US 20040140084A1

(19) **United States**
(12) **Patent Application Publication**
Lee et al.
(10) **Pub. No.: US 2004/0140084 A1**
(43) **Pub. Date: Jul. 22, 2004**

(54) HEAT DISSIPATING DEVICE WITH FORCED COOLANT AND AIR FLOW

(76) Inventors: **Hsieh Kun Lee**, Tu-Chen (TW); **Lei Li**, Shenzhen (CN); **Cheng-Tien Lai**, Tu-Chen (TW)

Correspondence Address:
WEI TE CHUNG
FOXCONN INTERNATIONAL, INC.
1650 MEMOREX DRIVE
SANTA CLARA, CA 95050 (US)

(21) Appl. No.: **10/636,844**

(22) Filed: **Aug. 6, 2003**

(30) **Foreign Application Priority Data**

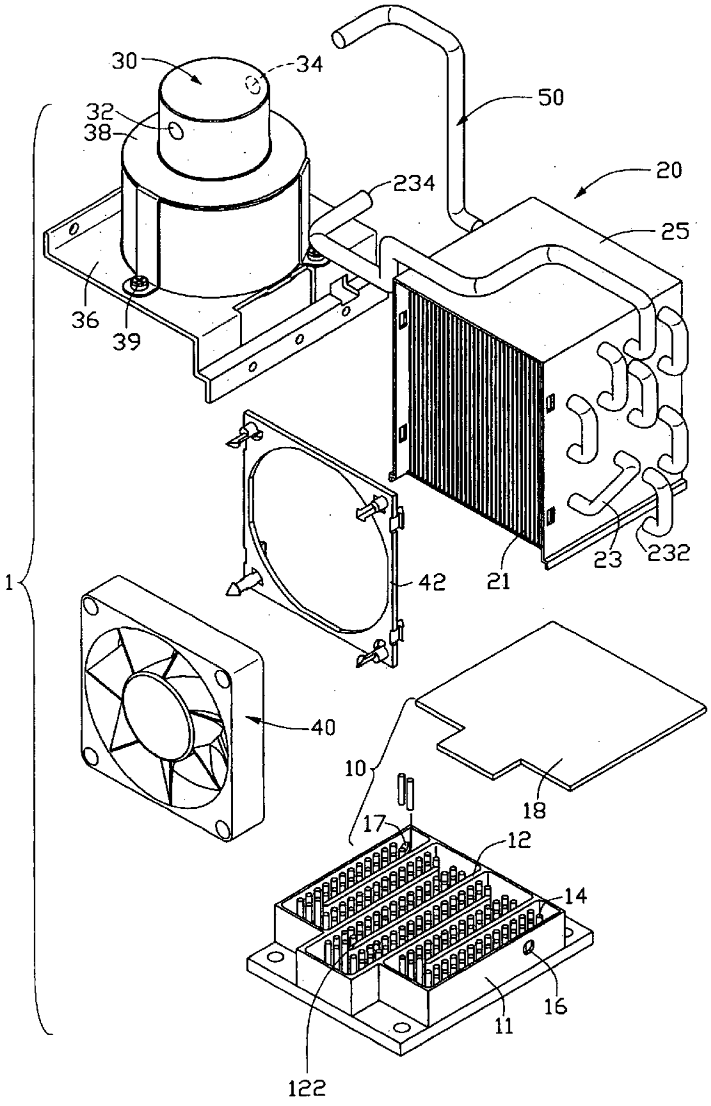
Jan. 22, 2003 (TW) 92201190

Publication Classification

(51) **Int. Cl.^{7}** **F28D 15/00**
(52) **U.S. Cl.** **165/104.11**

(57) ABSTRACT

A heat dissipating device (**1**) comprises a heat-conductive container (**10**), a heat sink (**20**), and an electric pump (**30**). The container defines a containing channel therein, a first inlet (**17**) and a first outlet (**16**) at opposite ends of the containing channel. The heat sink comprises a plurality of fins (**21**) and a heat pipe (**23**) extending through the fins. One end of the heat pipe is connected to the first outlet. The electric pump (**30**) has a second inlet (**32**) and a second outlet (**34**). The second inlet is connected to an opposite end of the heat pipe. The second outlet is connected to the first inlet. Thereby a hermetic loop is formed. Liquid coolant (not shown) is received in the hermetic loop and flows under driving force of the pump. Further, a fan is mounted to a side of the heat sink to provide forced convection.



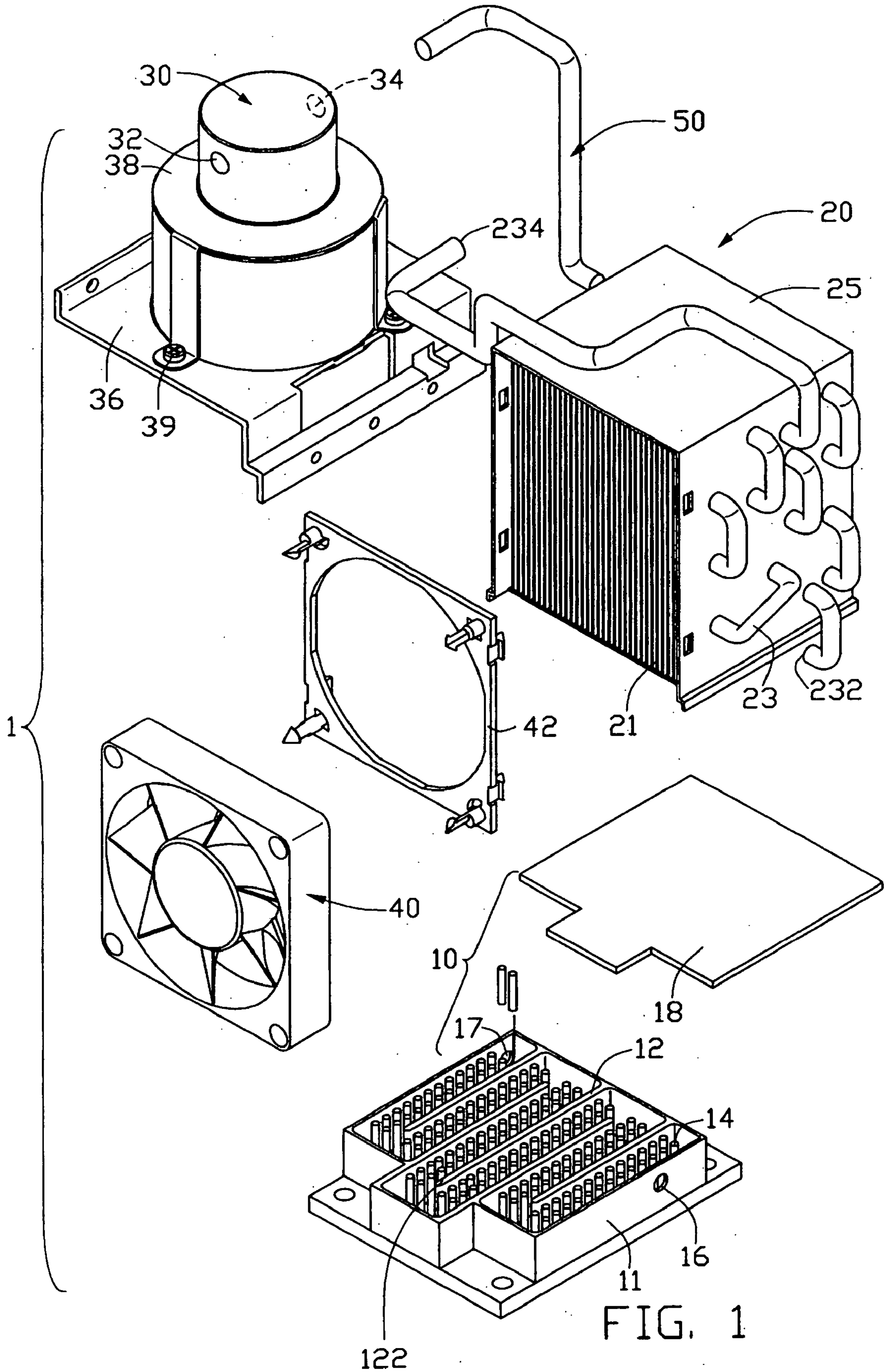

30
34
50
32
38
20
234
25
36
39
1
42
21
23
232
40
10
18
17
12
14
16
11
122

FIG. 1

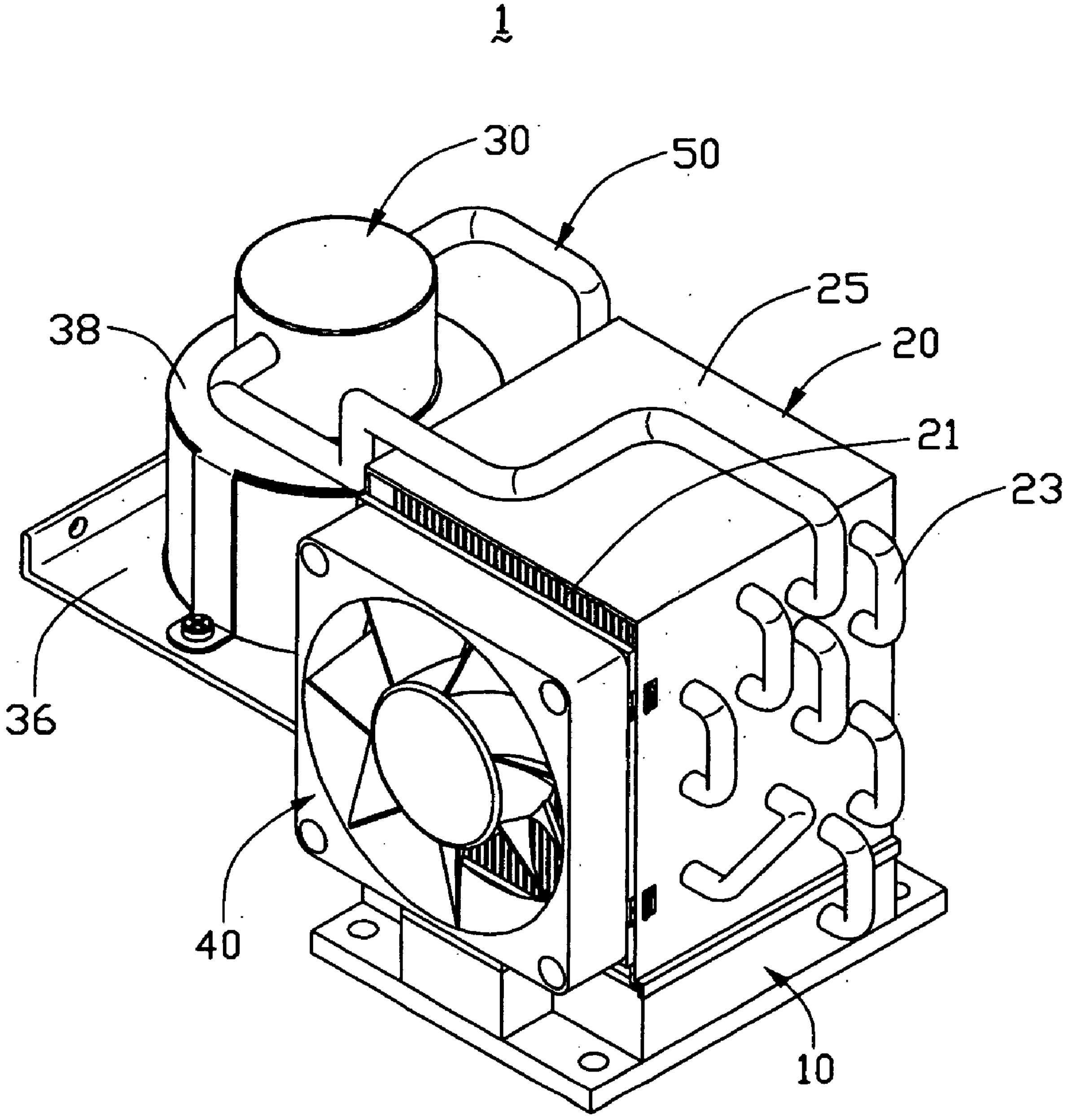


FIG. 2

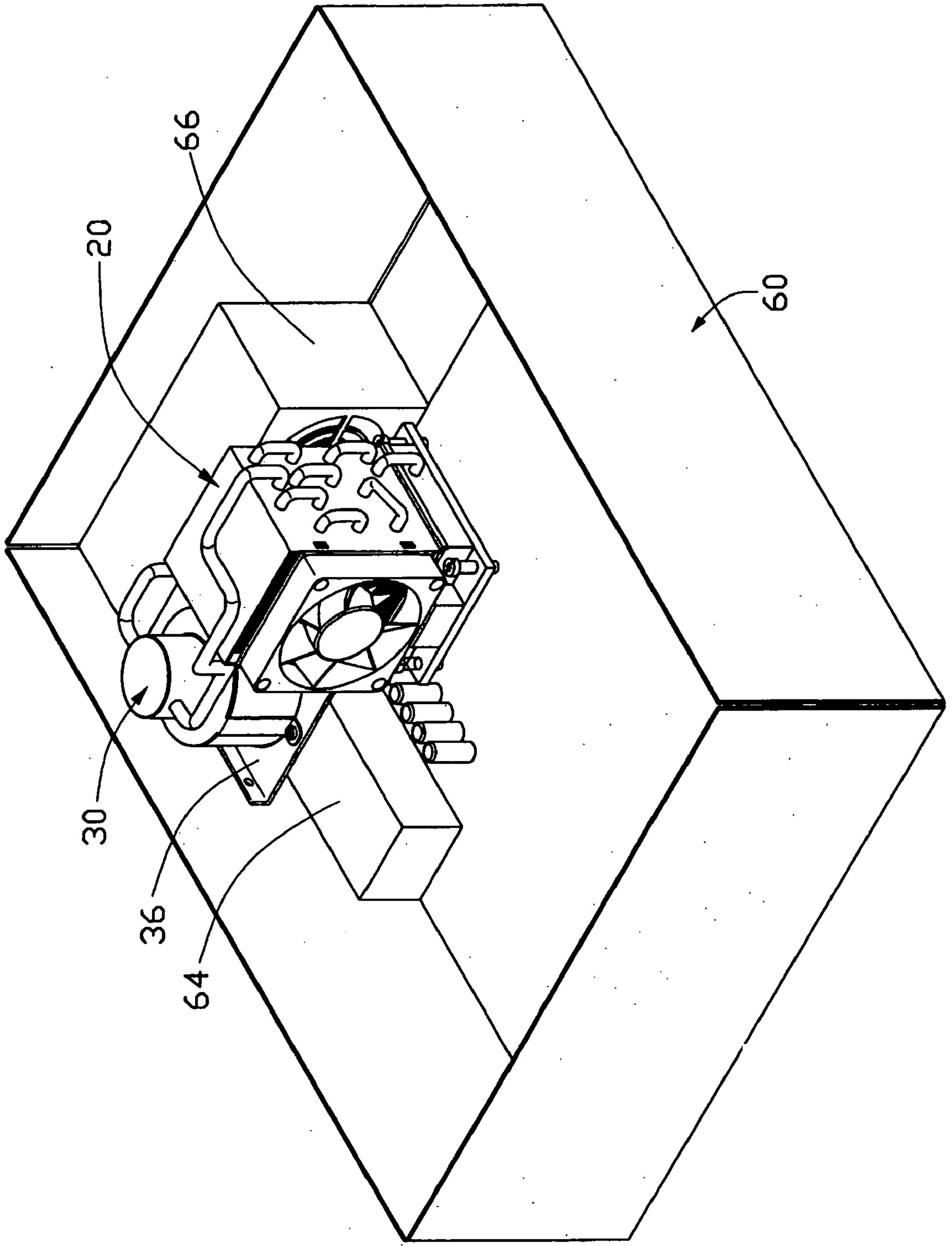


FIG. 3

HEAT DISSIPATING DEVICE WITH FORCED COOLANT AND AIR FLOW

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to heat dissipating devices having both forced coolant and air flow and, more particularly, to a heat dissipating device for cooling down an electronic component.

[0003] 2. Description of Related Art

[0004] With the rapid advancement of electronic technology, the processing speeds of electronic devices such as central processing units (CPUs) are constantly increasing. A modern high-density CPU generates more heat per unit area than its predecessors. Excessive heat in associated electronic equipment can degrade the performance and reliability of electronic components, and can even cause complete malfunction. Appropriate instantaneous cooling must be provided to prevent accumulation of excessive heat in the electronic components, in order to ensure that the electronic components can function effectively below their maximum permissible operating temperatures. Adequate cooling also protects the CPU itself from sudden or premature failure or interruption in operation, and ensures long-term reliability of the CPU. A conventional heat dissipating device comprises an electric fan coupled to the CPU. However, this kind of heat dissipating device is increasingly unable to satisfy the needs of contemporary high speed CPUs. This has given rise to another kind of heat dissipating device, in which both forced coolant flow and airflow are provided.

[0005] China Patent No. 99,254,044 discloses a heat dissipating device which is used in a computer. The heat dissipating device comprises a heat-conductive block, a water container, a heat sink, a pump, a heat pipe and cooling liquid. The heat-conductive block comprises a plurality of staggered partitions, the partitions cooperatively forming a circulatory passage containing the cooling liquid. The heat-conductive block is attached onto a surface of an electronic component such as a CPU, in order to absorb heat from a surface of the electronic component and transfer the heat to the cooling liquid. The cooling liquid absorbs the heat and flows to the water container via the pipe under driving force of the pump, and the heat is dissipated at the water container. The cooling liquid then flows into the heat sink, where more of the heat is dissipated. The heat dissipating device couples forced liquid cooling and forced airflow cooling, and thus provides improved heat dissipation efficiency.

[0006] However, in the above-described heat dissipating device, the heat-conductive block and the heat sink are separated. This makes the structure of the heat dissipating device unduly complicated and weighty, and difficult to mass-produce. The heat dissipating device runs contrary to the modern trend toward light and small electronic products. In addition, the circulatory passage of the heat-conductive block only has several separate blocks. A contact area of the cooling liquid in the circulatory passage is relatively small, which limits the efficiency of heat dissipation.

[0007] Therefore, an improved heat dissipating device for an electronic component which overcomes the above-mentioned problems is desired.

BRIEF SUMMARY OF THE INVENTION

[0008] Accordingly, object of the present invention is to provide a heat dissipating device with forced coolant and air flow which has excellent heat dissipation efficiency.

[0009] To achieve the above-mentioned objects, a heat dissipating device comprises a heat-conductive container, a heat sink, and an electric pump. The container comprises a main body and a top cover mounted to the main body. The main body defines a containing channel therein, and a first inlet and a first outlet at opposite ends of the containing channel. The container adapted to be intimately attached onto a heat-generating element. The heat sink comprises a plurality of fins and a heat pipe extending through the fins. One end of the heat pipe is connected to the first outlet of the container. The electric pump has a second inlet and a second outlet. The second inlet is connected to an opposite end of the heat pipe. The second outlet is connected to the first inlet of the container. The container, the heat sink and the pump thereby forms a hermetic loop. Liquid coolant is received in the hermetic loop and flows under driving force of the pump. Further, a fan is mounted to a side of the heat sink to provide forced convection. The heat generated from an electron component can be continuously dissipated via the heat sink by continuous circulation of the liquid coolant.

[0010] In achieving the said objectives of the invention herein, the technological means and overall structural innovations are disclosed to demonstrate the most feasible embodiments. Furthermore, the brief description of the drawings below and the following detailed description of the invention will enable a further understanding of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is an exploded, isometric view of a heat dissipating device in accordance with a preferred embodiment of the present invention;

[0012] **FIG. 2** is an assembled view of **FIG. 1**; and

[0013] **FIG. 3** is an isometric view of the heat dissipating device of **FIG. 2** installed in a computer cage.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] Referring to **FIGS. 1 and 2**, a heat dissipating device **1** in accordance with the preferred embodiment of the present invention comprises a heat-conductive container **10**, a heat sink **20**, an electric fan **40**, a heat-conductive pipe **50**, liquid coolant (not shown), and an electric pump **30**. The container **10** is attached to a primary surface of an electronic component such as a CPU (not shown), to transfer heat generated by the CPU to the heat sink **20** for subsequent dissipation therefrom.

[0015] The container **10** comprises a main body **11** and a top cover **18**. The main body **11** comprises a plurality of parallel partitions **12**. Each partition **12** has one end adjoining a peripheral wall of the main body **11**, and an opposite free end **122**. Consecutive adjacent partitions **12** are arranged so that the free ends **122** are staggered. Thus a zigzagged passageway (not shown) is defined in the main body **11**, for the liquid coolant to flow therealong. A plurality of vertical heat pins **14** is arranged between each two adjacent partitions **12**. A first outlet **16** and a first inlet **17** are respectively defined in two opposite sides of the peripheral wall.

[**0016**] The heat sink **20** comprises a bottom plate (not labeled), a plurality of parallel fins **21** supported on the bottom plate, a U-shaped shell **25** covering three sides of the plurality of fins **21**, and a heat pipe **23** that winds back and forth through the plurality of fins **21** from a bottom of the heat sink **20** to a top of the heat sink **20**. The bottom plate, shell **25** and plurality of fins **21** cooperatively define a plurality of parallel airflow passages between the fins **21**. The heat pipe **23** comprises an input portion **232** and an output portion **234** at respective opposite ends thereof. The input portion **232** of the heat pipe **23** is directly connected to the container **10** at the first outlet **16**. In an alternative embodiment of the present invention, the input portion **23** can be indirectly connected to the container **10** at the first outlet **16** via an intermediate pipe (not shown). The heat sink **20** is directly positioned on the container **10** such that the bottom plate of the heat sink **20** intimately contacts a top surface of the cover **18**, in order to enhance an efficiency of heat transfer therebetween.

[**0017**] The pump **30** defines a second inlet **32** and a second outlet **34**. The second inlet **32** engagingly receives the output portion **234** of the heat pipe **23**. The second outlet **34** is connected to the first inlet **17** of the container **10** through a conductive pipe **50**. The pump **30** is retained on a base **36** by a fastener **38**. A plurality of screws **39** attaches the fastener **38** to the base **36**.

[**0018**] Suitable sealing material is used to seal a joint where the first outlet **16** receives the input portion **232**, a joint where the second inlet **32** receives the output portion **234**, a joint where the second outlet **34** receives one end of the conductive pipe **50**, and a joint where the first inlet **17** receives an opposite end of the conductive pipe **50**. The container **10**, heat sink **20**, pump **30** and conductive pipe **50** thus cooperatively define a circulatory course therethrough. The liquid coolant is received in the circulatory course, and can flow under the driving force of the pump **30**. The sealing material provides hermetic sealing, which prevents the liquid coolant from leaking from the circulatory course.

[**0019**] The fan **40** is mounted to a front side of the heat sink **20** via a frame **42**. The fan **40** provides forced airflow directly through the airflow passages of the heat sink **20**.

[**0020**] In operation, the container **10** is attached to the primary surface of the CPU (not shown), and heat generated by the CPU is transferred to the liquid coolant via the main body **11** of the container **10**. The liquid coolant in the container **10** changes into high temperature liquid coolant, which flows out from the container **10** via the first outlet **16** into the heat pipe **23** of the heat sink **20** under driving force of the pump **30**. Heat of the high temperature liquid coolant is transferred to the fins **21** of the heat sink **20**, and dissipated therefrom by forced airflow provided by the fan **40**. The high temperature liquid coolant in the heat pipe **23** of the heat sink **20** is thus changed into low temperature liquid coolant. The low temperature liquid coolant flows through the circulatory course until it returns to the container **10**, whereupon it undergoes a new cycle as described above. The heat generated from the CPU can thus be continuously dissipated by continuous circulation of the liquid coolant. In addition, heat generated from the CPU is also directly transferred to the heat sink **20** through the cover **18** of the container **10**. The heat pins **14** of the container **10** enhance transfer of heat from the CPU to the cover **18**, and also enhance transfer of heat from the container **10** to the liquid coolant therein. By all the above-described means, the heat dissipation efficiency of the heat dissipating device **1** is considerable.

[**0021**] Referring to **FIG. 3**, the heat dissipating device **1** can be retained in a computer cage **60**. The pump **30** is mounted on a platform **64** of the cage **60** adjacent the heat sink **20**. Alternatively, the pump **30** may be mounted to another suitable part of the cage **60**. Forced airflow generated by the fan **40** flows directly from the airflow passages of the heat sink **20** into an inlet vent (not labeled) of a power supply **66**, and then to an outside of the cage **60** via an outlet vent (not shown) of the power supply **66**. The power supply **66** itself can also be cooled in this process. Indeed, other spaces inside the cage **60** can also be cooled in this process.

[**0022**] It is understood that the invention may be embodied in other forms without departing from the spirit thereof. Thus, the present examples and embodiments are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

What is claimed is:

1. A heat dissipating device comprising:

a heat-conductive container comprising a main body and a top cover mounted to the main body, the main body defining a containing channel therein, and a first inlet and a first outlet at opposite ends of the containing channel, the container adapted to be intimately attached onto a heat-generating element;

a heat sink comprising a plurality of fins and a heat pipe extending through the fins, one end of the heat pipe being connected to the first outlet of the container;

an electric pump having a second inlet and a second outlet, the second inlet being connected to an opposite end of the heat pipe, the second outlet being connected to the first inlet of the container, the container, the heat sink and the pump thereby forming a hermetic loop;

liquid coolant being received in the hermetic loop, and flowing under driving force of the pump; and

a fan mounted to a side of the heat sink to provide forced convection;

wherein the heat sink is directly attached to the top cover of the container.

2. The heat dissipating device as described in claim 1, wherein the main body comprises a plurality of parallel partitions, which define the containing channel as zigzagged.

3. The heat dissipating device as described in claim 1, wherein the main body comprises a plurality of heat pins positioned in the containing channel.

4. The heat dissipating device as described in claim 1, wherein the heat pipe winds back and forth through the heat sink.

5. The heat dissipating device as described in claim 1, wherein the heat sink further comprises a U-shaped shell covering three sides of the plurality of fins to define a plurality of airflow passages.

6. A heat dissipating device comprising:

a container defining a plane adapted to intimately contact a heat generation device, said container defining at least one containing channel with inlet and outlet communicating two opposite ends of the containing channel with an exterior;

a heat sink including a plurality of fins with at least one heat pipe engageably extending through said fins, said heat pipe further connecting to said inlet and said outlet and also serially connected to a pump, said heat pipe cooperating with said container and said pump to form a hermetic loop; and

liquid coolant circulated in said hermetic loop; wherein

a fan is located at one end f the heat sink and actuates air to move between the fins.

7. The heat dissipation device as described in claim 6, wherein said heat sink directly contacts said container;

8. The heat dissipation device as described in claim 7, wherein said heat sink is attached to another plane of the container which is opposite to said plane.

9. The heat dissipation device as described in claim 6, wherein a plurality of heat pins are located in the containing channel.

10. The heat dissipation device as described in claim 9, wherein said heat pins are integrally formed with the container.

11. The heat dissipation device as described in claim 6, wherein said heat pipe back and forth extend through said fins for more than one times.

* * * * *