**Title:** HEATING DISSIPATING DEVICE, ELECTRONIC DEVICE AND ILLUMINATING DEVICE COMPRISING THE HEAT DISSIPATING DEVICE

**Abstract:** The present invention relates to a heat dissipating device (100), characterized in that the heat dissipating device (100) comprises a heat dissipating body (1) made from a heat-conducting plastic and opened with at least one closable first accommodating chamber (R1) that accommodates fluid heat-conducting medium and allows thermal convection of the fluid heat-conducting medium in the accommodating chamber (R1). In addition, the present invention further relates to an electronic device comprising such heat dissipating device and an illuminating device.
Description

Heating Dissipating Device, Electronic Device and Illuminating Device Comprising the Heat Dissipating Device

Technical Field

The present invention relates to a heat dissipating device, an electronic device and an illuminating device comprising the heat dissipating device.

Background Art

Large-power components such as high-luminance LED light sources are widely used in current electronic devices, wherein these large-power components can be mounted on, for instance, a metal-based circuit board (MCPCB), and further the circuit board and the heat dissipating device are fixed together to form an electronic device having heat dissipating effect. Therefore, how to improve the heat dissipating device useful for the electronic device and/or to enhance its heat dissipating effect has become an important research direction.

In order to improve the heat dissipating effect of the heat dissipating device, the heat dissipating device usually is configured to have a sufficiently big heat dissipating area. This results in a big volume and further a big deadweight of the heat dissipating device. Regarding this drawback, a plastic can replace ceramic or aluminum to be used as a raw material to make a heat dissipating body. Due to its insulating property, such heat dissipating device is particularly suited to be mounted in an electronic device. In the prior art, the heat dissipating device is configured, for instance, to have
a cylindrical shape, wherein it has an accommodating via for accommodating a wire supplying power and/or transmitting a signal to the electronic device. A metal heat-conducting piece can be inserted or embedded in such heat dissipating device made from a common plastic so as to improve the cooling effect of the heat dissipating device. But the shortcoming therein is that the metal heat-conducting piece usually made from aluminum increases the deadweight of the heat dissipating device. And alternatively, a modified plastic is used to make the heat dissipating device. But since the modified plastic is expensive, the manufacturing cost of the heat dissipating device is high. Though the two heat dissipating devices above can satisfy heat dissipating requirements of some electronic devices, the thermal resistance thereof has to be reduced.

Summary of the Invention

Therefore, one object of the present invention lies in providing a heat dissipating device. The heat dissipating device not only has highly insulating property but also has good heat dissipating effect. In addition, the heat dissipating device has a simple structure and a small deadweight, and can be manufactured at a low cost.

The heat dissipating device in accordance with the present invention is characterized by comprising a heat dissipating body made from a heat-conducting plastic and opened with at least one closable first accommodating chamber that accommodates fluid heat-conducting medium and allows thermal convection of the fluid heat-conducting medium in the first accommodating chamber.

The concept of the present invention lies in simultaneously
using two heat-conducting materials, namely, heat-conducting plastic and fluid heat-conducting medium, to realize highly effective cooling at a low cost, wherein the fluid heat-conducting medium is sealedly accommodated in the first accommodating chamber of the heat dissipating body and can convect therein. Thus, heat can be transferred through convection to various parts of the heat dissipating device enclosing various accommodating cavities, and heat dissipation is conducted at a big surface area through the heat dissipating body made from plastic so as to improve the heat dissipating effect of the heat dissipating device.

In accordance with one preferred solution of the present invention, the first accommodating chamber is configured to be circular and to define a circumferential circulation path for the fluid heat-conducting medium. In order to simplify the manufacturing process, the first accommodating chamber preferably is configured to be annular. Such annular structure of the first accommodating chamber also can provide a circumferential circulation path for the fluid heat-conducting medium.

In accordance with one preferred solution of the present invention, the heat dissipating body comprises a bottom wall, a first tubular part and a second tubular part, wherein the first tubular part and the second tubular part extend from the bottom wall and surround each other circumferentially, and the first accommodating chamber is defined between the first tubular part and the second tubular part. For instance, the first tubular part and the second tubular part preferably can be formed in a concentrically nesting manner, and meanwhile, the base wall is used as one end surface of the heat dissipating body to close the first accommodating chamber at one side.
In accordance with one preferred solution of the present invention, the heat dissipating device further comprises a support plate assembly formed at sides of the first tubular part and the second tubular part, opposite to the bottom wall, and is configured to close the first accommodating chamber. The base wall and the support plate formed opposite to the base wall close, at two ends, the first accommodating chamber formed between the first tubular part and the second tubular part, so as to assure that the heat-conducting medium can convect sealedly in the first accommodating chamber.

In accordance with another preferred solution of the present invention, the bottom wall is opened with an injection port that is sealable and in communication with the first accommodating chamber. Preferably, the injection port has a threaded structure and is threadedly sealable by a plug. Uses can inject the heat-conducting medium into the heat dissipating device according to heat dissipation requirements to be met. And possibly, the heat-conducting medium also can be integrally encapsulated in the first accommodating chamber.

In accordance with one preferred solution of the present invention, the first tubular part defines a second cavity. The second cavity can accommodate some parts such as wire in connection with components to dissipate heat.

In accordance with one preferred solution of the present invention, the support plate assembly comprises a heat-conducting support plate and an encapsulation section, the encapsulation section has a first flange and a second flange engaged with the first tubular part and the second tubular part, respectively. The support plate assembly is connected with the first tubular part and the second tubular part through the first flange and the second flange, respectively,
so as to form an end section closing the heat dissipating device. One side surface of the support plate assembly closes the first accommodating chamber, and one side surface opposite to said side surface can be used for bearing components to dissipate heat. Thus, the components to dissipate heat and the fluid heat-conducting medium closed in the first accommodating chamber can be in thermal contact.

In accordance with one preferred solution of the present invention, the heat-conducting support plate is made from a metal, and the encapsulation section is made from a heat-conducting plastic. Since metal has the characteristic of low thermal resistance, the heat-conducting support plate can be made from a metal such as copper or aluminum. A heat-conducting plastic, the same as or different from that of the heat dissipating body, can be used to make the encapsulation section. Preferably, the heat-conducting support plate and the encapsulation section are made in one piece through an overmolding process.

In accordance with one preferred solution of the present invention, the heat-conducting support plate is opened with an opening matched with a cross section of the first tubular part. Size of the opening can be equal to or smaller than a surface area of the cross section of the first tubular part, and the opening is in communication with the second cavity defined by the first tubular part, so that components running through the second cavity can extend beyond the heat-conducting support plate.

In accordance with one preferred solution of the present invention, a circumferential edge of the heat-conducting support plate is embedded into the second flange. Therefore, a fixed connection between the heat-conducting support plate
and the encapsulation section is realized.

In accordance with one preferred solution of the present invention, the first tubular part, the second tubular part and the encapsulation section are connected together through an ultrasonic welding technology. Since all the first tubular part, the second tubular part and the encapsulation section are all made from heat-conducting plastic, the two tubular part and the encapsulation section can be welded ultrasonically, thus saving the manufacturing cost.

In accordance with one preferred solution of the present invention, the fluid heat-conducting medium is a liquid. Preferably, the fluid heat-conducting medium is water. Other liquids, e.g. liquids have a freezing point lower than 0°, also can be used as the fluid heat-conducting medium.

In accordance with one preferred solution of the present invention, the first tubular part is provided with cooling ribs. As a result, the heat dissipating area of the heat dissipating device can be increased.

In accordance with one preferred solution of the present invention, the cooling ribs and the first tubular part are made in one piece. Preferably, the cooling ribs and the first tubular part are made in one piece through an injecting process. Thus, the manufacturing process is simplified and the productivity is improved.

In addition, the present invention further relates to an electronic device comprising a circuit board, characterized by further comprising the above heat dissipating device, wherein the circuit board is carried by the heat dissipating body and performs heat transfer with the fluid heat-
conducting medium. The circuit board can be preferably mounted at one side of the heat-conducting support plate facing away from the base wall, thus, the circuit board and the fluid heat-conducting medium perform heat transfer through the heat-conducting support plate so that the heat generated by the circuit board is transferred to the heat dissipating body.

Besides, the present invention further relates to an illuminating device comprising a light-emitting assembly, characterized by further comprising the above heat dissipating device, wherein the light-emitting assembly is carried by the heat dissipating body and performs heat transfer with the fluid heat-conducting medium. The light-emitting assembly also can be mounted at one side of the heat-conducting support plate facing away from the base wall so that the heat generated by the circuit board is transferred to the heat dissipating body.

**Brief Description of the Drawings**

The accompanying drawings constitute a part of the present Description and are used to provide further understanding of the present invention. Such accompanying drawings illustrate the embodiments of the present invention and are used to describe the principles of the present invention together with the Description. In the accompanying drawings the same components are represented by the same reference numbers. As shown in the drawings:

Fig. 1 is a 3D sectional view, in a longitudinal direction, of a first embodiment of an electronic device in accordance with the present invention, wherein the electronic device comprises a heat dissipating device according to the present
invention;

Fig. 2 is 3D sectional view of a heat dissipating body in the first embodiment as shown in Fig. 1;

Fig. 3 is a sectional view of a support plate assembly in the first embodiment as shown in Fig. 1; and

Fig. 4 is a sectional view, in a longitudinal direction, of a first embodiment of an illuminating device in accordance with the present invention, wherein the illuminating device comprises the heat dissipating device according to the present invention.

**Detailed Description of the Embodiments**

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, directional terminology, such as “top”, “lower”, “inner”, “outer”, is used in reference to the orientation of the figures being described. Because components of embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

It is to be understood that the features of the various exem-
plicable embodiments described herein may be combined with each other, unless specifically noted otherwise.

Fig. 1 is a 3D sectional view, in a longitudinal direction, of a first embodiment of an electronic device 200 in accordance with the present invention, wherein the electronic device 200 comprises a heat dissipating device 100 according to the present invention and a circuit board 201 provided at one side thereof. The heat dissipating device 100 configured to be tubular has a heat dissipating body 1 in which a first accommodating chamber R1 is opened for accommodating fluid heat-conducting medium. Thus, the circuit board 201 can be enabled to be in thermal contact with the fluid heat-conducting medium, and the fluid heat-conducting medium, after heated, can convect in the sealed first accommodating chamber R1 so as to quickly transfer heat to various heat dissipating surfaces of the heat dissipating body 1. Since the heat dissipating body 1 in the present embodiment has an annular cross section, annular first accommodating chamber R1 can be defined. And therefore, a circumferential convective circulation path also can be provided for the fluid heat-conducting medium, and such structure is also easily manufactured.

The heat dissipating body 1 comprises a base wall 2 and a first tubular part 3 and a second tubular part 4 extending downwardly therefrom. The first and second tubular parts 3 and 4 surround each other circumferentially. Lower ends of the first and second tubular parts 3, 4 are connected with a support plate assembly 5 for closing the heat dissipating body 1. As a result, a sealed first accommodating chamber R1 can be defined by the above assembly. Meanwhile, the first tubular part 3 itself also defines a second cavity R2 for components such as wire running therethrough. In order to re-
alize good heat dissipating effect, a heat-conducting plastic is used to make the first and second tubular parts 3, 4 and the base wall 2. In the support plate assembly 5, a metal with low thermal resistance can be used to make the heat-conducting support plate 8, and the heat-conducting plastic is also used to encapsulate a circumferential edge of the heat-conducting support plate 8 to form the encapsulation section 9. The support plate assembly 5 can be manufactured through a suitable process such as an overmolding process.

In the present embodiment, the circuit board 201 is mounted at one side of the heat-conducting support plate 8 facing away from the base wall 2, and is in thermal contact with the fluid heat-conducting medium through the heat-conducting support plate 8. An opening 12 that has a surface area equal to or smaller than that of a cross section of the second cavity R2 is opened on the heat-conducting support plate 8. A wire or other parts for supplying power or transmitting a signal to the circuit board 201 can run through the second cavity R2 to be in connection with a power source or a signal source.

An injection port 6 for the fluid heat-conducting medium is opened on the base wall 2. The injection port 6 is in communication with the first accommodating chamber R1 and can be closed by a plug 7. In order to assure the closing effect, threaded structures in cooperation with each other can be formed on contact surfaces of the injection port 6 and the plug 7.

In a second embodiment not shown, the fluid heat-conducting medium also can be directly closed in the first accommodating chamber R1 while the heat dissipating body 1 and the support plate assembly 5 are manufactured, as a result, the injection port 6 and the plug 7 are not needed.
In a third embodiment not shown, the whole support plate assembly 5 also can be made from a heat-conducting plastic. In this situation, the heat dissipating body 1 can be made in one piece with the support plate assembly 5 from the heat-conducting plastic, thereby simplifying the manufacturing process.

In a fourth embodiment not shown, a layer of cooling ribs can be additionally formed outside the second tubular part 4. The layer of cooling ribs can be formed on an outer surface of the second tubular part 4 in a form of sleeve, insert or other suitable forms.

Fig. 2 is 3D sectional view of the heat dissipating body in the first embodiment as shown in Fig. 1. The base wall 2, and the first tubular part 3 and the second tubular part 4 extending therefrom of the heat dissipating body 1 are shown in Fig. 2. In order to increase a surface area of the heat dissipating body 1 for dissipating heat, cooling ribs 13 can be formed on the first tubular part 3. In order to reduce the manufacturing process and to improve the productivity, the cooling ribs 13 are preferably formed in one piece through an injecting process on an outer surface of the first tubular part 3.

Fig. 3 is a sectional view of a support plate assembly in the first embodiment as shown in Fig. 1. The encapsulation section 9 has a first flange 10 and a second flange 11. A circumferential edge of the heat-conducting support plate 8 is firmly encapsulated in a second flange 11, and a first flange 10 is formed on an edge region of the opening 12. Upper surfaces of the first flange 10 and the second flange are on the same horizontal plane in the present preferred embodiment, which is favorable for connection with corresponding
first tubular part 3 and second tubular part 4 through, e.g. an ultrasonic welding process. The heat-conducting support plate 8 in the support plate assembly 5 thus has a function of bearing components such as the circuit board 201 to dissipate heat, and also serves a heat-conducting function of transferring heat generated by the circuit board 201 to the fluid heat-conducting medium and the first and second tubular parts 3, 4.

Fig. 4 is a sectional view, in a longitudinal direction, of a first embodiment of an illuminating device in accordance with the present invention, wherein the electronic device comprises the heat dissipating device according to the present invention. In the present embodiment, the light-emitting assembly 301 comprises, for instance, LED chips and a circuit board bearing the LED chips. The circuit board of the light-emitting assembly 301, as shown in Fig. 4, can be directly mounted on one side of the heat-conducting support plate 8 so as to be in thermal contact with the fluid heat-conducting medium.

In the scope of the present invention, the fluid heat-conducting medium can be water and also can be other fluids suited as cooling medium, e.g. liquids having a freezing point of lower than 0°.

In addition, while a particular feature or aspect of an embodiment of the invention may have been disclosed with respect to only one of several implementations, such feature or aspect may be combined with one or more other features or aspects of the other implementations as may be desired and advantageous for any given or particular application. Furthermore, to the extent that the terms “include”, “have”, “with”, or other variants thereof are used in either the detailed de-
scription or the claims, such terms are intended to be inclusive in a manner similar to the term “comprise”.

The above is merely preferred embodiments of the present invention but not to limit the present invention. For the person skilled in the art, the present invention may have various alterations and changes. Any alterations, equivalent substitutions, improvements, within the spirit and principle of the present invention, should be covered in the protection scope of the present invention.
List of reference signs

1  heat dissipating body
2  base wall
3  first tubular part
4  second tubular part
5  support plate assembly
6  injection port
7  plug
8  heat-conducting support plate
9  encapsulation section
10 first flange
11 second flange
12 opening
13 cooling rib
100 heat dissipating device
200 electronic device
201 circuit board
300 illuminating device
301 light-emitting assembly
Claims

1. A heat dissipating device (100), characterized in that the heat dissipating device (100) comprises a heat dissipating body (1) made from a heat-conducting plastic and opened with at least one first accommodating chamber (R1) that accommodates fluid heat-conducting medium and allows thermal convection of the fluid heat-conducting medium in the first accommodating chamber (R1).

2. The heat dissipating device (100) according to Claim 1, characterized in that the first accommodating chamber (R1) is configured to be circular and to define a circumferential circulation path for the fluid heat-conducting medium.

3. The heat dissipating device (100) according to Claim 2, characterized in that the heat dissipating body (1) comprises a bottom wall (2), a first tubular part (3) and a second tubular part (4), wherein the first tubular part (3) and the second tubular part (4) extend from the bottom wall (2) and surround each other circumferentially, and the first accommodating chamber (R1) is defined between the first tubular part (3) and the second tubular part (4).

4. The heat dissipating device (100) according to Claim 3, characterized in that the heat dissipating device (100) further comprises a support plate assembly (5) formed at sides of the first tubular part (3) and the second tubular part (4), opposite to the bottom wall (2), and is configured to close the first accommodating chamber (R1).

5. The heat dissipating device (100) according to Claim 3, characterized in that the bottom wall (2) is opened with an injection port (6) that is sealable and in communication with
the first accommodating chamber (R1).

6. The heat dissipating device (100) according to Claim 5, characterized in that the injection port (6) has a threaded structure and is threadedly sealable by a plug (7).

7. The heat dissipating device (100) according to Claim 4, characterized in that the first tubular part (3) defines a second cavity (R2).

8. The heat dissipating device (100) according to Claim 4, characterized in that the support plate assembly (5) comprises a heat-conducting support plate (8) and an encapsulation section (9), the encapsulation section (9) has a first flange (10) and a second flange (11) engaged with the first tubular part (3) and the second tubular part (4), respectively.

9. The heat dissipating device (100) according to Claim 8, characterized in that the heat-conducting support plate (8) is made from a metal, and the encapsulation section (9) is made from a heat-conducting plastic.

10. The heat dissipating device (100) according to Claim 8, characterized in that the heat-conducting support plate (8) is opened with an opening (12) matched with a cross section of the first tubular part (3).

11. The heat dissipating device (100) according to Claim 8, characterized in that a circumferential edge of the heat-conducting support plate (8) is embedded into the second flange (11).

12. The heat dissipating device (100) according to Claim 8,
characterized in that the first tubular part (3), the second tubular part (4) and the encapsulation section (9) are connected together through an ultrasonic welding technology.

13. The heat dissipating device (100) according to Claim 8, characterized in that the heat-conducting support plate (8) and the encapsulation section (9) are made in one piece through an overmolding process.

14. The heat dissipating device (100) according to any of Claims 1-3, characterized in that the fluid heat-conducting medium is water.

15. The heat dissipating device (100) according to any of Claims 1-3, characterized in that the first tubular part (3) is provided with cooling ribs (13).

16. The heat dissipating device (100) according to Claim 15, characterized in that the cooling ribs (13) and the first tubular part (3) are made in one piece.

17. The heat dissipating device (100) according to Claim 16, characterized in that the cooling ribs (13) and the first tubular part (3) are made in one piece through an injecting process.

18. An electronic device (200) comprising a circuit board (201), characterized by further comprising the heat dissipating device (100) according to any of Claims 1-17, wherein the circuit board (201) is carried by the heat dissipating body and performs heat transfer with the fluid heat-conducting medium.

19. An illuminating device (300) comprising a light-emitting
assembly (301), characterized by further comprising the heat
dissipating device (100) according to any of Claims 1-17,
wherein the light-emitting assembly (301) is carried by the
heat dissipating body and performs heat transfer with the
fluid heat-conducting medium.
INTERNATIONAL SEARCH REPORT

PCT/EP2013/060892

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V29/00 F21V17/10
ADD. F21Y101/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F21V F21Y

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search
14 August 2013

Date of mailing of the international search report
21/08/2013

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk
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