pipes **20** are received in the grooves **120** of the heat sink **10**.

[0016] The substrates **30** each are formed from a material having a high heat conductivity, such as copper. Each of the substrates **30** is a flat plate and defines a first surface **32** and a second surface **34** opposite to the first surface **32** and facing the heat sink **10**. The LED chips **100** are mounted on the first surfaces **32**. The second surfaces **34** are kept in contact with and coupled with the first surface **122** of the heat sink **10** and the outer surfaces of the first walls **22** of the heat pipes **20** by means soldering or adhering. Two substrates **30** are positioned on each group of the heat pipes **20**.

[0017] In use of the heat dissipation device, the heat pipes **20** are received in the corresponding grooves **120** in the first surface **122** of the heat sink **10**. The outer surfaces of the first walls **22** of the heat pipes **20** and the first surface of the heat sink **10** cooperatively form a contacting surface in contact with the second surfaces **34** of the substrates **30**, wherein a major part of the second surfaces **34** of the substrates **30** are in contact with the heat pipes **20**.

[0018] It is well known that the outdoor LED lamp is positioned in such a way that the first surface **122** of the base plate **12** of the heat sink **10** faces downward to the ground. In this way, the capillary wick near the first walls **22** of the heat pipes **20** is submerged in the working liquid while the second walls **24** of the heat pipes **20** are away from the working liquid; thus, heat accumulated in the heat sink **10** by absorbing heat from sunlight can not be transferred to the first walls **22** of the heat pipes **20** via the second walls **24**, whereby the LED chips **100** are protected from being heated by heat of the heat sink **10**. In other words, thermal resistance of the heat pipes **20** regarding the heat transfer from the heat sink **10** to the heat pipes **20** is greatly higher than that regarding the heat transfer from the heat pipes **20** to the heat sink **10**. Accordingly, in daytime, when the outdoor LED lamp is not activated to generate light and is exposed to sunlight, heat of the sunlight will not heat the LED chips **100** via the heat sink **10**. Meanwhile, in night, when the outdoor LED lamp is activated to generate light, the heat generated by the LED chips **100** can be effectively dissipated to air by the heat sink **10**, where the working liquid in the heat pipes **20** has a continuous, two-phase circulation in the heat pipes **20** to transfer the heat of the LED chips **100** to the heat sink **10**.

[0019] It is believed that the present invention and its advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the examples hereinbefore described merely being preferred or exemplary embodiments of the invention.

What is claimed is:

1. A heat dissipation device adapted for removing heat from LED chips, comprising:

a heat sink comprising a base plate which defines a first surface and a second surface opposite to the first surface, and a plurality of fins formed on the second surface of the base plate;

a plurality of heat pipes of unidirectional heat transfer being embedded in the first surface of the heat sink, each of the heat pipes defining a first wall and a second wall coupled to the heat sink, the heat pipes only transferring heat from the first walls to the second walls and restrict a heat transfer in a reversed direction; and

a plurality of substrates in contact with first walls of the heat pipes, and the LED chips being mounted on the substrates;

wherein when the LED chips generate heat, the heat is transferred to the fins via the unidirectional heat pipes to lower a temperature of the LED chips.

2. The heat dissipation device as claimed in claim **1**, wherein each of the heat pipes is provided with a capillary wick which has one of the following structures: a plurality of fine grooves defined in a lengthwise direction of the casing, a fine-mesh wick, or a layer of sintered metal/ceramic powders only formed on an inner side of the first wall and away from the second wall.

3. The heat dissipation device as claimed in claim **2**, wherein the heat pipes each are half filled with working liquid which is just enough to submerge the capillary wick adjacent to the first wall when the first wall faces downwardly toward the ground.

4. The heat dissipation device as claimed in claim **1**, wherein each of the substrates is a flat plate and defines a first surface on which the LED chips are mounted and a second surface opposite to the first surface.

5. The heat dissipation device as claimed in claim **4**, wherein the second surfaces of the substrates are coupled to the first surface of the heat sink and the first walls of the heat pipes.

6. The heat dissipation device as claimed in claim **1**, wherein the heat pipes each can be one of various shapes: straight, L-shaped, U-shaped and S-shaped, and the first surface of the heat sink defines corresponding receiving grooves accommodating the heat pipes therein.

7. The heat dissipation device as claimed in claim **6**, wherein the heat pipes each are straight and are juxtaposed closely to each other and respectively received in the corresponding straight receiving grooves.

8. The heat dissipation device as claimed in claim **1**, wherein the fins extend from the second surface of the base plate and can be constructed in various configurations to maximize a heat-exchanging area of the heat sink.

9. A heat dissipation device adapted for removing heat from LED chips, comprising:

a finned heat sink comprising a base plate;

a plurality of heat pipes embedded in the base plate, each heat pipe comprising a casing which is half filled with working liquid and has a first wall and a second wall in contact with the base plate of the heat sink; and

a plurality of heat conductive substrates each defining a first surface on which the LED chips are mounted and a second surface in contact with the heat pipes;

wherein each of the heat pipes is provided with a capillary wick which has one of following structures: a plurality of fine grooves defined in a lengthwise direction of the casing, a fine-mesh wick, or a layer of sintered metal/ceramic powders only formed on an inner side of the first wall and away from the second wall, and working liquid which is just enough to submerge the capillary wick adjacent to the first wall when the first wall faces downwardly toward the ground.

10. The heat dissipation device as claimed in claim **9**, wherein the substrates each are a flat plate, the second surfaces of the substrates are coupled to the base plate of the heat sink and the first walls of the heat pipes, a major part of the second surfaces of the substrates being in contact with the first walls of the heat pipes.

11. The heat dissipation device as claimed in claim **10**, wherein the heat pipes each can be one of various shapes: straight, L-shaped, U-shaped and S-shaped, and the first surface of the heat sink defines corresponding receiving grooves accommodating the heat pipes therein.

12. The heat dissipation as claimed in claim **10**, wherein the heat pipes are straight and divided into two groups, and each group of the heat pipes are connected with at least two substrates.

13. The heat dissipation device as claimed in claim **12**, wherein the heat pipes of each group are juxtaposed closely to each other and respectively received in the corresponding straight receiving grooves.

14. The heat dissipation as claimed in claim **9**, wherein the base plate defines a first surface coupled with the second surfaces of the substrates and a second surface opposite to the first surface, and a plurality of fins are formed on the second surface of the base plate.

15. An LED assembly comprising:

a heat sink having a plurality of fins thereon;

a plurality of heat pipes embedded in the heat sink;

a plurality of heat conductive substrates coupled to the heat pipes; and

a plurality of LED chips mounted on the substrates;

wherein the heat pipes allow heat generated by the LED chips to be transferred to the heat sink via the substrates and the heat pipes, and inhibit heat in the heat sink to be transferred to the substrates via the heat pipes.

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