US 20100126700A1

(19) **United States**

(12) **Patent Application Publication**

**Chen**

(10) **Pub. No.: US 2010/0126700 A1**

(43) **Pub. Date: May 27, 2010**

(54) **HEAT-RADIATING BASE PLATE AND HEAT SINK USING THE SAME**

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(21) Appl. No.: **12/276,636**

(22) Filed: **Nov. 24, 2008**

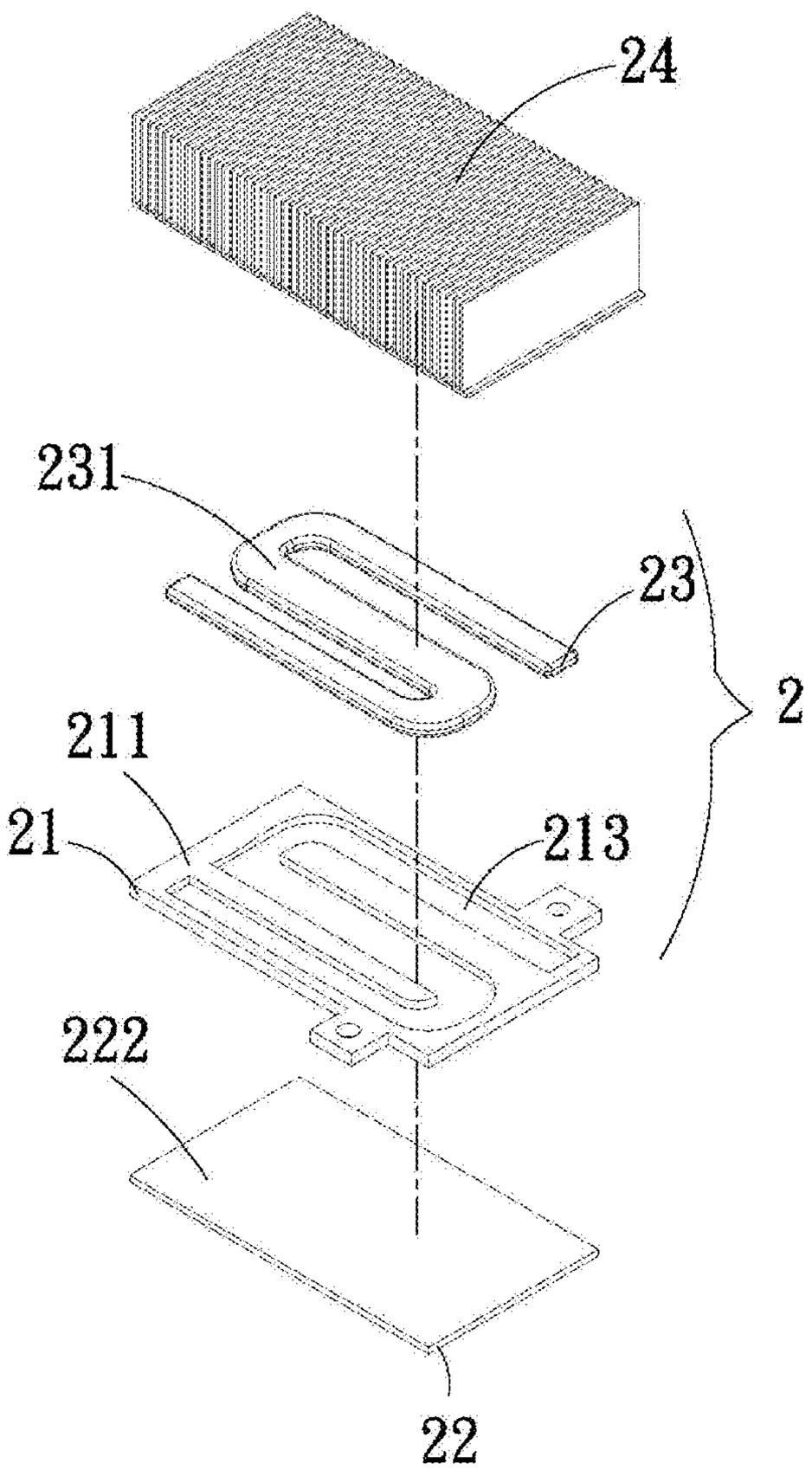
**Publication Classification**

(51) **Int. Cl.**
***F28D 15/00*** (2006.01)

(52) **U.S. Cl.** ..... **165/104.26**

(57) **ABSTRACT**

A heat-radiating base plate includes an aluminum-made upper base plate, a copper-made lower base plate, and a heat pipe unit. The upper base plate has a first face, an opposite second face, and a slotted pattern extended through the upper base plate in a thickness direction to communicate the first face with the second face. The heat pipe unit is set in the slotted pattern, and has a thickness equal to a depth of the slotted pattern. The heat pipe unit has a first and a second heat-conducting flat face flush with the first and the second face of the upper base plate, respectively. The second face and the second heat-conducting face are attached to the lower base plate, which has another flat face in contact with a heat-producing unit. A radiating fin assembly can be mounted to a top of the heat-radiating base plate to provide a heat sink.



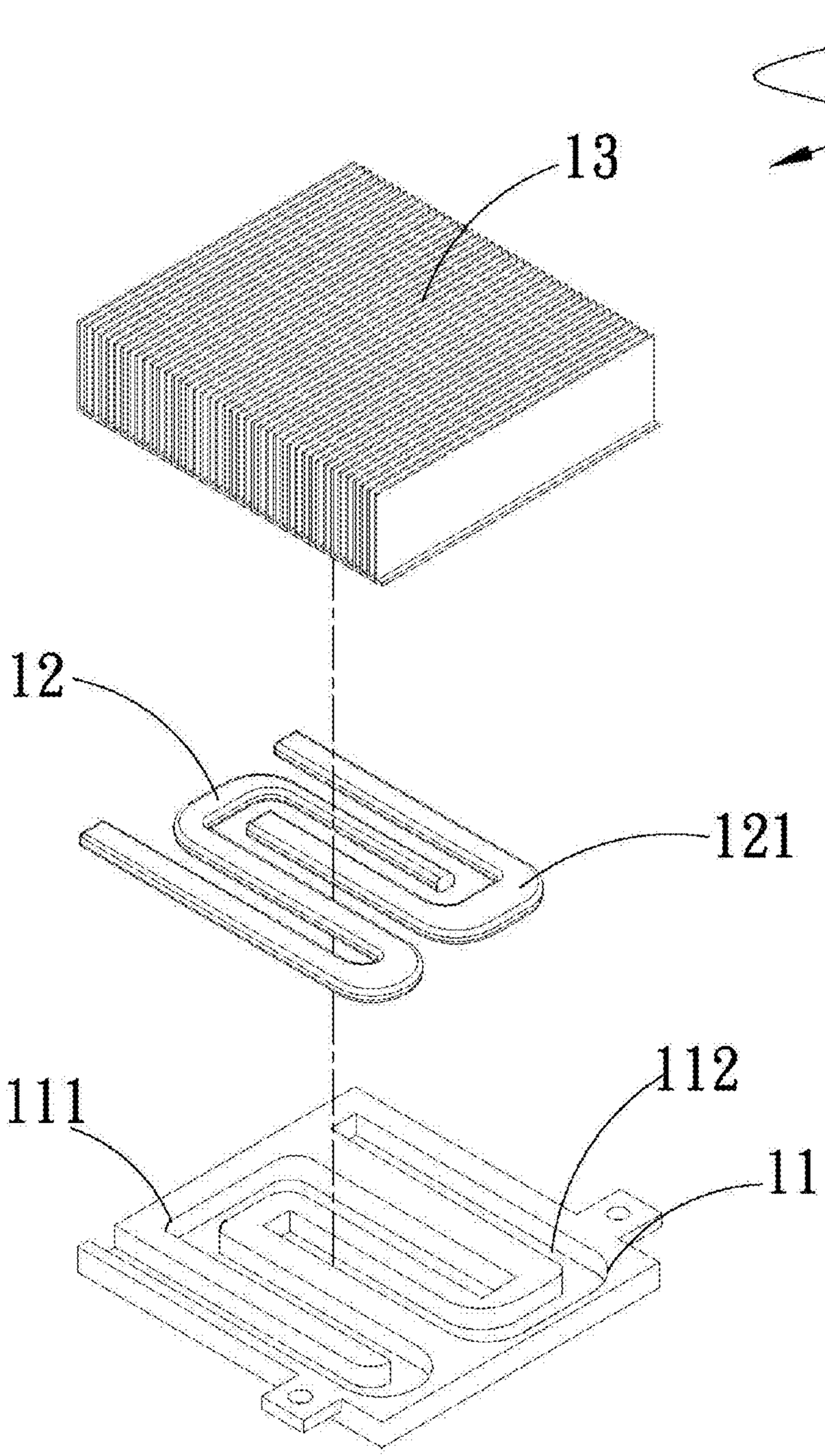



Fig.1 (PRIOR ART)

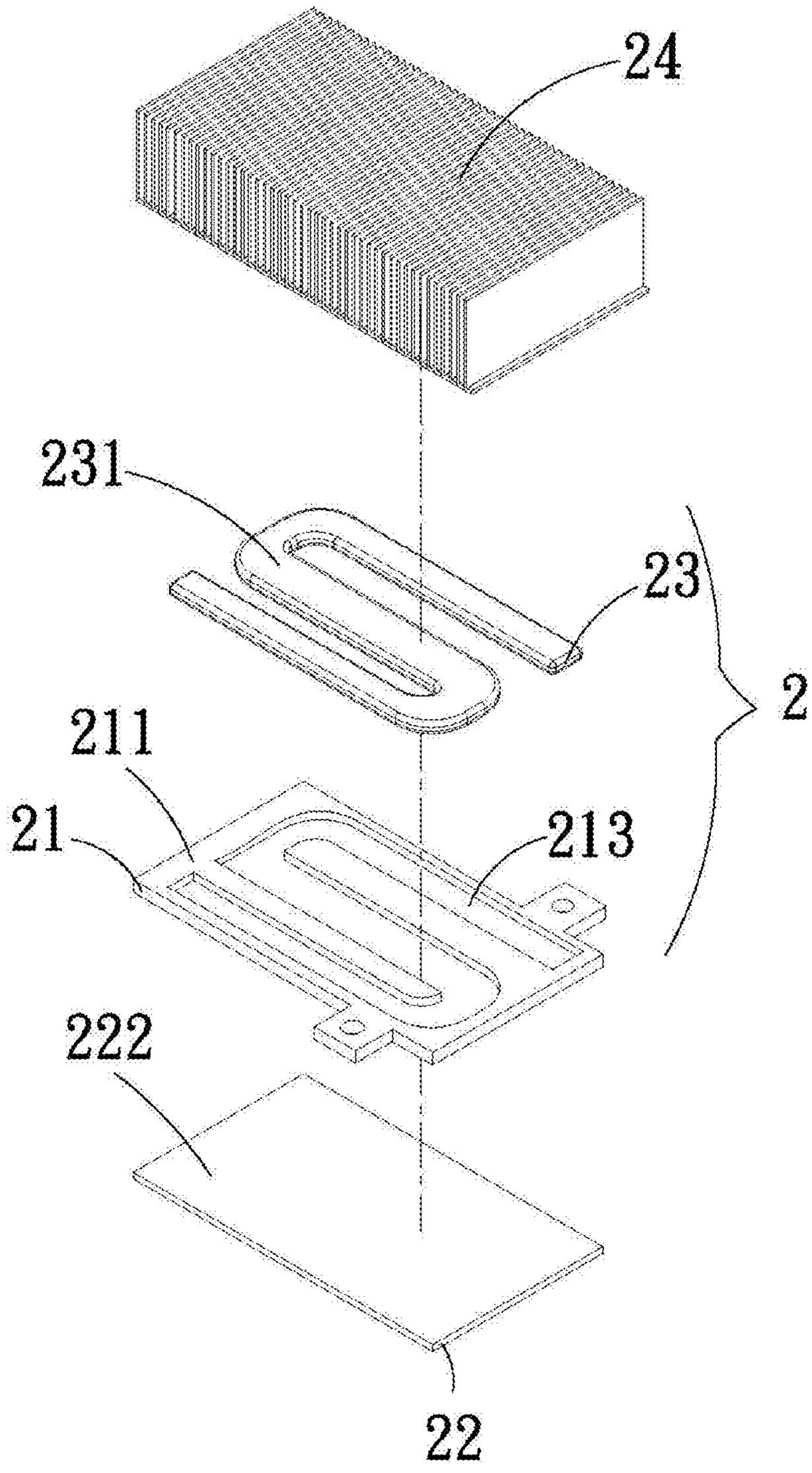



Fig.2

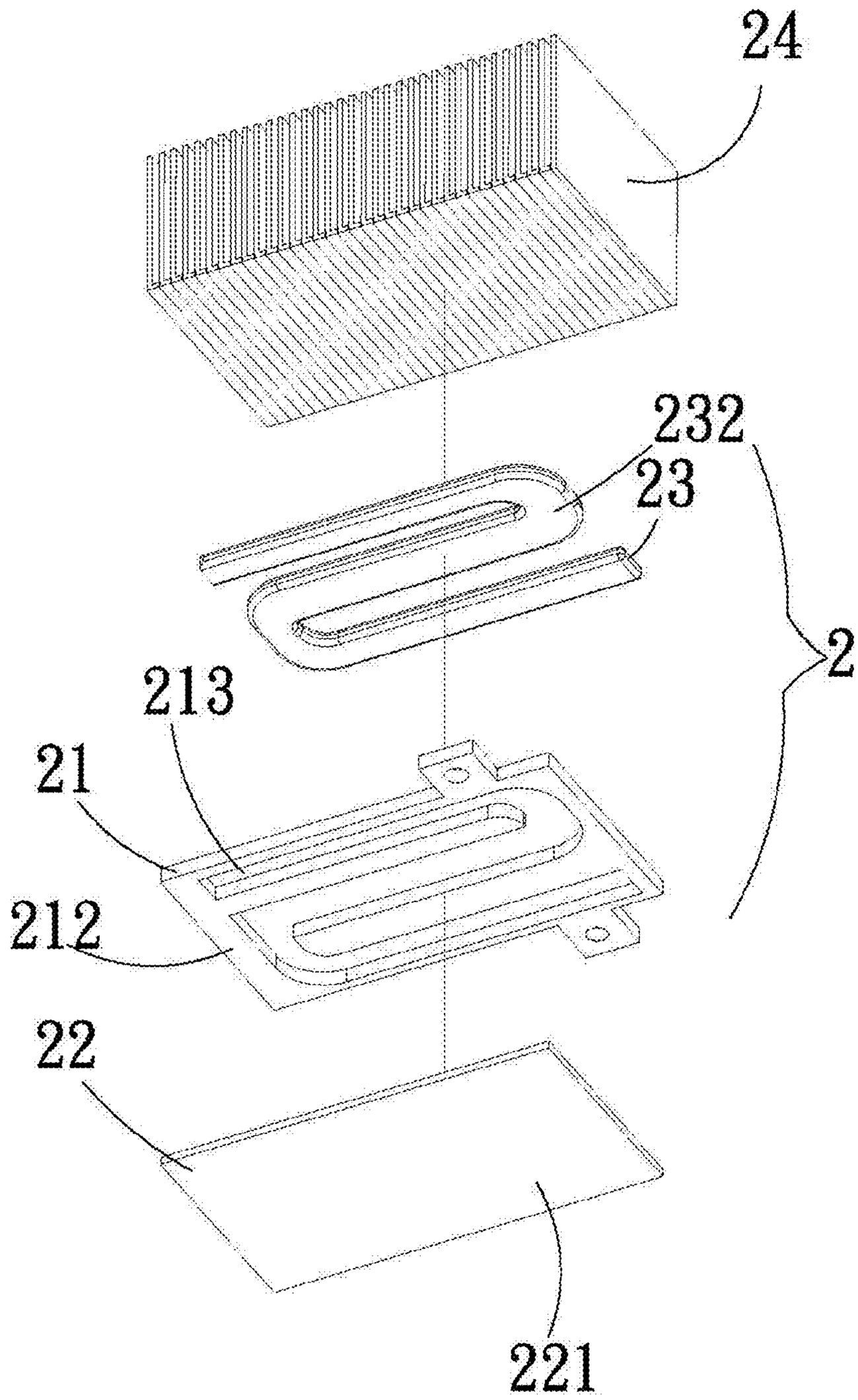



Fig.3

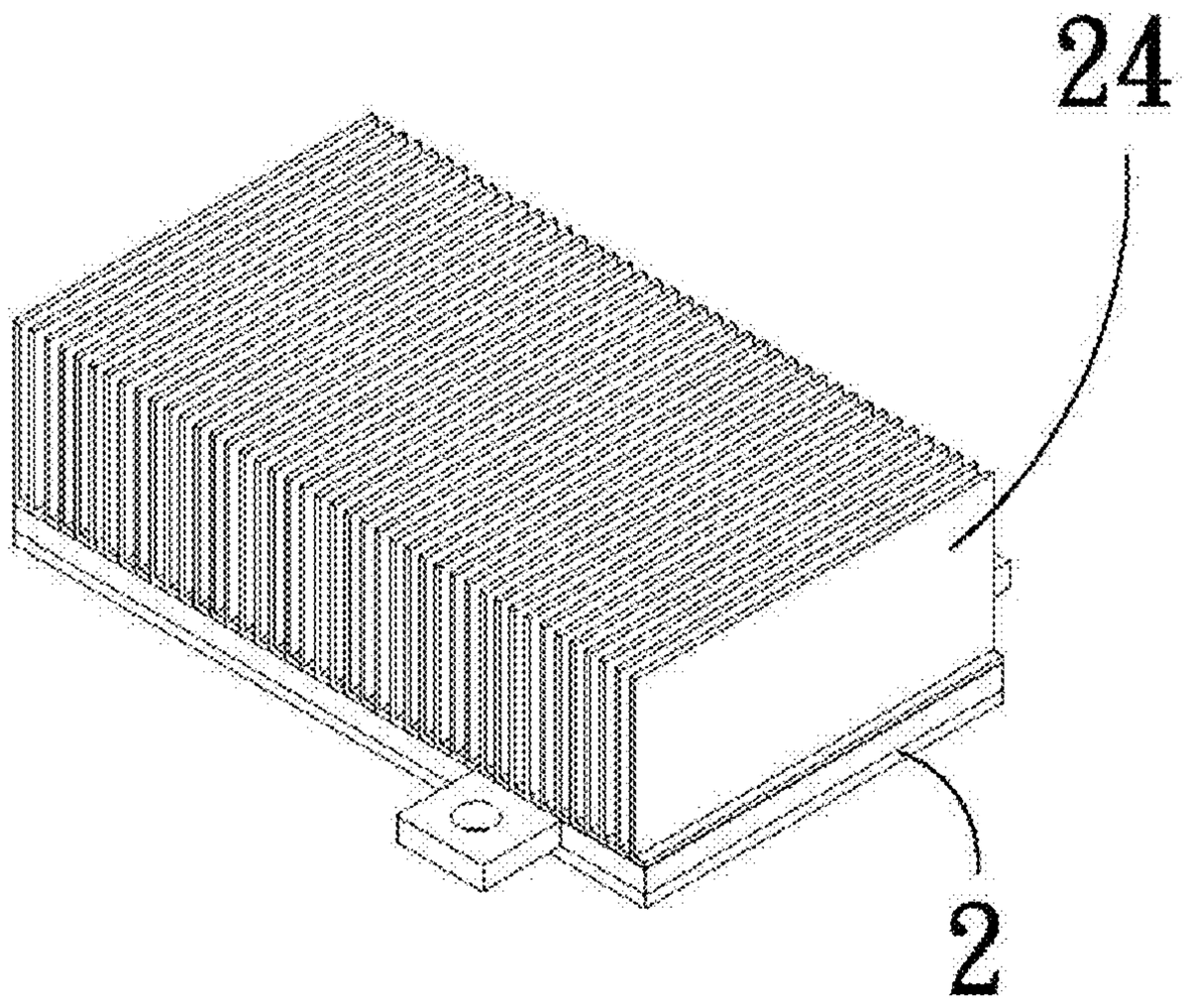



Fig.4

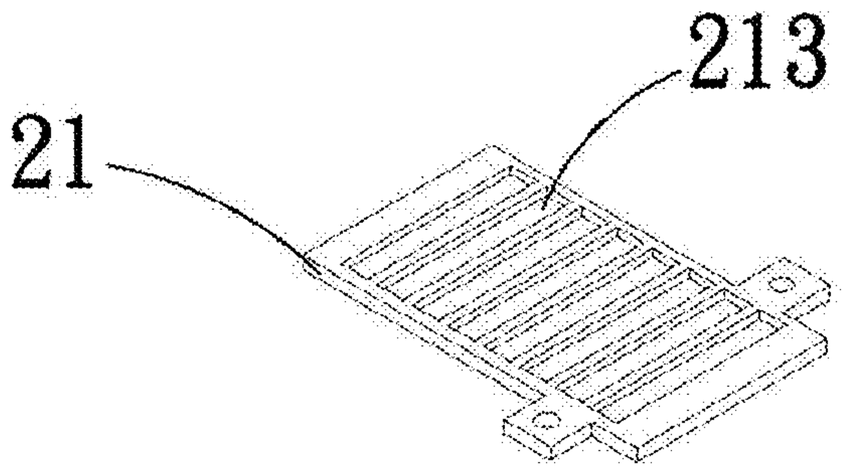



Fig.5A

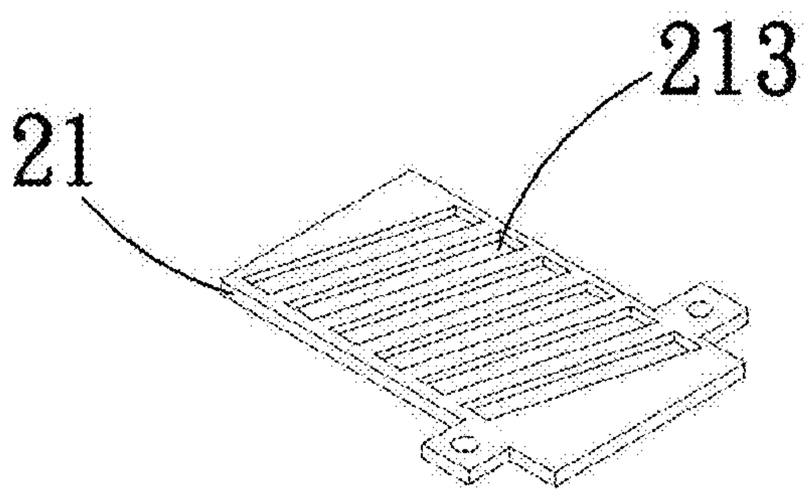



Fig.5B

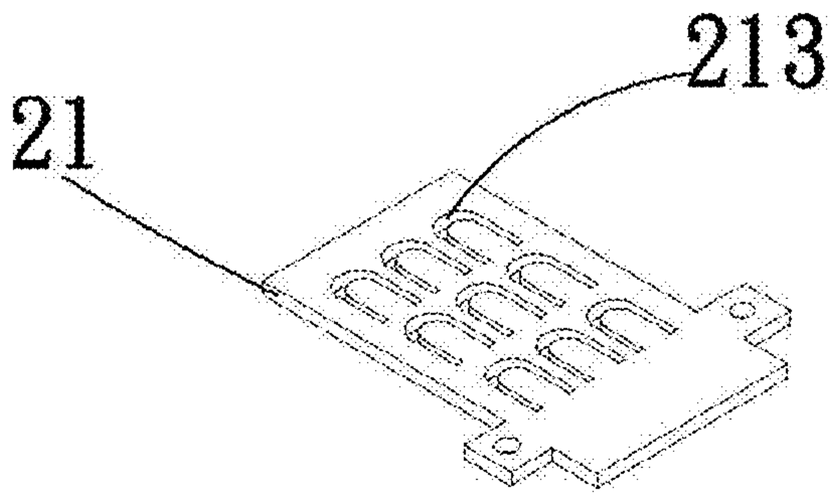



Fig.5C

# HEAT-RADIATING BASE PLATE AND HEAT SINK USING THE SAME

## FIELD OF THE INVENTION

**[0001]** The present invention relates to a heat-radiating base plate, and more particularly to a weight-reduced heat-radiating base plate including an aluminum-made upper base plate formed of a slotted pattern for a heat pipe unit to set therein, and a copper-made lower base plate corresponding to and attached to the upper base plate without losing its flatness. The present invention also relates to a heat sink including a radiating fin assembly mounted to a top of the heat-radiating base plate.

## BACKGROUND OF THE INVENTION

**[0002]** With the rapidly developed information, communication, and photoelectric industries, various highly advanced, lightweight and compact electronic products have been introduced into the market. Due to the demands for high operating speed and miniaturized volume, the electronic elements in the various electronic products produce more heat during the operation thereof to thereby have constantly increased heat density. Therefore, heat dissipation efficiency has become a critical factor in determining the stable operation of the electronic products. Due to the high-efficient heat conducting property thereof, heat pipes and heat spreaders have been widely applied in various electronic products as heat conducting elements. Either the heat pipe or the heat spreader is a closed and vacuumed hollow copper member with a capillary layer sintered on inner wall surfaces thereof. A working fluid is filled in the hollow member. The working fluid at a vaporizing end of the heat pipe or heat spreader absorbs heat produced by a heat-producing source, such as a CPU, and is vaporized. The vapor formed at the heated end is cooled by, for example, radiating fins and cooling fan to condense into liquid at a condensing end. The liquid then flows back to the vaporizing end due to an effect of the capillary force of the capillary layer. Thus, the working fluid continuously circulates in the closed heat pipe or heat spreader.

**[0003]** Taiwanese Patent Application No. 097202791 discloses a heat sink **1** as shown in FIG. **1**. The heat sink **1** includes a base **11**, an S-shaped heat pipe **12**, and a plurality of radiating fins **13**. The base **11** has a first face and a second face opposite to the first face. An S-shaped channel **111** is formed on the first face of the base **11**. The S-shaped heat pipe **12** is correspondingly set in the S-shaped channel **111**. The plurality of radiating fins **13** is arranged on the first face of the base **11**. The heat sink **1** is characterized in that at least one U-shaped channel **112** is further formed on the first face of the base **11** with an open side of the U-shaped channel **112** oriented toward one of two open sides of the S-shaped channel **111** to thereby partially block that open side of the S-shaped channel **111**. The heat sink **1** further includes at least one U-shaped heat pipe **121** correspondingly set in the U-shaped channel **112**. The S-shaped heat pipe **12** and the U-shaped heat pipe **121** enable quick conducting of heat from a central area of the base **11** to other peripheral areas thereof.

**[0004]** In the prior art, when forming the S-shaped channel **111** and the U-shaped channel **112** on the base **11**, it is uneasy to control the depth of the S-shaped channel **111** and the U-shaped channel **112** and therefore frequently results in the problem of error in size. Moreover, when machining the first face of the base **11** to form the S-shaped channel **111** and the U-shaped channel **112**, stress released therefrom will lead to poor levelness at the second face of the base **11**, especially at areas right behind the S-shaped channel **111** and the U-shaped channel **112**. As a result, areas on the first face and the second face of the base **11** corresponding to the S-shaped and U-shaped channels **111**, **112** fail to flatly bear on the radiating fins **13** and the heat-producing unit, respectively. Furthermore, since a large quantity of copper material is used to manufacture the base **11**, the base **11** is usually overweight.

**[0005]** In conclusion, the above-described conventional heat sink **1** has the following shortcomings: (1) being too heavy; (2) consuming too much copper material; (3) having size errors in the channels formed thereon; and (4) having poor levelness at areas immediately behind the formed channels.

**[0006]** It is therefore tried by the inventor to develop an improved heat-radiating base plate to overcome the drawbacks in the conventional heat-radiating base for a heat sink.

## SUMMARY OF THE INVENTION

**[0007]** A primary object of the present invention is to provide a heat-radiating base plate that can be more easily manufactured without detriment to the flatness behind areas having been machined to form needed slotted pattern and can therefore ensure good contact of heat pipes set on the heat-radiating base plate with a heat-producing unit and radiating fins.

**[0008]** Another object of the present invention is to provide a heat-radiating base plate that includes an upper base plate made of an aluminum material to reduce an overall weight of the heat-radiating base plate and the use of copper material in forming the heat-radiating base plate.

**[0009]** A further object of the present invention is to provide a heat sink being formed by mounting a radiating fin assembly to a top of the heat-radiating base plate provided by the present invention, so as to enable good heat dissipation.

**[0010]** To achieve the above and other objects, the heat-radiating base plate according to the present invention includes a copper-made lower base plate, at least one aluminum-made upper base plate, and a heat pipe unit. The upper base plate has a first face, a second face opposite to the first face, and at least one slotted pattern extended through the upper base plate in a thickness direction to communicate the first face with the second face. The heat pipe unit is set in the slotted pattern, and has a first heat-conducting face and a second heat-conducting face corresponding to and flush with the first and the second face of the upper base plate, respectively. Preferably, the first and second heat-conducting faces are flat faces.

**[0011]** And, the heat sink according to the present invention includes a radiating fin assembly mounted to a top of the first face of the heat-radiating base plate of the present invention. The radiating fin assembly includes a plurality of stacked and spaced radiating fins. With the heat pipe unit set in the slotted pattern, the first face of the aluminum-made upper base plate attached to the radiating fin assembly, and the second face of the upper base plate attached to the copper-made lower base plate, the heat sink of the present invention can provide enhanced heat dissipation effect.

**[0012]** In brief, with the above arrangements, the present invention has the following advantages: (1) less copper material is used to manufacture the heat-radiating base plate; (2) the problem of overweight heat-radiating base plate caused by using too much copper material is solved; (3) no second-

time machining is needed in forming the slotted pattern; and (4) flatness at areas of the lower base plate behind the slotted pattern can be maintained.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]** The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings, wherein:

**[0014]** FIG. **1** is an exploded perspective view of a conventional heat sink;

**[0015]** FIG. **2** is an exploded top perspective view of a heat sink according to a preferred embodiment of the present invention;

**[0016]** FIG. **3** is an exploded bottom perspective view of the heat sink of FIG. **2**;

**[0017]** FIG. **4** is an assembled perspective view of the heat sink of FIG. **2**; and

**[0018]** FIGS. **5**A, **5**B, and **5**C show different designs for the slotted pattern formed on the upper base plate of the heat-radiating base plate of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0019]** Please refer to FIGS. **2**, **3** and **4**. A heat-radiating base plate **2** according to a preferred embodiment of the present invention includes an upper base plate **21**, a lower base plate **22**, and a heat pipe unit **23**. The upper base plate **21** has a first face **211**, a second face **212** opposite to the first face **211**, and a slotted pattern **213**. The slotted pattern **213** is extended through the upper base plate **21** in a thickness direction to communicate the first face **211** with the second face **212**. The upper base plate **21** can be made of an aluminum material. The heat pipe unit **23** is set in the slotted pattern **213**. The heat pipe unit **23** includes at least one heat pipe, which is set in the slotted pattern **213**. The heat pipe unit **23** has a thickness equal to a depth of the slotted pattern **213**, and has a flat first heat-conducting face **231** and a flat second heat-conducting face **232** corresponding to and flush with the first face **211** and the second face **212** of the upper base plate **21**, respectively. The second face **212** of the upper base plate **21** and the second heat-conducting face **232** of the heat pipe unit **23** are attached to the lower base plate **22**. The lower base plate **22** can be made of a copper material. The heat-radiating base plate **2** can be combined with a radiating fin assembly **24** to form a heat sink. The lower base plate **22** has a contact face **221** being attached to at least one heat-producing unit (not shown), and a heat-transferring face **222** being attached to the second face **212** and the second heat-conducting face **232**. According to the above arrangements, the heat sink can be manufactured with reduced copper material to eliminate the problem of overweight caused by containing too much copper material. Also, the heat pipe unit **23** can be located in the slotted pattern **213** at one time. Moreover, portions of the copper-made lower base plate **22** corresponding to the slotted pattern **213** would not lose their flatness due to machining of the slotted pattern **213** on the upper base plate **21**.

**[0020]** The radiating fin assembly **24** is formed from a plurality of stacked and spaced radiating fins and mounted to the first face **211** of the upper base plate **21** and the first heat-conducting face **231** of the heat pipe unit **23**. The second face **212** of the upper base plate **21** and the second heat-conducting face **232** of the heat pipe unit **23** are attached to the heat-transferring face **222** of the lower base plate **22**. The contact face **221** of the lower base plate **22** is in contact with the heat-producing unit (not shown).

**[0021]** A plurality of different designs is available for the slotted pattern **213** extended through the upper base plate **21** in the thickness direction to communicate the first face **211** with the second face **212**. For example, the slotted pattern **213** can include a plurality of straightly extended and parallelly spaced slots as shown in FIG. **5**A, or a plurality of obliquely extended arid parallelly spaced slots, as shown in FIG. **5**B, or a plurality of curved and spaced slots, as shown in FIG. **5**C. No matter what design the slotted pattern is, the heat pipe unit **23** can always in direct contact with the lower base plate **22** and the radiating fin assembly **24** to transfer the heat produced by the heat-producing unit to the radiating fin assembly **24** to achieve the purpose of heat dissipation.

**[0022]** The present invention has been described with some preferred embodiments thereof and it is understood that many changes and modifications in the described embodiments can be carried out without departing from the scope and the spirit of the invention that is intended to be limited only by the appended claims.

What is claimed is:

**1**. A heat-radiating base plate, comprising:
- a lower base plate;
- at least one upper base plate being corresponding to and attached to the lower base plate, the upper base plate having a first face, an opposite second face, and a slotted pattern extended through the upper base plate in a thickness direction to communicate the first face with the second faces; and
- a heat pipe unit having at least one heat pipe and being set in the slotted pattern on the upper base plate.

**2**. The heat-radiating base plate as claimed in claim **1**, wherein the heat pipe unit has a first heat-conducting face and a second heat-conducting face corresponding to and flush with the first face and the second face of the upper base plate, respectively.

**3**. The heat-radiating base plate as claimed in claim **1**, wherein the first and the second heat-conducting face of the heat pipe unit are flat faces.

**4**. The heat-radiating base plate as claimed in claim **1**, wherein the slotted pattern is selected from the group consisting of a plurality of straightly extended and parallelly spaced slots, a plurality of obliquely extended and parallelly spaced slots, and a plurality of curved and spaced slots.

**5**. The heat-radiating base plate as claimed in claim **1**, wherein the lower base plate has a contact face for bearing on a heat-producing unit.

**6**. A heat sink with heat-radiating base plate, comprising:
- a heat-radiating base plate including:
  - a lower base plate;
  - at least one upper base plate being corresponding to and attached to the lower base plate, the upper base plate having a first face, an opposite second face, and a slotted pattern extended through the upper base plate in a thickness direction to communicate the first face with the second face; and
  - a heat pipe unit having at least one heat pipe and being set in the slotted pattern; and
- a radiating fin assembly formed from a plurality of stacked and spaced radiating fins, and the radiating fin assembly being mounted to the first face of the upper base plate.

**7**. The heat sink with heat-radiating base plate as claimed in claim **6**, wherein the heat pipe unit has a first heat-conducting face and a second heat-conducting face, which are corresponding to and flush with the first face and the second face of the upper base plate, respectively.

**8**. The heat sink with heat-radiating base plate as claimed in claim **6**, wherein the slotted pattern is selected from the group consisting of a plurality of straightly extended and parallelly spaced slots, a plurality of obliquely extended and parallelly spaced slots, and a plurality of curved and spaced slots.

**9**. The heat sink with heat-radiating base plate as claimed in claim **6**, wherein the lower base plate has a contact face for bearing on a heat-producing unit.

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