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(54) **HEAT SINK HAVING BUMPS FOR POSITIONING HEAT PIPES THEREIN**

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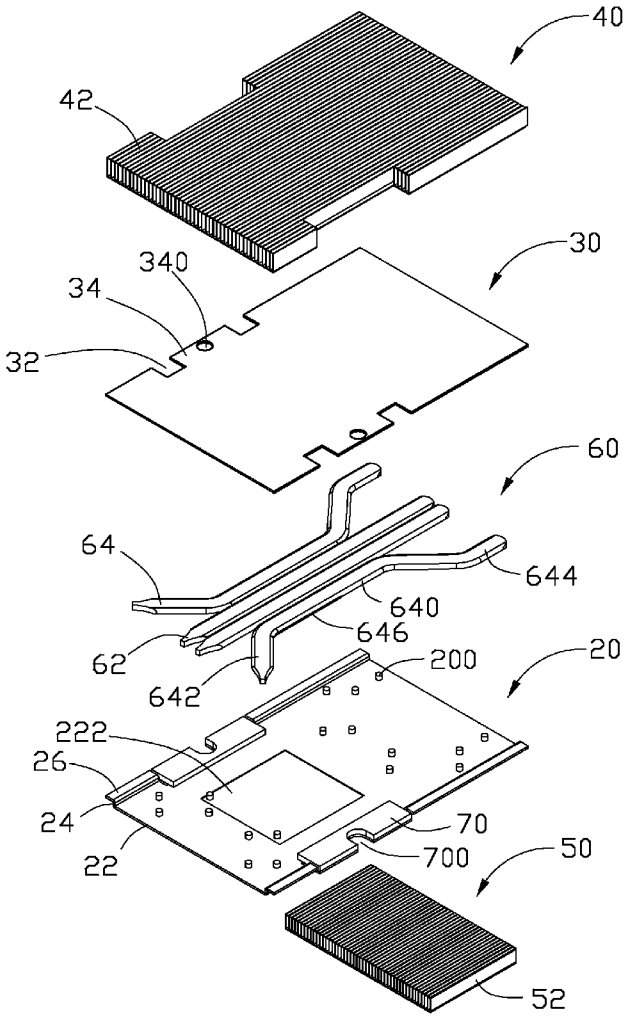
(57) **ABSTRACT**

A heat sink adapter for cooling an electronic component includes a lower plate, an upper plate, an upper fin set and a lower fin set respectively fixed on the upper plate and the lower plate, and a plurality of heat pipes sandwiched between the upper plate and the lower plate. The lower plate forms a plurality of bumps projecting upwardly therefrom, which sandwich the heat pipes therebetween to position the heat pipes on the lower plate, wherein some of the heat pipes are bent and sandwiched between two bumps at each bended position, and some of the heat pipes are straight and located near one bump at each end portion thereof.



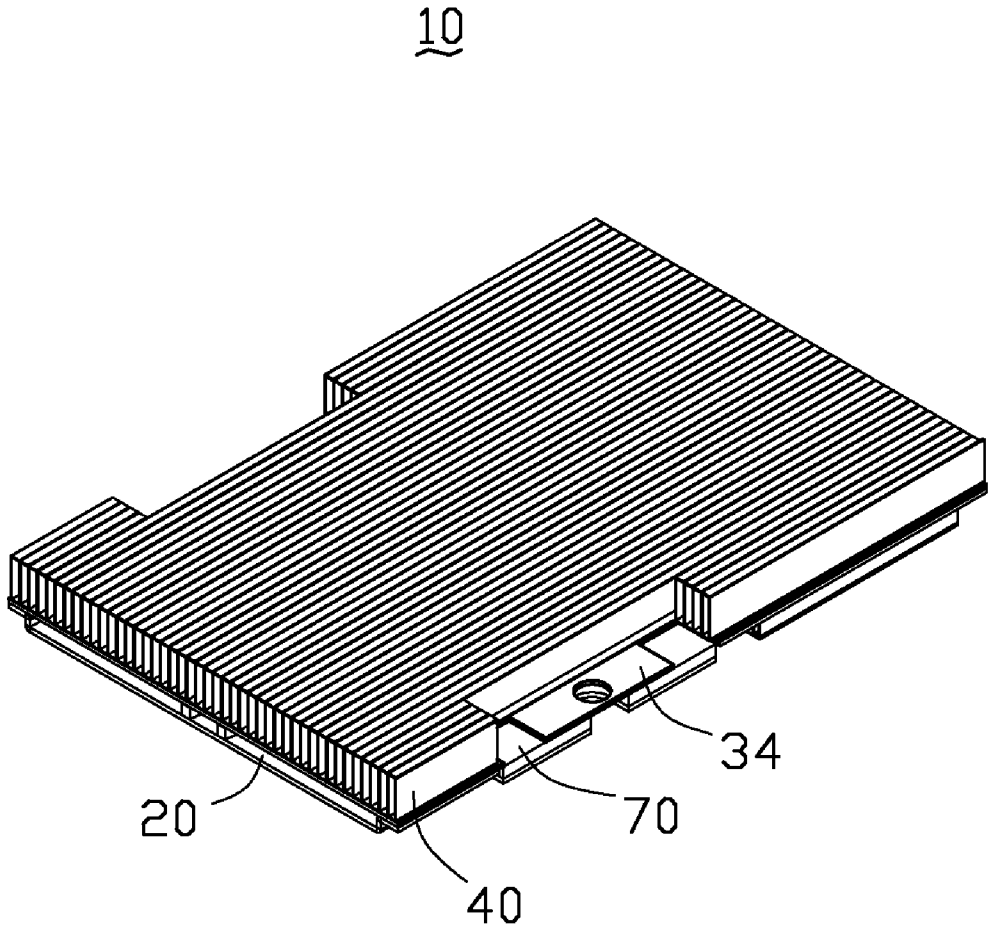
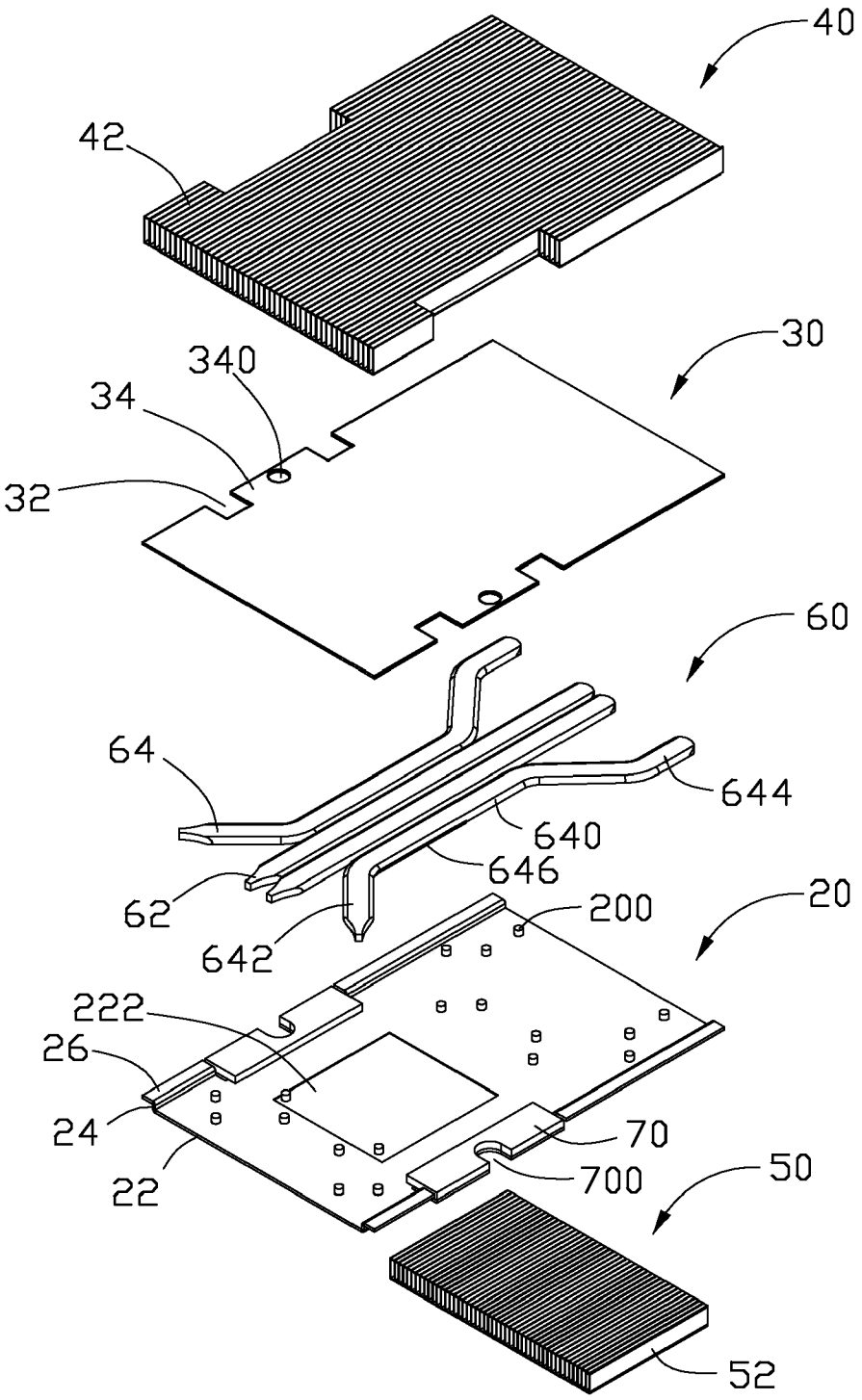


FIG. 1


40
42
30
340
34
32
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646
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20
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52

FIG. 2

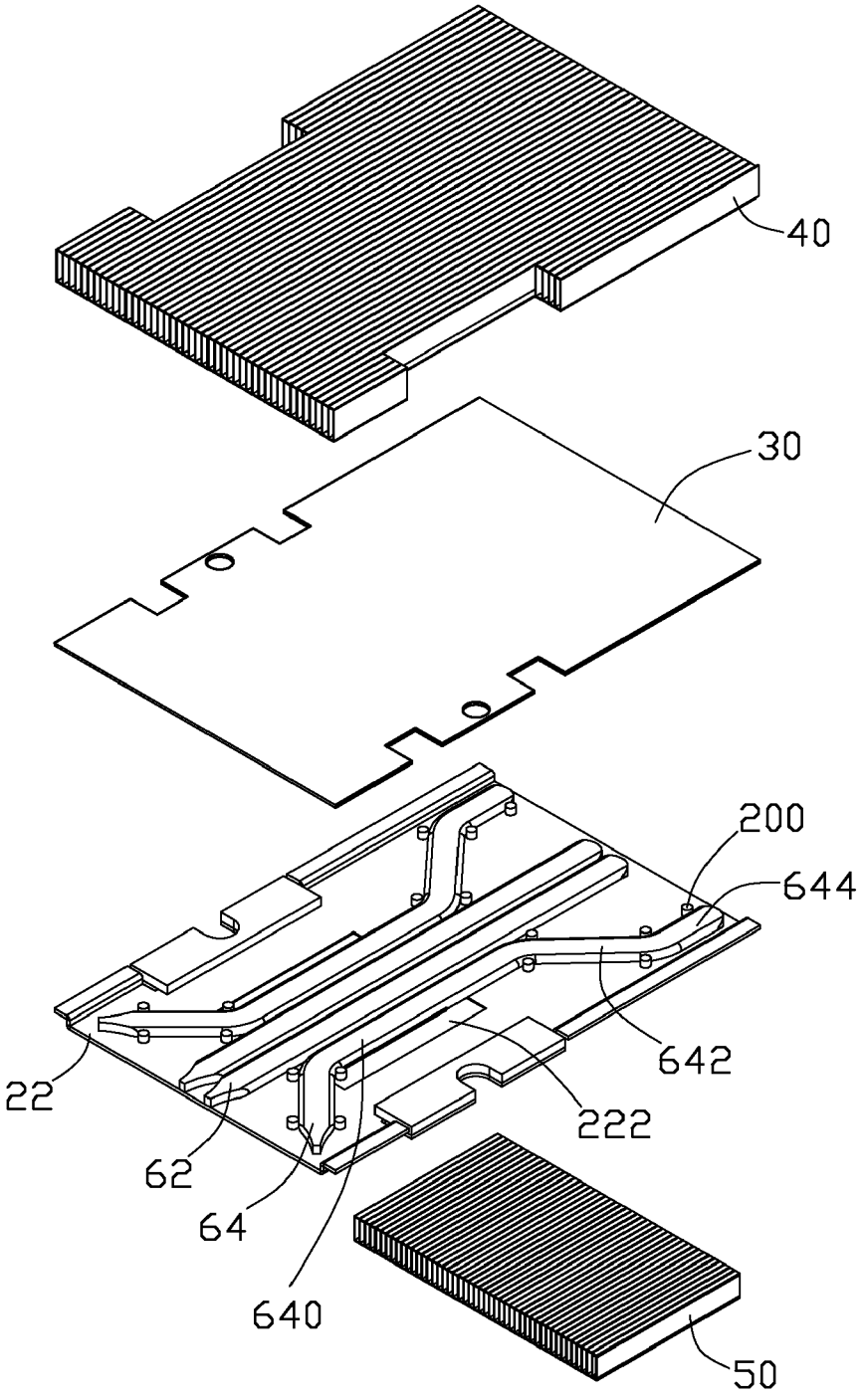

FIG. 3

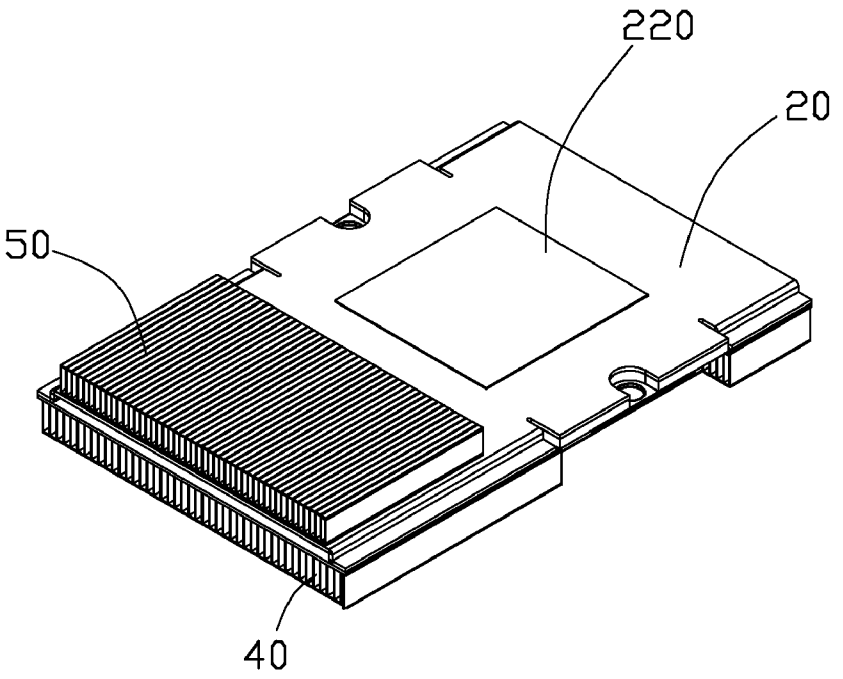

FIG. 4

HEAT SINK HAVING BUMPS FOR POSITIONING HEAT PIPES THEREIN

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a heat sink, and more particularly to a heat sink having bumps for positioning heat pipes therein.

[0003] 2. Description of Related Art

[0004] The central processing unit (CPU) mounted on the motherboard in a computer is the center of operations of the computer. During the operations of the computer, the CPU produces heat. The heat must be quickly carried away from the CPU during the operations of the computer. Accordingly, a heat sink is used to remove the heat from the CPU.

[0005] Conventionally, a heat sink includes a metal base contacting the CPU and a plurality of fins extending from the metal base for dissipating heat absorbed by the metal base from the CPU to an ambient. Heat pipes are often mounted to the metal base for enhancing a heat dissipating efficiency of the heat sink.

[0006] In order to position the heat pipes in the heat sink, the metal base usually defines a plurality of grooves for receiving the heat pipes therein. Nevertheless, for receiving the heat pipes therein substantially, the metal base should be made to have a thickness larger than diameters of the grooves, whereby a material cost of the metal base is increased.

[0007] Another method to position the heat pipes in the heat sink is to use positioning clamps. The positioning clamps are disposed on the metal base at first, and then the heat pipes are brought to fit into gaps between the positioning clamps, thereby realizing the positioning of the heat pipes on the metal base. However, if a size of the heat sink is small, there will have not enough area of the metal base for disposing the positioning clamps thereon; therefore, the positioning of the heat pipes becomes difficult.

[0008] What is needed, therefore, is a heat dissipating device which can overcome the above-mentioned disadvantages.

SUMMARY OF THE INVENTION

[0009] A heat sink adapter for cooling an electronic component includes a lower plate, an upper plate, an upper fin set and a lower fin set respectively fixed on the upper plate and the lower plate, and a plurality of heat pipes sandwiched between the upper plate and the lower plate. The lower plate forms a plurality of bumps projecting upwardly therefrom, which sandwich the heat pipes therebetween to position the heat pipes on the lower plate, wherein some of the heat pipes are bent and sandwiched between two bumps at the bended positions. Compared with the conventional heat sink that forms grooves on a base to position heat pipes therein and the conventional heat sink that use positioning clamps to position heat pipes on the base, the heat sink of the present invention just forms the plurality of bumps on the lower plate, which do not need the lower plate being thick and are able to provide a convenient positioning for the heat pipes.

[0010] Other advantages and novel features of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Many aspects of the present apparatus can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present apparatus. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0012] FIG. **1** is an assembled, isometric view of a heat sink in accordance with a preferred embodiment of the present invention;

[0013] FIG. **2** is an exploded view of FIG. **1**;

[0014] FIG. **3** is a view similar to FIG. **2** with heat pipes being mounted on a lower plate of the heat sink; and

[0015] FIG. **4** is an inverted view of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Referring to FIGS. **1** and **2**, a heat sink **10** in accordance with a preferred embodiment of the present invention is for being mounted on an electronic component (not shown) to dissipate heat therefrom. The heat sink **10** comprises a lower plate **20**, an upper plate **30**, a plurality of heat pipes **60** sandwiched between the lower plate **20** and the upper plate **30**, and an upper fin set **40** and a lower fin set **50** attached on the upper plate **30** and the lower plate **20**, respectively.

[0017] Also referring to FIG. **4**, the lower plate **20** is made by bending a metal plate, it comprises a rectangular and planar panel **22**, a pair of sidewalls **24** extending upwardly and perpendicularly from two opposite lateral sides of the panel **22**, and a pair of flanges **26** formed horizontally and oppositely from tops of the pair of sidewalls **24**, respectively. A square area of the panel **22** is stamped downwardly to form a protrusion **220** (shown in FIG. **4**) projecting beyond a bottom face the panel **22**, and a cavity **222** located corresponding to the protrusion **220** and beneath a top face of the panel **22**. The protrusion **220** is adapted for contacting the electronic component to absorb heat therefrom. In the preferred embodiment of the present invention, the protrusion **220** is located at a front part of the panel **22**; nevertheless, a location of the protrusion **220** on the panel **22** can be varied according to positions of the electronic component. A plurality of bumps **200** are formed on the panel **22** by stamping corresponding points of the panel **22** upwardly. The bumps **200** are arranged according to profiles of the heat pipes **60** so as to suitably sandwich the heat pipes **60** therebetween, wherein two of the bumps **200** are located in the cavity **222**, and other bumps **200** are located outside the cavity **222**. Corresponding portions of the sidewalls **24** and the flanges **26** are bent outwardly and oppositely to form a pair of horizontal wings (not labeled) at two lateral sides of the lower plate **20**, respectively. A pair of rectangular securing members **70** are disposed on the two wings of the lower plate **20** and inserted into the flanges **26** and the sidewalls **24**, with an outer side thereof being coincidental with an outer edge of a corresponding wing. Each of the securing members **70** has a height larger than that of the sidewalls **24**, whereby a top of the each securing member **70** extends beyond the flanges **26** for contacting the upper plate **30**. A hole **700** is defined through each securing member **70** and each wing to provide a passage for a fastener (not shown).

[0018] The upper plate **30** is soldered on the two flanges **26** of the lower plate **20**. The upper plate **30** has a periphery coincidental with a periphery of the lower plate **20**. A pair of cutouts **32** are defined at each lateral side of the upper plate **30** corresponding to one of the wings, while a part of the upper plate **30** located between the pair of cutouts **32** forms a rectangular tab **34**, which is for resiliently abutting against a corresponding securing member **70**. Total areas of the two cutouts **32** and the tab **34** are identical to an area of the securing member **70** (illustrated in FIG. **1**). A circular hole **340** is defined in each tab **34** corresponding to the hole **700** in the lower plate **20** and the securing member **70**. The fastener extends through the circular hole **340** of the upper plate **30** and a corresponding hole **700** of the lower plate **20** and the securing member **70** to attach them on a printed circuit board (not shown) where the electronic component is mounted.

[0019] The upper fin set **40** and the lower fin set **50** are fixed on the upper plate **30** and the lower plate **20** by soldering, respectively. Each of the upper fin set **40** and the lower fin set **50** comprises a plurality of parallel fins **42**, **52**, each of which consists of an upright sheet (now labeled) and a pair of pieces (not labeled) bent horizontally from a top and a bottom of the sheet, respectively. The lower fin set **50** is secured on a rear part of the bottom face of the panel **22** and near the protrusion **220** (viewed from FIG. **4**), by soldering upper pieces of the fins **52** on the panel **22**; the upper fin set **40** is secured on a whole top face of the upper plate **30**, by soldering lower pieces of the fins **42** on the upper plate **30**, wherein every two adjacent fins **42**, **52** form a passage therebetween for allowing an airflow therethrough. The lower fin set **50** has a width similar to that of the panel **22**, and the upper fin set **40** has a profile similar to that of the upper plate **30** and a width larger than that of the lower fin set **50** (shown in FIG. **4**).

[0020] As viewed from FIGS. **2-3**, the heat pipes **60** are sandwiched between the upper plate **30** and the lower plate **20**. In the preferred embodiment of the present invention there are four heat pipes **60**; however, the number of the heat pipes **60** is adjustable according to the amount of heat that the electronic component generates. Two middle ones **62** of the four heat pipes **60** are straight and planar and parallel to each other; two lateral ones **64** of the four heat pipes **60** are planar and each have a straight section **640** parallel to the two middle heat pipes **62**, two bended sections **642** extended slantwise and outwardly from two opposite ends of the straight section **640**, and an extremity end **644** extending backwardly from a rear bended section **642**, wherein each bended section **642** defines an angle approximate to 135 degrees with the straight section **640**. The four heat pipes **60** are so arranged that the two middle heat pipes **62** abut side-by-side against each other along a lengthwise direction of the lower plate **20**, and the two lateral heat pipes **64** are juxtaposed with the two middle heat pipes **62** in a manner that the straight sections **640** thereof directly contact the two middle heat pipes **62**, the bended sections **642** are inclinedly spaced from the two middle heat pipes **62**, and the extremity ends **644** are gapped from and parallel to the two middle heat pipes **62**. A distance from an outmost portion of a front bended section **642** to an outmost portion of the extremity end **644** of each lateral heat pipe **64** is identical to a length of the middle heat pipe **62**. A distance between two extremity ends **644** of the two lateral heat pipes **64** is less than that between two sidewalls **24** of the lower plate **20**, whereby when the four heat pipes **60** are fixed on the lower plate **20**, the extremity ends **644** would be spaced from the sidewalls **24** to define gaps (not labeled) therebetween (illustrated in FIG. **5**), which allow the airflow therethrough to increase heat dissipation of the heat sink **10**. The four heat pipes **60** are positioned on the panel **22** by the bumps **200** in a manner such that the two middle heat pipes **62** are sandwiched between two bumps **200** near each end thereof; each junction (not labeled) of the two lateral heat pipes **64** between the bended sections **642** and the straight sections **640** is sandwiched by two bumps **200**, each of joints of the bended sections **642** and the extremity ends **644** is sandwiched by two bumps **200**, each front bended section **642** is located between two bumps **200**, and each extremity end **644** abuts against one bump **200**. In other words, two bumps **200** sandwich the two lateral heat pipes **64** at each bended position thereof. Each heat pipe **60** has a part projecting downwardly from a bottom face thereof to form a rectangular chassis **646**, which has a length less than that of the cavity **222** of the lower plate **20**, and a thickness approximate to a depth of the cavity **222** of the lower plate **20**. Four chassises **646** are located just above the cavity **222** and for being substantially accommodated into the cavity **222** and directly contacting a top face of the protrusion **220** to absorb heat therefrom.

[0021] In assembly, the heat pipes **60** are brought to be disposed downwardly on the panel **22** between the bumps **200** and soldered to the panel **20**; then the upper plate **30** is put and soldered on the flanges **26** of the lower plate **20**; finally, the lower fin set **50** and the upper fin set **40** are soldered on the lower plate **20** and the upper plate **30**, respectively.

[0022] In use, the heat sink **10** is disposed on the printed circuit board with its protrusion **220** contacting with the electronic component, wherein the upper fin set **40** is located above the printed circuit board, and the lower fin set **50** extends downwardly beyond the printed circuit board and has a part located lower than the printed circuit board. Heat generated by the electronic component is absorbed by the protrusion **220**, and then is transferred to other portions of the heat pipes **60** via the chassises **646**. The heat pipes **60** distribute the heat over the upper plate **30** and the lower plate **20**, which disperses the heat to the ambient via the lower fin set **50** and the upper fin set **40**.

[0023] On contrary to the conventional heat sink which needs forming grooves in a base to position heat pipes therein, and the conventional heat sink which needs positioning clamps disposed on a base to position heat pipes thereon, the lower plate **20** of the present invention only forms the bumps **200** thereon, which do not need the lower plate **20** having a large thickness to form them, and also do not occupy so much areas of the panel **22**; therefore, a thickness of the lower plate **20** is capable of being controlled in a small range and a material cost is reduced accordingly, and a convenient positioning between the heat pipes **60** and the lower plate **20** is achieved which is not sensitive relative to a size of the lower plate **20**.

[0024] It is believed that the present invention and its advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the examples hereinbefore described merely being preferred or exemplary embodiments of the invention.

What is claimed is:

1. A heat sink adapted for an electronic component, comprising:

a lower plate; and

heat pipes fixed on the lower plate, wherein the lower plate forms a plurality of bumps according to peripheries of the heat pipes to position the heat pipes relative to the lower plate.

2. The heat sink as claimed in claim **1**, wherein the heat pipes comprises bended heat pipes, each of the bended heat pipes being sandwiched between two bumps at each bended position.

3. The heat sink as claimed in claim **2**, wherein the heat pipes comprises straight heat pipes sandwiched between the bended heat pipes, the straight heat pipes being juxtaposed and contacting with each other.

4. The heat sink as claimed in claim **3**, wherein each bended heat pipe comprises a straight section, a pair of bended sections extending slantwise and outwardly from the straight section, and an extremity end extending from one of the pair of bended sections, the straight sections of the bended heat pipes abutting side-by-side against the straight heat pipes.

5. The heat sink as claimed in claim **4**, wherein each of junctions of the straight sections and the bended sections of the bended heat pipes is sandwiched between and positioned by two bumps.

6. The heat sink as claimed in claim **4**, wherein at least one of the bended sections is located between two bumps, and at least one of the extremity ends of the bended sections is located adjacent to one bump.

7. The heat sink as claimed in claim **1**, wherein the lower plate forms a protrusion projecting downwardly therefrom and a trough defined in the protrusion and opened upwardly, the protrusion being adapted for contacting the electronic component.

8. The heat sink as claimed in claim **7**, wherein the heat pipes have a plurality of bulges projecting downwardly therefrom, the plurality of bulges being received in the cavity and abutting against the protrusion of the lower plate.

9. The heat sink as claimed in claim **1**, wherein the lower plate comprises a planar board, a pair of sidewalls extending upwardly from two opposite sides of the board, and a pair of flanges formed vertically from tops of the pair of sidewalls, the bumps being formed on the board.

10. The heat sink as claimed in claim **9** further comprising an upper plate fixed on the flanges of the lower plate, wherein the heat pipes are sandwiched between and directly contact the board and the upper plate, and spaced from the sidewalls of the lower plate.

11. The heat sink as claimed in claim **10** further comprising an upper fin arrangement fixed on the upper plate and a lower fin arrangement fixed on the board, wherein the upper fin arrangement occupies a total area of a top face of the upper plate and the lower fin arrangement occupies a half area of a bottom face of the board.

12. A heat sink adapted for dissipating heat from an electronic component, comprising:

a lower plate;

an upper plate fixed on the lower plate; and

a plurality of heat pipes sandwiched between the lower plate and the upper plate, wherein the lower plate has a plurality of embosses formed upwardly corresponding to shapes of the plurality of heat pipes, and wherein the plurality of heat pipes are sandwiched between the plurality of embosses to be positioned on the lower plate.

13. The heat sink as claimed in claim **12**, wherein the plurality of heat pipes comprises at least a bended heat pipe and at least a straight heat pipe, the at least a bended heat pipe being sandwiched between two embosses at each bended position, and the at least a straight heat pipe being located near one emboss at each end thereof.

14. The heat sink as claimed in claim **13**, wherein the at least a bended heat pipe comprises a straight portion parallel to and contacting the at least a straight heat pipe, a pair of bended portions extending slantwise from two ends of the straight portion, and an extremity end extending from one of the bended portions and parallel to the straight portion.

15. The heat sink as claimed in claim **14**, wherein one emboss is located adjacent to the end of the at least a straight heat pipe and sandwiches an junction of the straight portion and one of the pair of bended portions of the at least a bended heat pipe with another emboss.

16. The heat sink as claimed in claim **12** further comprising an upper fin arrangement fixed on the upper plate and a lower fin arrangement fixed on the lower plate, wherein each of the upper fin arrangement and the lower fin arrangement comprises a plurality of fins parallel to each other.

17. The heat sink as claimed in claim **12**, wherein a protrusion projects downwardly from a part of the lower plate and a trough is defined in the protrusion and opened upwardly, the heat pipes having at least a part received in the trough and contacting the protrusion.

18. A heat sink for cooling an electronic component comprising:

a lower plate;

a lower fin set fixed on the lower plate;

an upper plate;

an upper fin set fixed on the upper plate; and

a plurality of heat pipes sandwiched between the lower plate and the upper plate comprising straight heat pipes and bended heat pipes, wherein a plurality of bumps projecting upwardly from the lower plate and sandwich the heat pipes therebetween to position the heat pipes on the lower plate, and wherein some of the bumps are located adjacent to ends of the straight heat pipes and other some of the bumps are located adjacent to the bended heat pipes at bended positions and still other some of the bumps are located adjacent to ends of the bended heat pipes.

19. The heat sink as claimed in claim **18**, wherein the upper fin set occupies a whole area of a top face of the upper plate and the lower fin set occupies a half area of a bottom face of the lower plate.

20. The heat sink as claimed in claim **18**, wherein the lower plate forms a protrusion projecting downwardly therefrom and adjacent to the lower fin set, and a trough defined in the protrusion and opened upwardly, the heat pipes having portions being received in the trough and contacting with the protrusion.

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