United States Patent	12392560
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Wang; Yung-Chih et al.

Thermal dissipation module

Abstract

A heat dissipation module used for an electronic device is provided. The electronic device has a heat source. The heat dissipation module includes an evaporator, a plurality of heat conducting components, a pipe connected to the evaporator to form a loop, and a working fluid filled in the loop. An exterior of the evaporator has a heat conducting zone thermally contacted with the heat source to absorb heat generated from the heat source. The heat conducting components are disposed in the evaporator, located at an interior of the evaporator corresponding to the heat conducting zone. The heat conducting components are in pillar shape or rib shape respectively. The working fluid in liquid passes through the evaporator, absorbs heat, and is transformed into vapor to flow out of the evaporator. Each of the heat conducting components in rib shape is oriented in a flow direction of the working fluid.

Inventors: **Wang; Yung-Chih (New Taipei, TW), Ke; Jau-Han (New Taipei, TW), Liao; Wen-Neng (New Taipei, TW), Hsieh; Cheng-Wen (New Taipei, TW)**

Applicant: **Acer Incorporated** (New Taipei, TW)

Family ID: **1000008767432**

Assignee: **Acer Incorported (New Taipei, TW)**

Appl. No.: **18/505136**

Filed: **November 09, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20240068754 A1	Feb. 29, 2024

Foreign Application Priority Data

TW	104130535	Sep. 16, 2015
TW	105108930	Mar. 23, 2016
TW	105110817	Apr. 06, 2016

Related U.S. Application Data

continuation parent-doc US 15189291 20160622 US 9835382 20171205 child-doc US 15796858
division parent-doc US 18169857 20230215 US 11852420 child-doc US 18505136
division parent-doc US 16792195 20200215 US 11609048 20230321 child-doc US 18169857
division parent-doc US 15796858 20171030 US 10634435 20200428 child-doc US 16792195

Publication Classification

Int. Cl.: **F28D15/02** (20060101); **F28F1/00** (20060101); **F28F13/08** (20060101); **G06F1/20** (20060101); **H05K7/20** (20060101); F28D21/00 (20060101)

U.S. Cl.:

CPC **F28D15/025** (20130101); **F28D15/02** (20130101); **F28D15/0266** (20130101); **F28F1/006** (20130101); **F28F13/08** (20130101); **G06F1/203** (20130101); **H05K7/20336** (20130101); F28D2021/0028 (20130101)

Field of Classification Search

CPC: G06F (1/203); G06F (2200/201); F28D (15/0275); F28D (15/043); F28D (15/0266)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
5309457	12/1993	Minch	165/104.33	H01S 5/4025
5579830	12/1995	Giammaruti	165/104.27	F28D 20/02
6900990	12/2004	Tomioka	361/679.48	H01L 23/473
9721869	12/2016	Sun	N/A	F28D 15/04
2007/0006994	12/2006	Liu	165/104.33	F28D 15/043

Primary Examiner: Jones; Gordon A

Attorney, Agent or Firm: JCIPRNET

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION (1) This application is a divisional application of and claims the priority benefit of U.S. application Ser. No. 18/169,857, filed on Feb. 15, 2023, now allowed. The prior U.S. application Ser. No. 18/169,857 is a divisional application of and claims the priority benefit of U.S. application Ser. No. 16/792,195, filed on Feb. 15, 2020, now patented. The prior U.S. application Ser. No. 16/792,195 is a divisional application of and claims the priority benefit of U.S. application Ser. No. 15/796,858, filed on Oct. 30, 2017, now patented. The prior U.S. application Ser. No. 15/796,858 is a continuation application of and claims the priority benefit of a prior application Ser. No. 15/189,291, filed on Jun. 22, 2016, which claims the priority benefit of Taiwan application serial no. 105110817, filed on Apr. 6, 2016, Taiwan application serial no. 105108930, filed on Mar. 23, 2016, and Taiwan application serial no. 104130535, filed on Sep. 16, 2015. The entirety of each of the above-mentioned patent applications is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND OF THE INVENTION

1. Field of the Invention

(1) The present invention relates to a heat dissipation module.

2. Description of Related Art

(2) With the increasing development of hi-tech industry, mobile devices such as mobile phones and tablet PCs have become one of the most indispensable necessities of our daily life. As people become growingly rely on the mobile devices, usages times are also getting longer and longer. However, prolonged use of the mobile devices usually causes the integrated circuits of the mobile devices to crash due to overheating, and thereby is very inconvenient.

(3) As the mobile phones or the tablet PCs are restricted by the size and weight requirements and are unable to use a fan as a heat dissipation means. A conventional method of heat dissipation is to attach a heat dissipation material thereon or to use a heat pipe. Nevertheless, under the operation of high power electronic components within the mobile devices, a heat dissipation efficiency provided by the aforesaid heat dissipation method is still very limited.

SUMMARY OF THE INVENTION

(4) The present invention provides a heat dissipation module, having a compact structure disposition and improved heat dissipation efficiency.

(5) The heat dissipation module of the present invention is suitable for an electronic device. The electronic device has a heat source. The heat dissipation module includes an evaporator, a plurality of heat conducting components, a pipe connected to the evaporator to form a loop, and a working fluid filled in the loop. An exterior of the evaporator has a heat conducting zone thermally contacted with the heat source to absorb heat generated from the heat source. The heat conducting components are disposed in the evaporator, located at an interior of the evaporator corresponding to the heat conducting zone. The heat conducting components are in pillar shape or rib shape respectively. The working fluid in liquid passes through the evaporator, absorbs heat, and is transformed into vapor to flow out of the evaporator. Each of the heat conducting components in rib shape is oriented in a flow direction of the working fluid.

(6) In view of above, in the aforementioned embodiment of the present invention, through a structural characteristic of the evaporator of the heat dissipation module, i.e., having the heat conducting zone at the exterior thereof to thermally contact with the heat source, can increase a thermal contact area between the heat source and the evaporator. In addition, the working fluid as being filled in the loop formed after connecting the pipe to the evaporator can efficiently absorb heat while passing through an inner space of the evaporator corresponding to the heat conducting zone. Thus, the working fluid transforms to vapor and carries away the heat by flowing away from the inner space of the evaporator, to attain a heat dissipation effect.

(7) To make the above features and advantages of the invention more comprehensible, several embodiments accompanied with drawings are described in detail as follows.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a partial exploded view of an electronic device according to an embodiment of the present invention.

(2) FIG. **2** is an exploded view of the electronic device of FIG. **1**.

(3) FIG. **3** is a partial schematic view of the heat dissipation module of FIG. **1**.

(4) FIG. **4** is a partial sectional view of the evaporator of FIG. **3**.

(5) FIG. **5** is a top view illustrating the heat dissipation module of FIG. **3**.

(6) FIG. **6** is a partial sectional view illustrating an evaporator in another embodiment of the present invention.

(7) FIG. **7** is a sectional view illustrating the evaporator in another embodiment of the present invention.

(8) FIG. **8** is a partial exploded view of an electronic device according to another embodiment of the present invention.

(9) FIG. **9** is a schematic view of the heat dissipation module of FIG. **7**.

(10) FIG. **10** and FIG. **11** are respective sectional views taken along the line A-A′ and line B-B′.

DESCRIPTION OF THE EMBODIMENTS

(11) Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

(12) FIG. **1** is a partial exploded view of an electronic device according to an embodiment of the present invention. Referring to FIG. **1**, in the present embodiment, electronic device **10** is, for example, a portable electronic device such as a notebook computer or a tablet PC, which has a slim and light appearance for complying with demands of convenient carrying. Nevertheless, with increasing demands in computation and display, an electronic device **10** has to be disposed with relative components having a heat dissipation effect in casings **310**, **320**, so as to meet the requirements in heat dissipation aroused in correspondence to the aforesaid demands in performance. Accordingly, the electronic device **10** includes a heat source **200** and a heat dissipation module **100**, wherein the heat source **200** is, for example, an electronic module such as a central processor or a display chip, and the heat dissipation module **100** can absorb a heat generated from the heat source **200** and can dissipate the heat from the other parts of the electronic device **10**.

(13) In the present embodiment, the heat dissipation module **100** is, for example, a siphon type heat dissipation component, which includes an evaporator **110**, a pipe **120** and a working fluid F**1** (only arrows representing a flow direction thereof are provided in the drawing). The evaporator **110** is configured to thermally contact the heat source **200**, so as to absorb the heat from the heat source **200**. The pipe **120** is connected to the evaporator **110** to form a loop, and the working fluid F**1** is filled in the loop. When flowing through the evaporator **110**, a phase transformation of the working fluid F**1** is occurred via heat absorption or dissipation. For example, the working fluid F**1** transforms from liquid to vapor by absorbing the heat, and then transforms to liquid again after heat dissipation. The vapor state working fluid F**1** moves away from the evaporator **110** to carry away the heat and flows through the other parts of the electronic device **10** with lower temperature along with the pipe **120**, in order to enable the working fluid F**1** to undergo a phase change condensation (transforming from the vapor state back to the liquid state). Thus, the heat is able to be dissipated away from the electronic device **10**.

(14) In detail, the heat dissipation module **100** of the present embodiment further comprises a heat pipe **130**, which is thermally contacted between the heat source **200** and the evaporator **110** to transfer the heat generated from the heat source **200** to the evaporator **110**. Further speaking, as shown in FIG. **1**, a first end E**1** of the heat pipe **130** is clasped on a plate body **500** of the electronic device **10** and structurally contacted on the heat source **200** by the clasp members **400**. A second

end E**2** of the heat pipe **130** is structurally contacted to the evaporator **110** by welding, and is substantially contacted to a recess **112** of a portion of an exterior surface S**1** of the evaporator **110**. Therefore, the heat pipe **130** can transfer the heat generated from the heat source **200** to the recess **112** of the evaporator **110** through a phase transition of another working fluid therein. It is worth noting that, as the disposition shown in FIG. **1**, the electronic device **10** in the present embodiment can provide certain heat dissipation effect to the heat source **200** through the plate body **500**, i.e., the heat is uniformly distributed to all over the plate body **500** and the heat dissipation module **100** by contacting the heat pipe **130** and the pipe **120** to the plate body **500** together. In other embodiments not being illustrated, the plate body **500** can also be a partial structure or whole structure of the casings **310**, **320**. Moreover, in the present embodiment, the plate body **500** is made of metal material, so that it can also provide an electromagnetic interference (EMI) shielding effect to the heat source **200** (such as the aforementioned central processor or display chip.)

(15) FIG. **2** is an exploded view of the electronic device of FIG. **1** to illustrate the other elements not shown in FIG. **1**. Referring both of FIG. **1** and FIG. **2**, further speaking, in the present embodiment, the plate body **500** is assembled to a circuit board **210** via protrusion structures (elements such as fasten components that are known in prior art are omitted here.) The heat dissipation module **100** further comprises a heat conducting sheet **170** is contacted to the heat source **200** (i.e., the electronic module) and substantially located between the plate body **500** and the heat source **200** (i.e., the electronic module), so that a portion of the heat generated from the heat source **200** (i.e., the electronic module) can be transferred to the plate body **500** through the heat conducting sheet **170**. Herein, the heat conducting sheet **170** has a recessed main body **174** and an opening **172**, and the heat dissipation module **100** further comprises a heat conducting pad **243** and a heat conducting glue **242**. The recessed main body **174** of the heat conducting sheet **170** is contacted to the heat source **200** (i.e., the electronic module) through the heat conducting glue **242**, and can expose the plate body **500** through an opening **510**, so that a portion of the heat pipe **130** is supported on the recessed main body **174**. The heat conducting pad **243** is passed through the opening **172** and contacted to the heat pipe **130** disposed at the recessed main body **174**. In addition, a central portion of the clasp members **400** are contacted to the plate body **500**, and an end of the clasp members **400** is passed through the opening **520** of the plate body **500** and assembled to the circuit board **210** (as the resultant structure shown in FIG. **2**, but the form thereof is not limited here), so that forming a state that the heat conducting sheet **170** and the plate body **500** are clasped between the clasp members **400** and the circuit board **210**. Thus, the heat conducting sheet **170** and the plate body **500** can be more tightly contacted to the heat source **200** (i.e., the electronic module) through the heat conducting pad **243**.

(16) The heat pipe **130** is disposed at the trench **530** of the plate body **500**, and the first end E**1** of the heat pipe **130** is thermally contacted to the heat source **200** (i.e., the electronic module), and the second end E**2** of the heat pipe **130** is thermally contacted to the evaporator **110**. Therefore, another portion of the heat generated from the heat source **200** (i.e., the electronic module) is transferred to the evaporator **110** through the heat pipe **130**.

(17) Accordingly, a portion of the heat generated from the heat source **200** (i.e., the electronic module) is sequentially transferred to the plate body **500** through the heat conducting glue **242** and the heat conducting sheet **170**, and another portion of the heat is transferred to the heat pipe **130** through the heat conducting pad **243**, wherein the aforementioned heat transfer paths are close to each other and located at the first end E**1** of the heat pipe **130**. Thus, the heat transferred to the plate body **500** can also provide a heating effect to the heat pipe **130** because of structural contact thereof. As a result, a portion of the heat generated from the heat source **200** (i.e., the electronic module) can be dissipated through the plate body **500**, i.e., the plate body **500** can provide not only an EMI shielding effect by covering the heat source **200** (i.e., the electronic module), but a heat dissipation effect due to properties of the material (such as metal) thereof and relatively large area (compared to the other elements.)

(18) In addition, as shown in FIG. **1**, the heat dissipation module **100** can also be further contacted to the casing **310** through the heat conducting pad **241** disposed on the plate body **500**. Such that, the heat on the plate body **500** can be further transferred to the casing **310** to attain an effect of dissipating heat away from the electronic device **10**.
(19) FIG. **3** is a partial schematic view of the heat dissipation module of FIG. **1**, such that an internal structure thereof can be successfully identified by partially disassembling the evaporator **110**. FIG. **4** is a partial sectional view of the evaporator of FIG. **3**. Referring to both of FIG. **3** and FIG. **4**, in the present embodiment, the second end E**2** of the heat pipe **130** substantially fills up the recess **112**. That is, the heat pipe **130** is structurally contacted to walls W**1**, W**2** at the recess **112** of the evaporator **110**, so that a thermal contact area of the heat pipe **130** and the evaporator **110** is increased, and a heat conduction efficiency is effectively increased due to a compact disposition of the heat pipe **130** and the evaporator **110** (i.e., the walls W**1**, W**2** can be served as heat conducting walls of the evaporator **110**.)
(20) Moreover, a top surface S**2** of the heat pipe **130** is coplanar with the exterior surface S**1** of the evaporator **110** because of the compact disposition of the aforementioned heat pipe **130** and the evaporator **110** at the exterior surface S**1** of the evaporator **110**. As a result, in consideration of structure disposition, this configuration can also increase a disposition efficiency of the heat dissipation module **100** and surrounding elements thereof in the electronic device **10**, i.e., a space utilization efficiency in the electronic device **10** is increased.
(21) As shown in FIG. **4**, portions of the evaporator **110** at the walls W**1**, W**2** are the thinnest of the whole structure thereof, such that the evaporator **110** in the present embodiment can efficiently absorb a heat from the second end E**2** of the heat pipe **130**. That is, thickness of the walls W**1**, W**2** is smaller than that of the other walls of the evaporator **110**, e.g., a thickness t**1** and a thickness t**2** are substantially smaller than a thickness t**4** and a thickness t**5**. In addition, the second end E**2** of the heat pipe **130** is disposed compactly with the recess **112** of the evaporator **110**, so that the heat pipe **130** can provide a structural support to the aforementioned walls W**1**, W**2**, and thus bring about both effects of increasing heat conduction efficiency and enhancing structure strength. Besides, in another embodiment not being illustrated, the thickness t**1** and the thickness t**2** can also be substantially smaller than thickness t**3**, t**4** and t**5**. Similarly, by applying the thickness difference, the heat of the heat pipe **130** can be transfer to the evaporator **110** through the walls with smaller thickness.
(22) As shown in FIG. **3** and FIG. **4**, the evaporator **110** is substantially formed by assembling a main body **111** and a cover body **113**, in order to form an inner space that the working fluid F**1** flows therein, wherein the main body **111** has openings E**3**, E**4** connecting to the pipe **120** that the working fluid F**1** flows in or out thereby (The flow direction of the working fluid F**1** are presented by the arrows in the figures, but it is not limited thereby. In another embodiment not being illustrated, the working fluid can also flow in a reversed direction.) In addition, the main body **111** has the aforementioned recess **112** and thus forms a protrusion in the inner space thereof. Further speaking, the inner space of the evaporator **110** thus can be separated into a flowing region R**2** and a heating region R**1**, wherein the protrusion thereof is the heating region R**1**, and a region thereof connected to the pipe **120** and the openings E**3**, E**4** is the flowing region R**2**. Further illustration will be given below.
(23) In the present embodiment, the heat dissipation module **110** further comprises a plurality of heat conducting components **140**, which are disposed in the heating region R**1** and located on the wall W**1** corresponding to the recess **112**. Herein, the plurality of heat conducting components **140** are in pillar shape and arrayed on the wall W**1**. That is, when the working fluid F**1** flows from the opening E**3** to the heating region R**1** of the evaporator **110**, a heat exchange efficiency of the working fluid F**1** and the walls W**1**, W**2** can be increased. The heat of the walls W**1**, W**2** connected to the heat pipe **130** is more efficiently exchanged through the heat conducting components **140** extended from the wall W**1**, so that the working fluid F**1** in liquid absorbs the heat and is

transformed to the working fluid F**1** in vapor, and flows into the pipe **120** through the opening E**4**.
(24) It is worth noting that, as the structure disposition shown in FIG. **1**, the pipe **120** is substantially disposed around the plate body **500**. That is, in the present embodiment, the plate body **500** further comprises a plurality of side protrusions **540**. At least a portion of the pipe **120** is substantially contacted to the side protrusions **540**, wherein a formation method of the contact is not limited here, it can be performed by welding. In other words, all methods, which can form thermal contact between the pipe **120** and the plate body **500** to efficiently transfer the heat from the evaporator **110** to the plate body **500**, are suitable in the present embodiment. Accordingly, the working fluid F**1** in the evaporator **110** absorbs the heat and is transformed to vapor from liquid, and is collected and transferred to the pipe **120**. When the working fluid F**1** in vapor is transferred to where the pipe **120** is thermally contacted to the plate body **500**, the plate body **500** thus can absorb the heat, in order to provide a condensation effect to the working fluid F**1**. Therefore, the working fluid F**1** in vapor is transformed back to liquid, and can be transferred back to the evaporator **110** through the pipe **120**. Herein, an improved heat conduction efficiency is provided due to properties of the plate body **500**, which include larger area and material properties of metal. Accordingly, the working fluid F**1** in vapor can attain the condensation effect while passing through the plate body **500** along with the pipe **120**, such that the working fluid F**1** in vapor is transformed back to the working fluid F**1** in liquid and returned to the evaporator **110** again through the opening E**3**.
(25) Moreover, in the evaporator **110**, each of the heat conducting components **140** is contacted between the wall W**1** of the main body **111** and the cover body **113**. Thus, during the assembly of the main body **111** and the cover body **113**, the heat conducting components **140** can also serve as a support structure thereof, in order to avoid a deformation of the inner space of the evaporator **110** resulted from improper assembly.
(26) FIG. **5** is a top view illustrating the heat dissipation module of FIG. **3**. Referring to FIGS. **3** and **5**, a structure of a connection portion between the inner space of the evaporator **110** and pipe **120** presents a profile gradually converging towards the pipe **120** in relation to other structure of the inner space. Further speaking, the inner space of the evaporator **110** further includes a first guiding surface U**1**, a second guiding surface U**2** and the third guiding surface U**3** located at the periphery of the inner space respectively, wherein the first guiding surface U**1** and the second guiding surface U**2** are gradually converging from the inner space towards the pipe **120** (namely, the opening E**4**) while the third guiding surface U**3** is gradually converging from the inner space towards the pipe **120** (namely, the opening E**3**), and gradually converging directions for the two profiles are opposite to each other. In other words, the first guiding surface U**1** and the second guiding surface U**2** are located at two opposite sides of the opening E**4** and are tilted towards the opening E**4**, while the third guiding surface U**3** is adjacent to the opening E**3** and is titled towards the opening E**3**.
(27) Besides, the second guiding surface U**2** and the third guiding surface U**3** are located at the heating region R**1**, the first guiding surface is located at the flowing region R**2**, and the heat conducting components **140** disposed at the heating region R**1** is located between the second and the third guiding surfaces.
(28) In view of the above, when the working fluid F**1** flows into the inner space of the evaporator **110** through the opening E**3**, the flow direction thereof will produce a jet stream effect due to a sudden open space formed by the third guiding surface U**3**, as shown by the dashed-arrows in FIG. **3**. Next, the working fluid F**1** absorbs the heat mainly through the heat conducting components **140** and a phase transformation is occurred (the working fluid F**1** transforms from liquid state to vapor state), and after being converged by the gradually converging profile formed by the first guiding surface U**1** and the second guiding surface U**2**, the working fluid F**1** then flows into the pipe **120** through the opening E**4**.
(29) It is to be mentioned that, although as shown in the present embodiment, only the third guiding

surface U**3** is located at the opening E**3** while the first guiding surface U**1** and second guiding surface U**2** are located at the opening E**4**, the present embodiment does not intend to limit the number of guiding surfaces at the two sides of the chamber within the evaporator **110** and their degree of tilt. That is, those skilled in the art should be able to dispose a proper number of guide surfaces at the two openings of the inner space according to the characteristics of the working fluid and the heat dissipation requirements thereof so as to form the structures that gradually converge towards the pipe. On the other hand, the pipe **120** of the present embodiment is substantially divided into a main segment E**5** and two end portions E**1**, E**2**, wherein the main segment E**5** is located between the end portions E**1**, E**2**, and the pipe **120** is connected with the openings E**3**, E**4** of the evaporator **110** through the end portions E**1**, E**2** thereof (e.g., the end portion E**1** connects to the opening E**3**, and the end portion E**2** connects to the opening E**4**). Herein, it is to be noted that, at least one of the end portions E**1**, E**2** of the pipe **120** has a structure gradually converging towards the evaporator **110**. In other words, a size relationship between the pipe **120** and the inner space of the evaporator **110** of the present embodiment is that: a pipe diameter of the main segment E**5** is substantially greater than or equal to a thickness of the inner space of the evaporator **110**, and the thickness of the inner space of the evaporator **110** is greater than a pipe diameter of each of the end portions E**1**, E**2**.
(30) As a result, since the main segment E**5** has a pipe diameter relatively greater than that of the end portions E**1**, E**2**, the working fluid F**1** can maintain a larger flow and a lower pipeline loss at the main segment E**5**, and when the working fluid F**1** flows from the end portion E**1** or E**2** into the evaporator **110**, through using the gradually converging pipe diameter in collaboration with the gradually converging structure of the inner space of the evaporator **110** (which is a gradually diverging profile to the working fluid F**1**), the jet stream effect can enhance the working fluid F**1** to be uniformly sprayed to every part of the inner space. As previously described, the invention does not limit the flow direction of the working fluid, that is, the heat dissipation module **100** of the present embodiment can enable the working fluid F**1** to flow towards different directions in correspondence to a use state of the electronic device **10**, and can also enable the working fluid F**1** to maintain its flow volume and flow rate regardless of any direction through using the gradually converging pipe diameters of the two end portions E**1**, E**2** of the pipe **120**, and thereby achieves the jet stream effect.
(31) Furthermore, the main segment E**5** is substantially thermally contacting with the plate body **500**, and thus, with the feature that the plate body **500** has a larger area and is made of metal material, a favorable heat transfer effect can be provided so as to enable the vapor state working fluid F**1** to attain a condensation effect when flowing through the main segment E**5** of the pipe **120** from end portion E**2** or E**1**, so that the vapor state working fluid F**1** can be transformed back into the liquid state working fluid F**1** and flows into the evaporator **110** through the end portion E**1** or E**2**, again.
(32) FIG. **6** is a partial sectional view illustrating an evaporator in another embodiment of the present invention. Referring to FIG. **6**, the difference from the aforementioned embodiment is that heat conducting components **640** in the present embodiment are in rib shape, and an extending direction thereof is oriented in a flow direction of the working fluid F**1**. This configuration can also attain the aforementioned effects of support and heat conduction.
(33) FIG. **7** is a sectional view illustrating the evaporator in another embodiment of the present invention. The difference from the aforementioned embodiments is that a heat source **200**A in the present embodiment is directly contacted to a recess **112**A of an evaporator **110**A, so that a heat generated from the heat source **200**A can be more directly transferred to the evaporator **110**A. The other structure of the present embodiment can be known by the aforementioned embodiments, so that they are omitted here.
(34) FIG. **8** is a partial exploded view of an electronic device according to another embodiment of the present invention. FIG. **9** is a schematic view of the heat dissipation module of FIG. **8**. FIG. **10**

and FIG. **11** are respective sectional views taken along the line A-A′ and line B-B′. Referring FIG. **8** to FIG. **11**, a part of the present embodiment that is the same as the aforementioned embodiments, this includes that a configuration of relative elements of the electronic device **20** is the same as that of the aforementioned electronic device **10**. Besides, most elements of a heat dissipation module **600**, such as the heat conducting sheet **170**, the heat pipe **130**, the evaporator **110** and the pipe **120** are the same as those of the aforementioned embodiments. Besides, the heat conducing pads **241** between the pipe **120** and the casing **310**, are merely different in appearance that do not affect their function. In other words, the heat transfer paths of the aforementioned embodiments can also be realized in the present embodiment.

(35) Another part of the present embodiment that is different to the aforementioned embodiments is described below. A plate body **630** not only provides the aforementioned EMI shielding effect, and is contacted to the heat conducting sheet **170**, the evaporator **110** and the pipe **120** to provide the corresponding condensation effect, but also has an inner space **631** to be a hollow plate body. Besides, a block wall **640** and a plurality of heating pillars **620** are disposed in the inner space **631**, wherein the block wall **640** separates the inner space **631** into a heating region R**3** and a condensation region R**4**. Heating pillars **620** are stood in the heating region R**3**, and a plurality of channels **610** are disposed in the condensation region R**4** by disposing a plurality of block-wall-like structures parallel to each other in the condensation region R**4**. A working fluid F**2** is filled in the inner space **631** to flow between the heating region R**3** and the condensation region R**4**.

(36) It is worth noting that, as shown in FIG. **9**, as the plate body **640** covers the circuit board **210** to shield the heat source **200** (i.e., the electronic module), the heating region R**3** is substantially and correspondingly contacted and stacked on the heat conducting sheet **170** and a heat absorbing end of the heat pipe **130** on the heat source **200** (i.e., the electronic module). Accordingly, the heating region R**3** thus can absorb the heat generated from the heat source **200** (i.e., the electronic module) and further heat the working fluid F**2** in liquid therein, in order to transform the working fluid F**2** to vapor. Such that, the working fluid F**2** in vapor can be guided, and flow to the condensation region R**4** along with the block wall **640**. Afterwards, as shown in FIG. **8**, the heat conducting pads **241** are sandwiched between the plate body **630** of the heat dissipation module **600** and the casing **310**, so that the working fluid F**2** in the condensation region R**4** can transfer the heat to the casing **310** through the heat conducting pads **241**, so that the heat is then dissipated away from the electronic device **20**. Thus, the working fluid F**2** in vapor in the channels **610** is gradually condensed to liquid, and then flows back to the heating region R**3** again.

(37) It is worth noting that, when the electronic device **20** is placed at certain positions to be, for example, in a standing state, the heating region R**3** appears to be under the condensation region R**4** of the inner space **631** in the plate body **630**. In this case, the channels **610** in the condensation region R**4** substantially appear to be extending along with a direction from upper left to lower right, thus the working fluid F**2** can be circulated more efficiently in the inner space **631**, and properties of the working fluid F**2** is better exploited to attain higher working efficiency.

(38) In addition, the block wall **640** further comprises backflow prevention part **641** at where the working fluid F**2** flows back from the condensation region R**4** to the heating region R**3**. The backflow prevention part **641** is extended from the condensation region R**4** toward the heating region R**3**, in order to serve as a guiding structure that guides the working fluid F**2** in liquid to flow back to the heating region R**3**, and also avoid the working fluid F**2** in vapor from flowing from the heating region R**3** to the condensation region R**4**, which disrupts a fluid circulation.

(39) Besides, in another embodiment not being illustrated, the channels **610** shown in FIG. **9** can also be disposed at two opposite sides of the heating pillars **620** at the same time. In other words, the channels **610** shown in FIG. **9** are further disposed at the opposite side of the heating pillars **620**, so that the heating region R**3** is located between two condensation regions R**4**. This configuration can attain an effect of circulation of the working fluid F**2** through the heating pillar **620** and the channels **610** in the inner space **631** of the plate body **630**, while the electronic device

20 is used with different angles. That is, appropriate number of the condensation regions R**4** can be disposed around the heating region R**3** by users according to their requirements. Such that, the plate body **630** can realize a heat dissipation efficiency in correspondence to different usage states of the electronic device **20**, in order to improve an applicability of the heat dissipation effect of the plate body **630**.
(40) In view of above, in the above mentioned embodiments of the present invention, a heat dissipation module is thermally contacted to a heat source through a recess of an evaporator, to absorb a heat generated from the heat source effectively according to the structure of appearance thereof. In addition, an effect of compact disposition of the structure of the heat dissipation module is attained, so that elements in the electronic device can be better disposed, and a space utilization efficiency in the electronic device is improved. Moreover, thickness of walls at the recess of the evaporator is smaller than thickness of the other walls of the evaporator, which is beneficial for transferring the heat to a working fluid in an inner space of the evaporator. A plurality of heat conduction components is disposed in the inner space of the evaporator corresponding to the recess, in order to increase a heat conduction area and a heat conduction efficiency between the evaporator and the working fluid. In one of the embodiments, the heat generated from the heat source is transferred to the evaporator through a heat pipe, and the recess is substantially filled up by the heat pipe. Therefore, a structure strength at the recess of the evaporator is improved, and it is beneficial for designers to dispose elements in the electronic device according to a compact disposition of the heat pipe and the evaporator. Moreover, the heat pipe and a pipe of the heat dissipation module can be contacted to a plate body of the electronic device, so that the heat is uniformly transferred to all over the plate body and the heat dissipation module through the plate body, which is advantageous to dissipate the heat.
(41) It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

Claims

1. A heat dissipation module, which is suitable for an electronic device having a heat source, the heat dissipation module comprising: an evaporator, having a recess at an exterior surface of the evaporator, the recess forming a heat conducting zone to absorb heat generated from the heat source; a heat pipe, thermally contacted to the heat source and disposed between the heat source and the evaporator, and the heat pipe is structurally contacted to the recess to transfer heat from the heat source to the evaporator; a plurality of heat conducting components, disposed in the evaporator, located at an interior of the evaporator corresponding to the heat conducting zone, and the plurality of heat conducting components being in pillar shape or rib shape respectively; a pipe, disposed outside the evaporator and connected to two openings disposed at opposite sidewalls of the evaporator that face each other in the interior of the evaporator so as to form a loop; and a working fluid filled in the loop, wherein the working fluid in liquid enters the evaporator from the pipe via one of the two openings, passes through the evaporator, absorbs heat, and is transformed into vapor to flow out of the evaporator and flow into the pipe via the other one of the two openings, wherein each of the heat conducting components in rib shape is oriented in a flow direction of the working fluid.