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(19) **United States**(12) **Patent Application Publication****Huang**(10) **Pub. No.: US 2009/0151900 A1**(43) **Pub. Date: Jun. 18, 2009**(54) **HEAT SINK****Publication Classification**(76) Inventor: **Tsung-Hsien Huang, I-Lan Hsien**
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F28F 7/00 (2006.01)(52) **U.S. Cl.** **165/80.3**

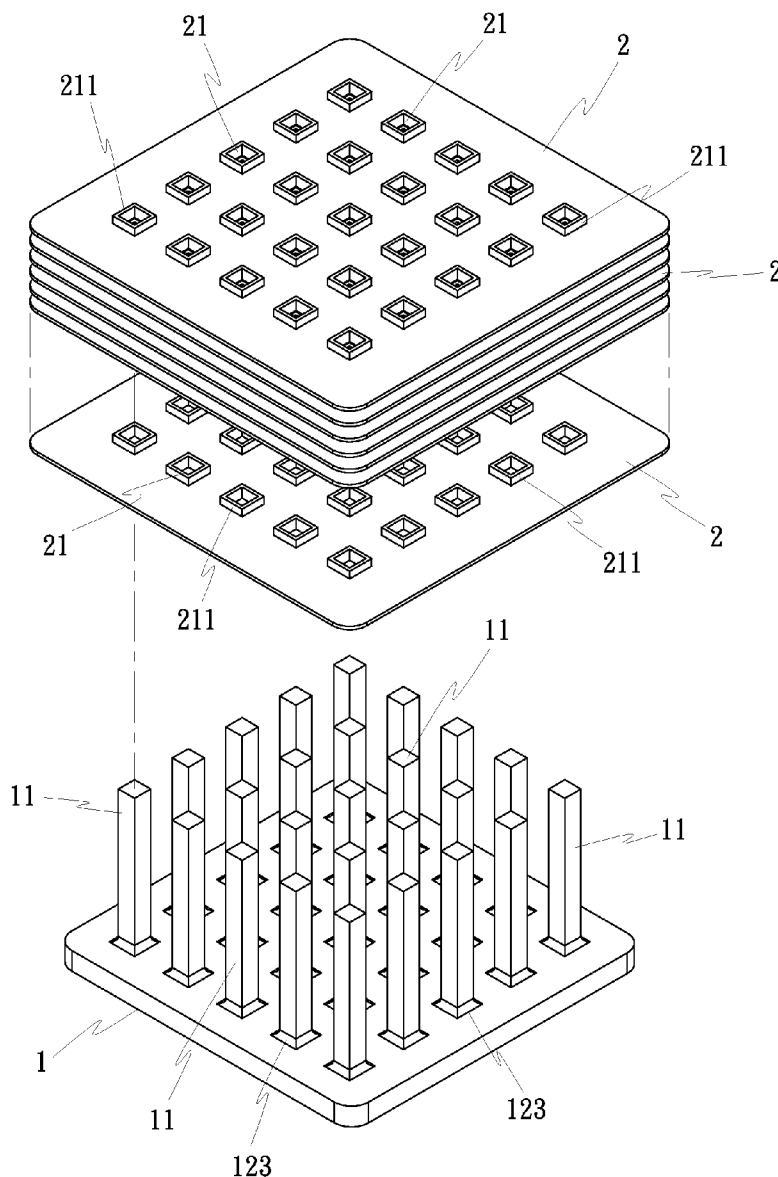
Correspondence Address:

PAI PATENT & TRADEMARK LAW FIRM**1001 FOURTH AVENUE, SUITE 3200****SEATTLE, WA 98154 (US)**(57) **ABSTRACT**

A heat sink includes a thermal conductive base panel that has a plurality of heat dissipation columns of any of a variety of configurations perpendicularly upwardly extending from the top wall, and radiation fins mounted on the heat dissipation columns at different elevations, each radiation fin having a plurality of mounting through holes respectively press-fitted onto the heat dissipation columns. The base panel may be provided with a fan and/or heat pipes to enhance heat dissipation efficiency.

(21) Appl. No.: **12/018,187**(22) Filed: **Jan. 22, 2008**(30) **Foreign Application Priority Data**

Dec. 12, 2007 (TW) 096147379



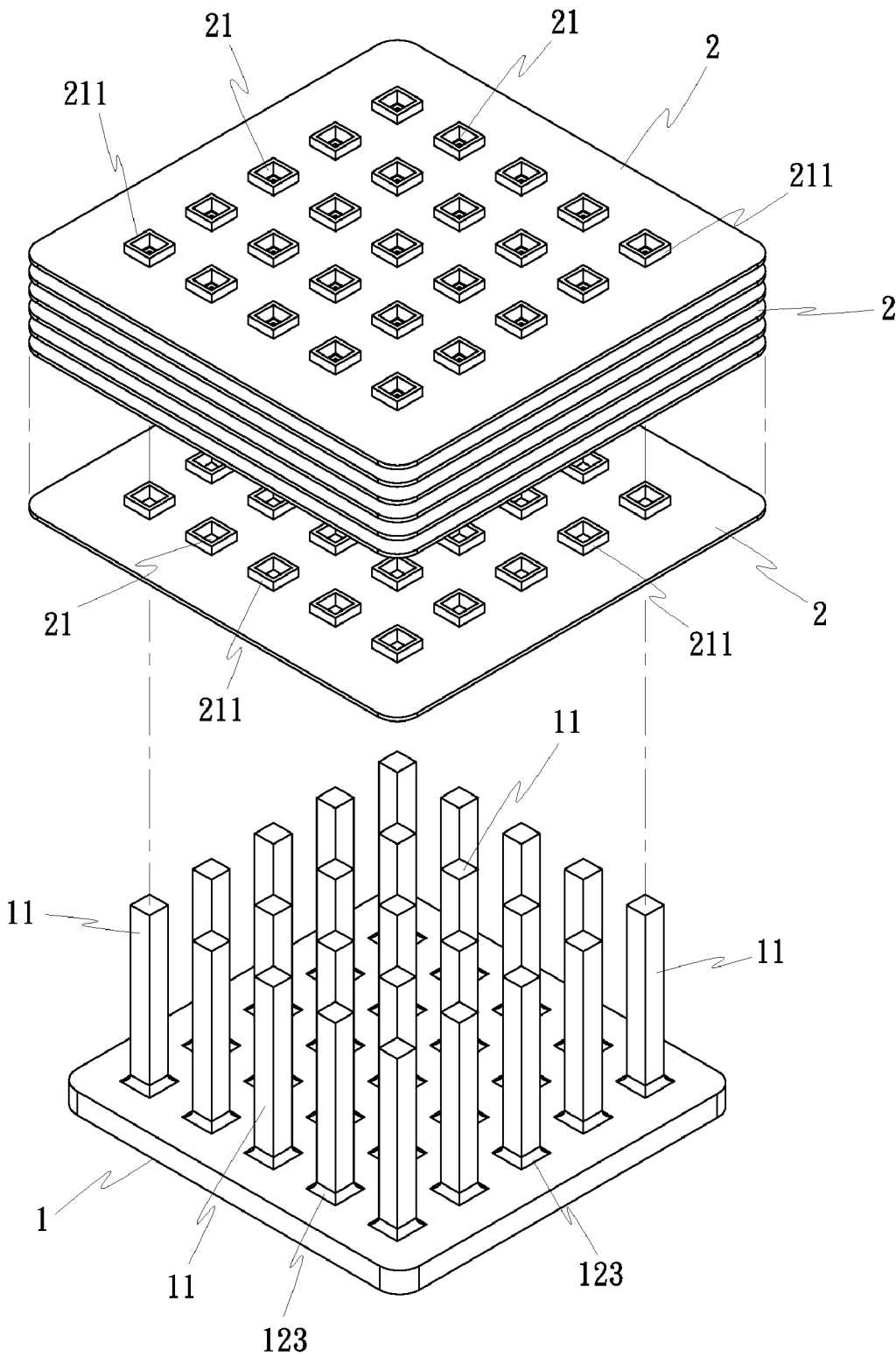


FIG. 1

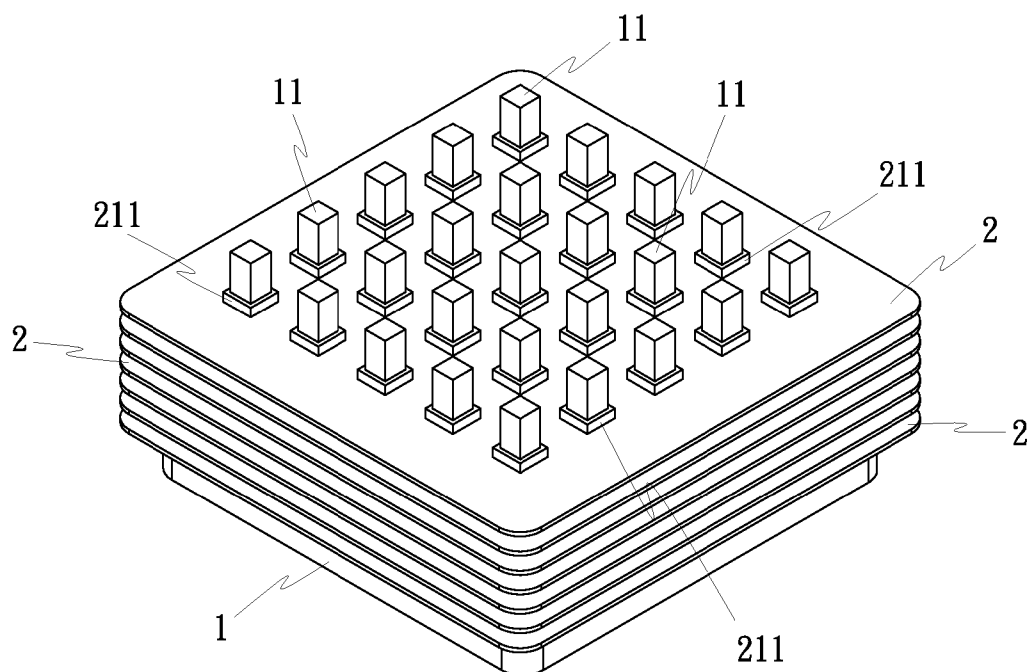


FIG. 2

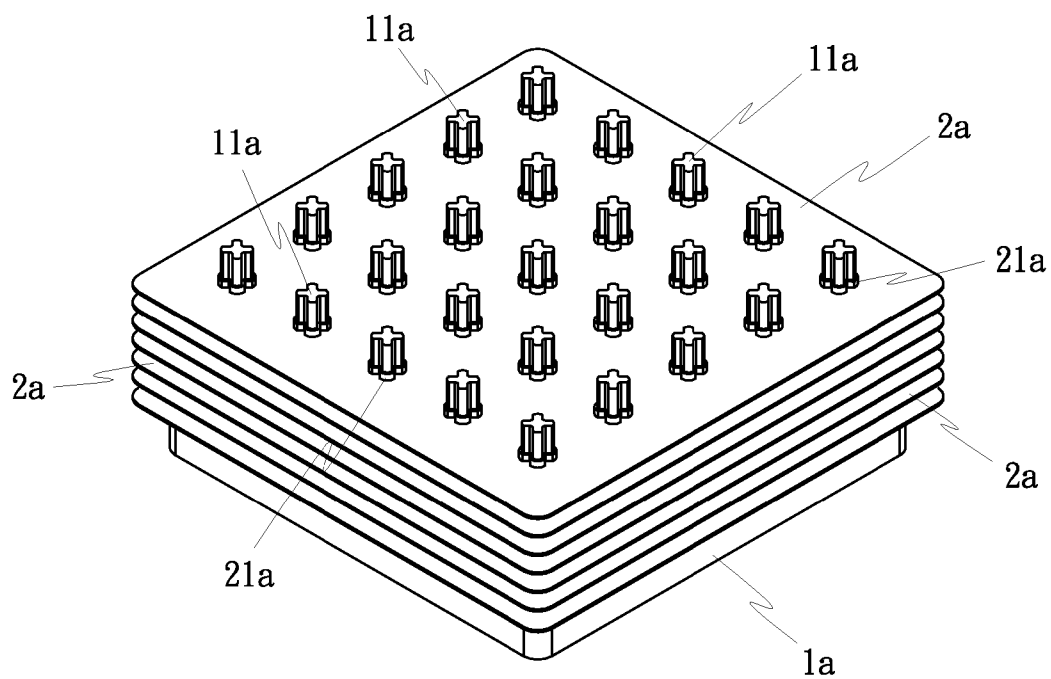


FIG. 3

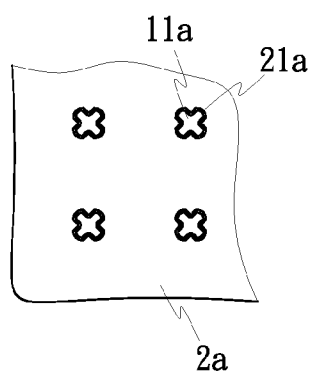


FIG. 4

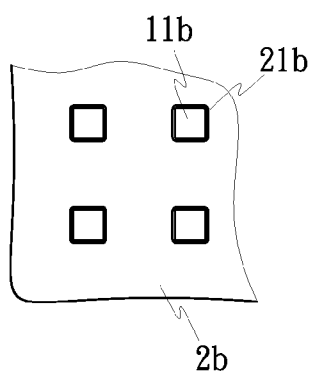


FIG. 5

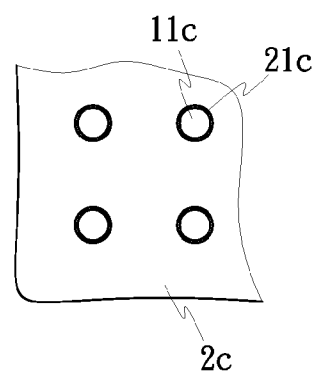


FIG. 6

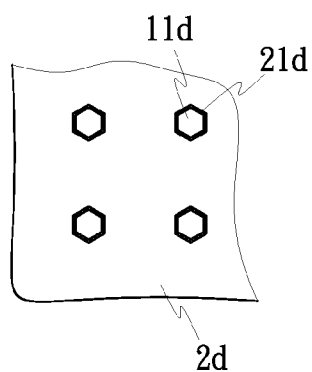


FIG. 7

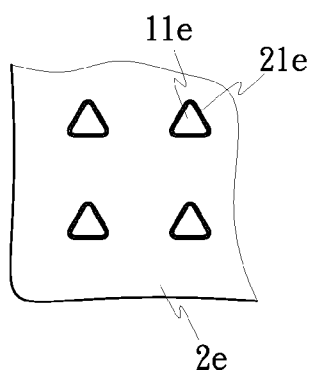


FIG. 8

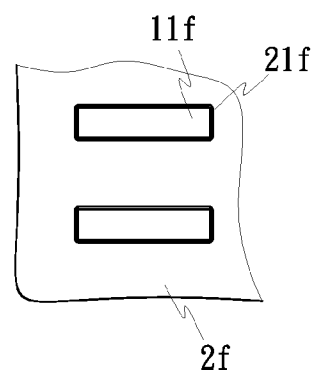


FIG. 9

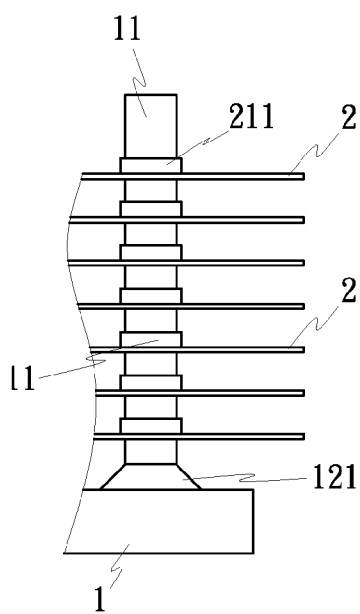


FIG. 10

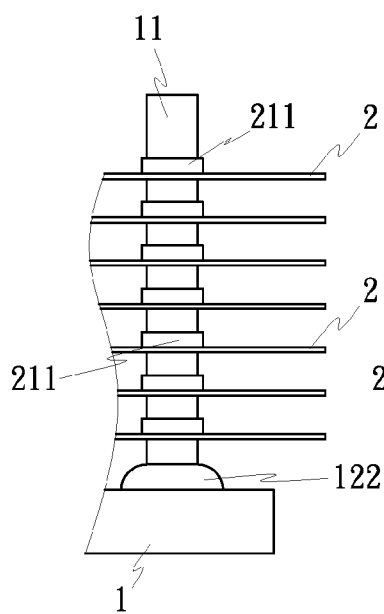


FIG. 11

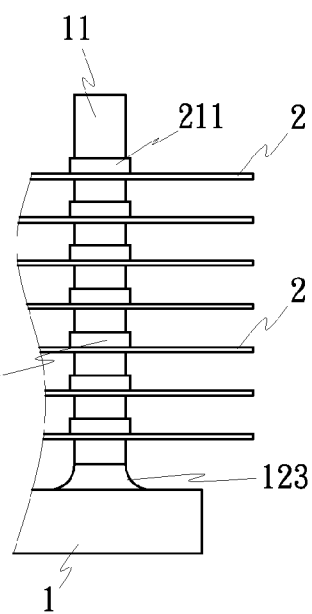


FIG. 12

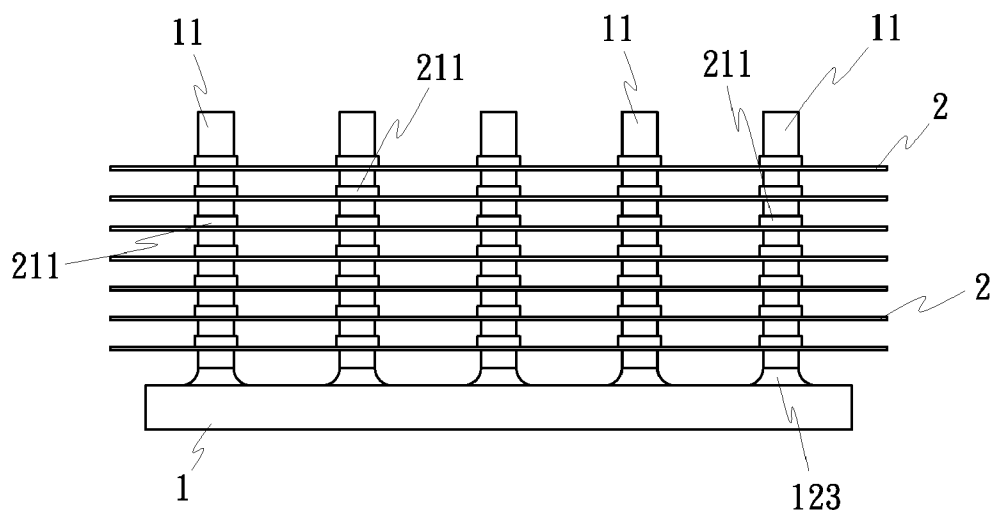


FIG. 13

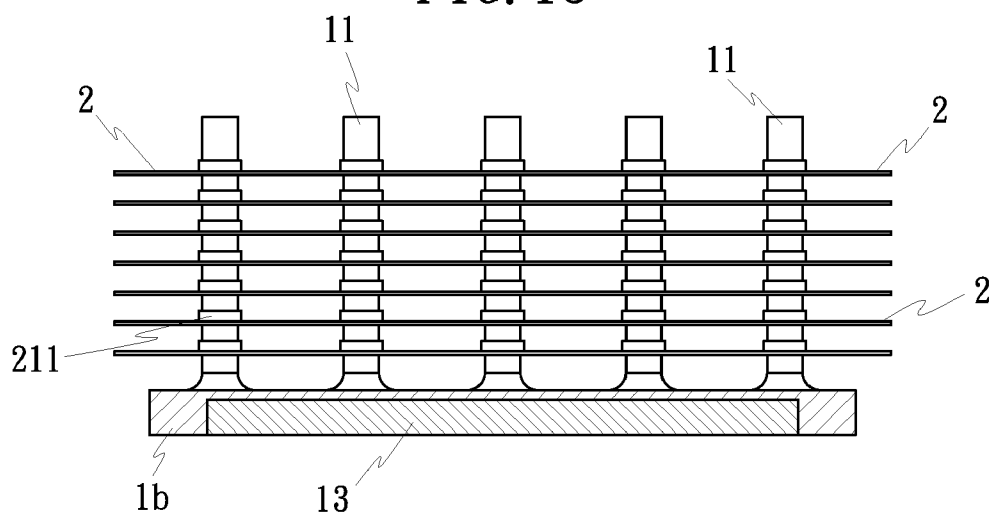


FIG. 14

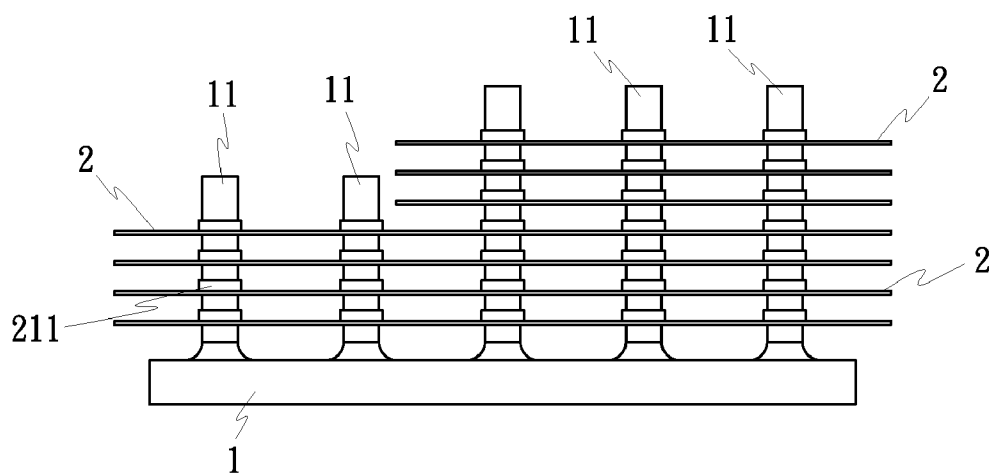


FIG. 15

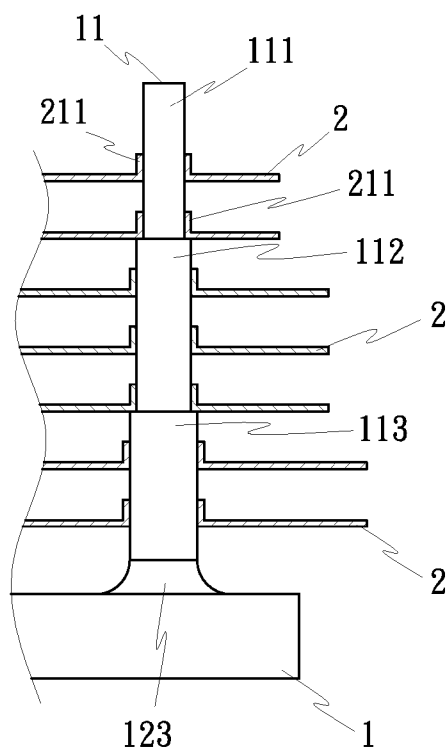


FIG. 16

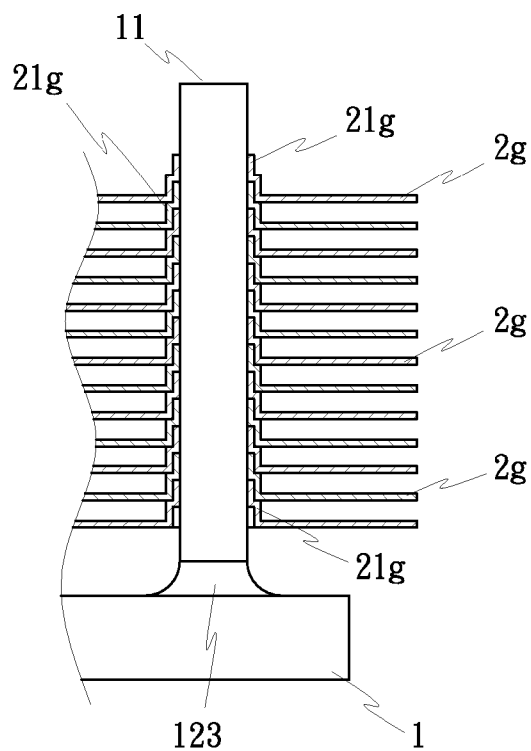


FIG. 17

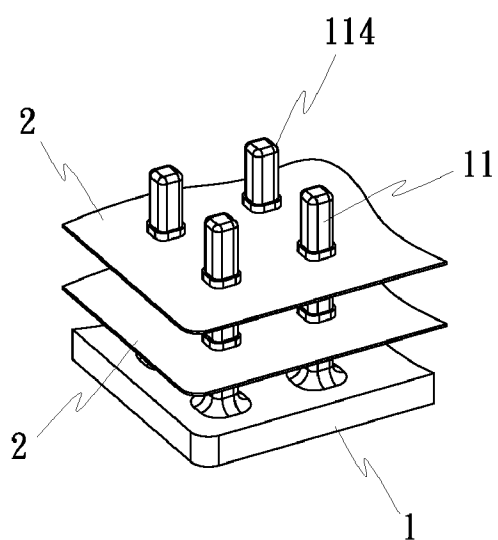


FIG. 18

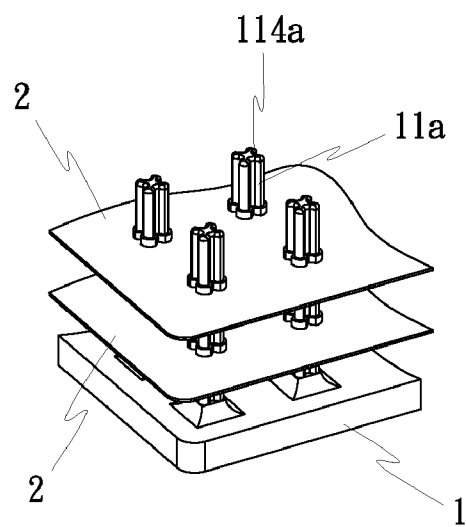


FIG. 19

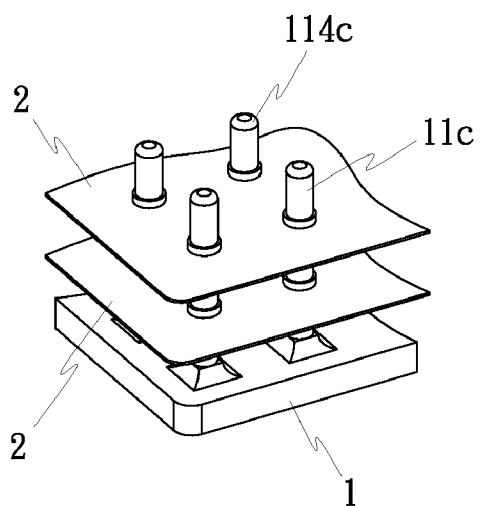


FIG. 20

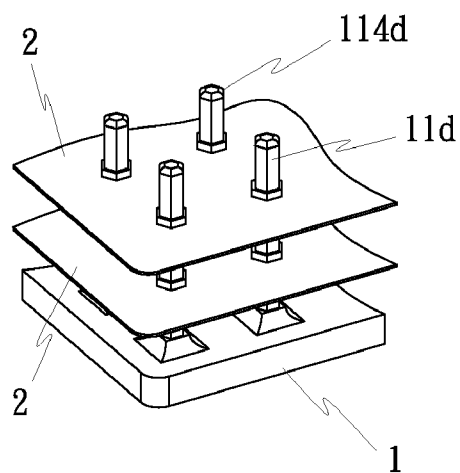


FIG. 21

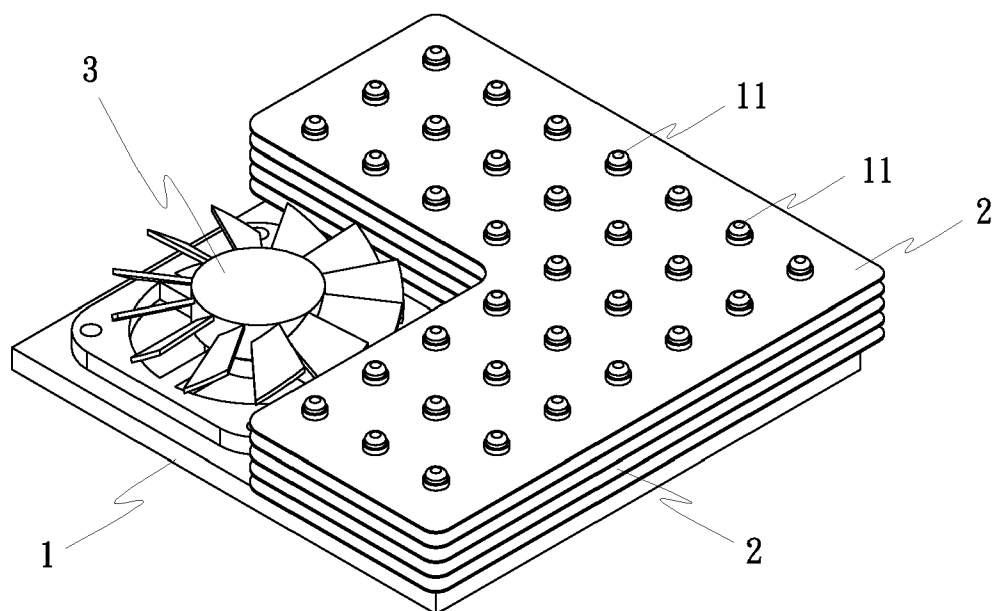


FIG. 22

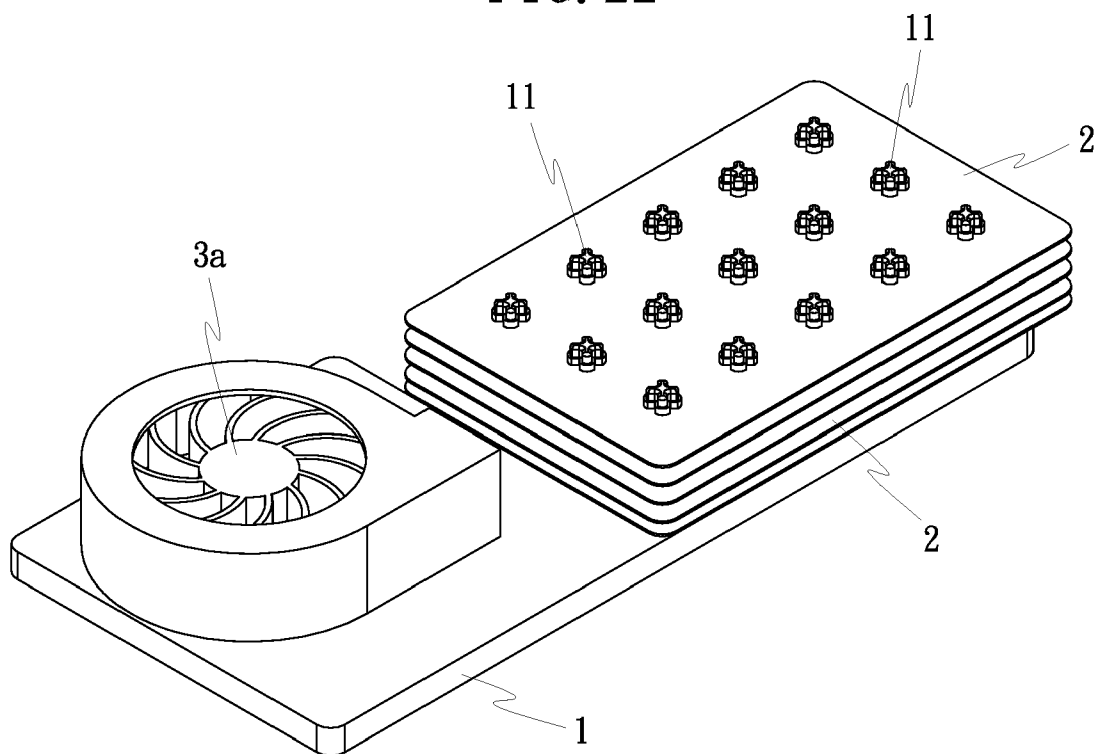


FIG. 23

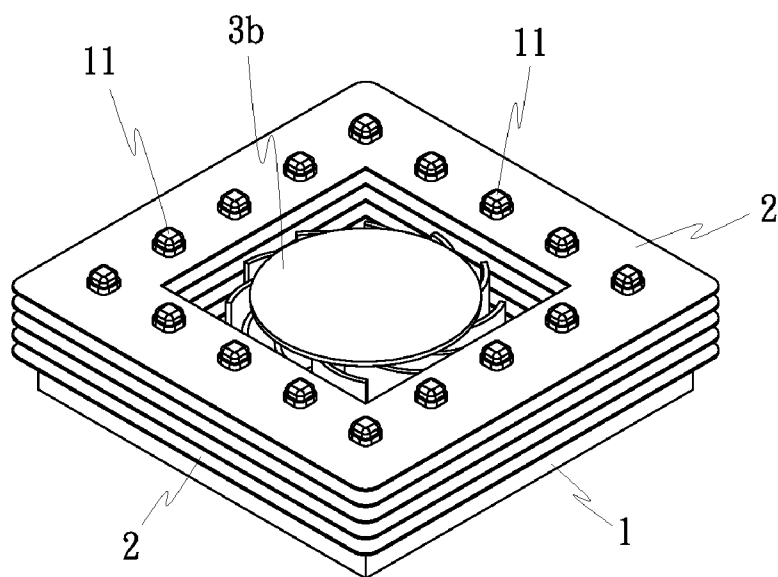


FIG. 24

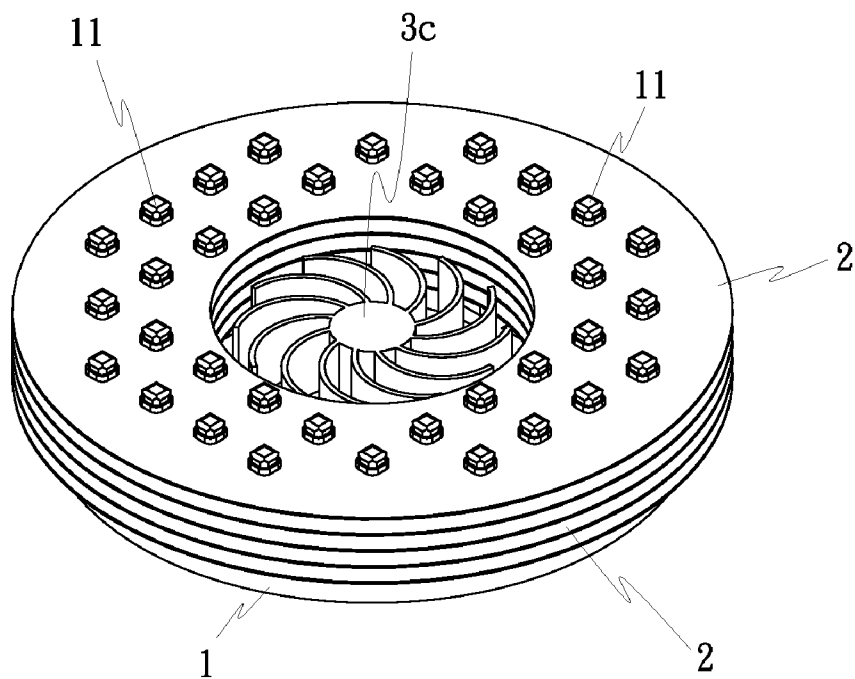


FIG. 25

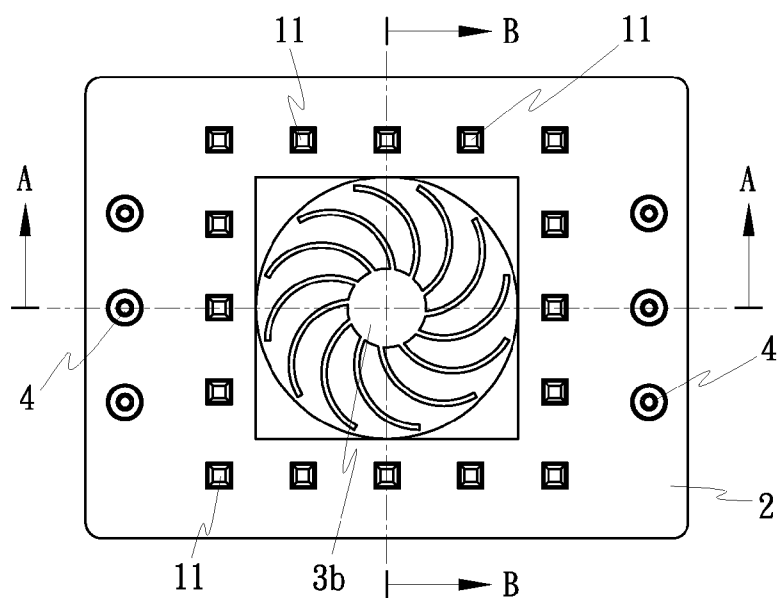


FIG. 26

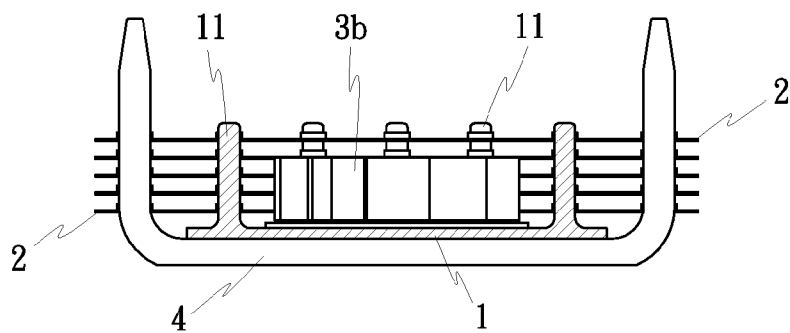


FIG. 27

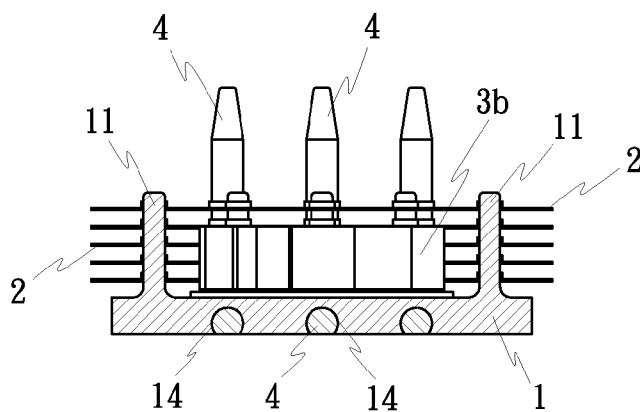


FIG. 28

HEAT SINK

BACKGROUND OF THE INVENTION

[0001] (a) Field of the Invention

[0002] The present invention relates to a heat sink for dissipation of heat from a semiconductor heat source and more particularly to a heat sink, which comprises a base panel having upright heat dissipation columns, and radiation fins with mounting through holes mounted on the heat dissipation columns at different elevations. The base panel of the heat sink may be provided with a fan and/or heat pipes to enhance heat dissipation efficiency.

[0003] (b) Description of the Prior Art

[0004] Conventional heat sinks are commonly comprised of a flat base panel and a plurality of radiation fins directly bonded to the base panel. Heat pipes may be bonded to the base panel to enhance heat dissipation performance. The base panel and the radiation fins are commonly extruded from aluminum or copper. The radiation fins are arranged on the base panel and spaced from one another at a distance. The base panel transfers heat energy from the semiconductor heat source to which the heat sink is attached to the radiation fins for dissipation into the outside open air.

[0005] There are mini heat sinks in which the radiation fins are integrally formed with the base panel, and arranged in lines. These heat sinks have low performance in heat dissipation. They cannot satisfy actual heat dissipation requirements. There are known heat sinks equipped with heat pipes to provide enhanced heat dissipation performance. However, these heat sinks are big in size, complicated, and expensive, therefore not practical for use in situations where lower heat dissipation power is required. In conclusion, conventional heat sinks cannot fit different heat dissipation requirements.

SUMMARY OF THE INVENTION

[0006] The present invention has been accomplished under the circumstances in view. According to one aspect of the present invention, the heat sink comprises a thermal conductive base panel and radiation fins. The base panel has a plurality of heat dissipation columns perpendicularly upwardly extending from the top wall. The radiation fins are mounted on the heat dissipation columns at different elevations. Each radiation fin has a plurality of mounting through holes respectively press-fitted onto the heat dissipation columns.

[0007] According to another aspect of the present invention, the number of the radiation fins can be adjusted subject to different heat dissipation requirements. When a relatively higher heat dissipation power is required, the number of the radiation fins is increased. On the contrary, when a relatively lower heat dissipation power is required, the number of the radiation fins is reduced. This arrangement fits different heat dissipation requirements for different applications, providing the optimal heat dissipation effect while simplifying the structure and saving the cost.

[0008] According to still another aspect of the present invention, the heat dissipation columns and the mounting through holes of the radiation fins are made in any of a variety of shapes, for example, rectangular, circular, cross-shaped, hexagonal, triangular or elongated rectangular cross section.

[0009] According to still another aspect of the present invention, the heat dissipation columns are stepped columns, and the size of the mounting through holes of the radiation fins is relatively modified to fit the stepped columns.

[0010] According to still another aspect of the present invention, the base panel is extruded from aluminum or copper, and the bottom wall of the base panel is mounted with a metal block that has a relatively higher heat transfer coefficient.

[0011] According to still another aspect of the present invention, the mounting through holes of the radiation fins are stepped mounting through holes such that the flanges that extend around each stepped mounting through hole of one radiation fin can be fitted into the stepped mounting through holes of another radiation fin.

[0012] According to still another aspect of the present invention, the root or top end of each heat dissipation column is chamfered in a taperedly chamfered form, convexly chamfered form or concavely chamfered form. The chamfered foot of each heat dissipation column facilitates transfer of heat energy from the base panel to the body of the respective heat dissipation column and then to the radiation fins. The chamfered top end of each heat dissipation column facilitates insertion of the heat dissipation columns into the mounting through holes of the radiation fins.

[0013] According to still another aspect of the present invention, the base panel has a fan mounting region (either at one side or at the center) for the mounting of a fan that is controlled to cause currents of air toward the heat dissipation columns and the radiation fins.

[0014] According to still another aspect of the present invention, heat pipes may be fastened to the base panel and the radiation fins to enhance heat dissipation performance. The heat pipes can be directly press-fitted in bottom pipe grooves on the bottom wall of the base panel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is an exploded view of a heat sink in accordance with one embodiment of the present invention.

[0016] FIG. 2 is an elevational assembly view of the heat sink shown in FIG. 1.

[0017] FIG. 3 is an elevational assembly view of a heat sink in accordance with another embodiment of the present invention.

[0018] FIG. 4 is a schematic top view of a part of the heat sink shown in FIG. 3.

[0019] FIGS. 5~9 illustrate matching of radiation fins with different configurations of heat dissipation columns according to the present invention.

[0020] FIGS. 10~12 illustrate different shapes of the roots of the heat dissipation columns according to the present invention.

[0021] FIG. 13 is a side plan view of one embodiment of the heat sink according to the present invention.

[0022] FIG. 14 is a schematic drawing of the present invention, showing a bi-metal design of the base panel of the heat sink.

[0023] FIG. 15 is a schematic drawing of the present invention, showing different heights of heat dissipation columns matched with different sizes of radiation fins.

[0024] FIG. 16 is a schematic drawing of the present invention, showing stepped form of heat dissipation columns matched with different sizes of radiation fins.

[0025] FIG. 17 is a schematic drawing of the present invention, showing the radiation fins provided with stepped mounting through holes.

[0026] FIGS. 18–21 illustrate the top ends of the heat dissipation columns of the base panel of the heat sink chamfered differently according to the present invention.

[0027] FIG. 22 is an oblique elevation, showing a fan mounted on the top wall of the base panel beyond the area of the heat dissipation columns and the radiation fins according to the present invention.

[0028] FIG. 23 illustrates another form of heat sink equipped with a fan on the base panel according to the present invention.

[0029] FIG. 24 is an elevational view of a rectangular heat sink with a fan mounted on the base panel at the center and surrounded by the radiation fins according to the present invention.

[0030] FIG. 25 is an elevational view of a circular heat sink with a fan mounted on the base panel at the center and surrounded by the radiation fins according to the present invention.

[0031] FIG. 26 is a schematic top view of a rectangular heat sink with heat pipes installed in the base panel and extended through the radiation fins.

[0032] FIG. 27 is a sectional view taken along line A-A of FIG. 26.

[0033] FIG. 28 is a sectional view taken along line B-B of FIG. 26.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] Referring to FIGS. 1 and 2, a heat sink in accordance with the present invention comprises a base panel 1 and a plurality of radiation fins 2.

[0035] The base panel 1 is a flat metal member made of an excellent heat conduction metal material (for example, aluminum or copper, i.e., the so-called aluminum base or copper base), having a plurality of heat dissipation columns 11 perpendicularly upwardly extending from its top wall. The heat dissipation columns 11 are arranged on the top side of the base panel 1 either in a regular or irregular manner. According to this embodiment, the heat dissipation columns 11 are arranged in an array. The radiation fins 2 have mounting through holes 21 respectively and tightly fastened to the heat dissipation columns 11 in such a manner that the radiation fins 2 are firmly supported on the heat dissipation columns 11 at different elevations in a parallel manner.

[0036] By tightly fastening the mounting through holes 21 of the radiation fins 2 to the heat dissipation columns 11 of the base panel 1 to constitute the heat sink, the base panel 1 absorbs heat energy from the attached semiconductor heat source (not shown) for quick dissipation into the outside open air through the radiation fins 2 via the heat dissipation columns 11.

[0037] According to the present invention, the heat dissipation columns 11 are press-fitted into the mounting through holes 21 of each radiation fin 2. The diameter of the mounting through holes 21 of the radiation fins 2 is slightly smaller than the diameter of the heat dissipation columns 11 so that the heat dissipation columns 11 can be tightly fitted into the mounting through holes 21 of each radiation fin 2. This assembly procedure is quite simple and can save much of the cost.

[0038] The number of the radiation fins 2 is determined according to the heat dissipation power required. When a relatively higher heat dissipation power is required, the number of the radiation fins 2 is increased. On the contrary, when

a relatively lower heat dissipation power is required, the number of the radiation fins 2 is reduced. This arrangement fits different heat dissipation requirements for different applications, therefore it is able to provide the optimal heat dissipation effect while simplifying the structure and saving the cost.

[0039] There is no special limitation on the shape of the heat dissipation columns 11 and the mounting through holes 21 of the radiation fins 2. In the example shown in FIGS. 3 and 4, the heat dissipation columns 11a and the mounting through holes 21a of the radiation fins 2a have a cross-shaped cross section. In the example shown in FIG. 5, the heat dissipation columns 11b and the mounting through holes 21b of the radiation fins 2b have a rectangular cross section. In the example shown in FIG. 6, the heat dissipation columns 11c and the mounting through holes 21c of the radiation fins 2c have a circular cross section. In the example shown in FIG. 7, the heat dissipation columns 11d and the mounting through holes 21d of the radiation fins 2d have a hexagonal cross section. In the example shown in FIG. 8, the heat dissipation columns 11e and the mounting through holes 21e of the radiation fins 2e have a triangular cross section. In the example shown in FIG. 9, the heat dissipation columns 11f and the mounting through holes 21f of the radiation fins 2f have an elongated cross section.

[0040] Referring to FIGS. 10–12, the roots 121, 122 or 123 of the heat dissipation columns 11 (11a–11f) that are bonded to the top wall of the base panel 1 are made in any of a variety of shapes, for example, taperedly chamfered, convexly chamfered, or concavely chamfered, to allow heat energy to be rapidly transferred from the base panel 1 through the roots 121, 122 or 123 to the heat dissipation columns 11 (11a–11f) and then to the radiation fins 2 for quick dissipation.

[0041] Referring to FIG. 13 and FIG. 1 again, each radiation fin 2 (or 2a–2f) has a flange 211 protruding from the top surface around each mounting through hole 21 (or 21a–21f). The flanges 211 increase the contact surface area between the radiation fins 2 and the heat dissipation columns 11 (or 11a–11f) to enhance heat transfer speed.

[0042] Referring to FIG. 14, the base panel 1b has a metal block 13 embedded in its bottom side in a flash manner for direct contact with the semiconductor heat source (not shown). The metal block 13 is made of a metal material having a heat transfer coefficient higher than the metal material (copper or aluminum) of the base panel 1b.

[0043] Referring to FIG. 15, the heat dissipation columns 11 (or 11a–11f) can be made having different heights and mounted with different sizes of radiation fins 2.

[0044] Further, the heat dissipation columns 11 (or 11a–11f) of the base panel 1 can be stepped columns. As shown in FIG. 16, each heat dissipation column 11 (or 11a–11f) has an upper section 111, a middle section 112, and a lower section 113. The middle section 112 has a diameter greater than the upper section 111 but smaller than the lower section 113. Further, the sizes of the mounting through holes 21 of the respective radiation fins 2 fit the diameters of the sections 111, 112 and 113 of the heat dissipation columns 11 (or 11a–11f) respectively.

[0045] Referring to FIG. 17, the mounting through holes 21g of the radiation fins 2g are stepped through holes so that the radiation fins 2g can be fastened together in a stack (by means of fitting the stepped flanges that extend around each mounting through hole of one radiation fin into the stepped flanges of another radiation fin). This stepped mounting

through hole design can also be used in the design where the base panel is provided with stepped heat dissipation columns.

[0046] Referring to FIG. 18, the top end 114 of each heat dissipation column 11 is taperedly, convexly or concavely chamfered to facilitate insertion of the heat dissipation columns 11 through the mounting through holes of the radiation fins 2. Similarly, the heat dissipation columns 11a, 11c, 11d shown in FIGS. 19~21 have the respective top ends 114a, 114c, 114d taperedly, convexly or concavely chamfered.

[0047] The heat sink may be provided with a fan at the base panel 1. FIGS. 22 and 23 show a fan 3 or 3a mounted on a blank area at the top wall of the base panel 1 at one side relative to the heat dissipation columns 11 and the radiation fins 2.

[0048] Referring to FIG. 24, the heat sink has a rectangular profile with a fan 3b mounted on the top wall of the base panel 1 at the center and surrounded by the radiation fins 2.

[0049] Referring to FIG. 25, the heat sink has a circular profile with a fan 3c mounted on the top wall of the base panel 1 at the center and surrounded by the radiation fins 2.

[0050] The heat sink can be mounted with a fan 3, 3a or 3b, and can also be provided with one or a number of heat pipes 4. As shown in FIGS. 26~28, the base panel 1 has a plurality of bottom pipe grooves 14 on the bottom wall, and heat pipes 4 are respectively press-fitted in the bottom pipe grooves 14 of the base panel 1 with the flat bottom side of each heat pipe 4 kept in flush with the bottom wall of the base panel 1 for direct contact with the semiconductor heat source (not shown) to enhance heat dissipation performance.

[0051] The arrangement of the base panel 1, the radiation fins 2, the fan 3 (3a, 3b, 3c) and the heat pipes 4 is not limited to the aforesaid embodiments. The heat pipes 4 can be fastened to the radiation fins 2 with only their one end respectively extended to the bottom side of the base panel 1 and embedded in the bottom pipe grooves 14.

[0052] A prototype of heat sink has been constructed with the features of FIGS. 1~28. The heat sink functions smoothly to provide all of the features discussed earlier.

[0053] Although particular embodiments of the invention have been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

What is claimed is:

1. A heat sink comprising:
 - a thermal conductive base panel, said base panel having a plurality of heat dissipation columns perpendicularly upwardly extending from a top wall thereof and respectively spaced from one another at a distance; and
 - a plurality of radiation fins mounted on said heat dissipation columns at different elevations, said radiation fins each having a plurality of mounting through holes respectively press-fitted onto said heat dissipation columns.
2. The heat sink as claimed in claim 1, wherein said heat dissipation columns are arranged in an array.
3. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins have a cross-shaped cross section, and said heat dissipation columns have a cross-shaped cross section respectively tightly fitted into said mounting through holes of said radiation fins.
4. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins have a rectangular

cross section, and said heat dissipation columns have a rectangular cross section respectively tightly fitted into said mounting through holes of said radiation fins.

5. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins have a circular cross section, and said heat dissipation columns have a circular cross section respectively tightly fitted into said mounting through holes of said radiation fins.

6. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins have a hexagonal cross section, and said heat dissipation columns have a hexagonal cross section respectively tightly fitted into said mounting through holes of said radiation fins.

7. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins have a triangular cross section, and said heat dissipation columns have a triangular cross section respectively tightly fitted into said mounting through holes of said radiation fins.

8. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins have an elongated rectangular cross section, and said heat dissipation columns have an elongated rectangular cross section respectively tightly fitted into said mounting through holes of said radiation fins.

9. The heat sink as claimed in claim 1, wherein said heat dissipation columns each have a chamfered foot fixedly connected to the top wall of said base panel.

10. The heat sink as claimed in claim 9, wherein the chamfered foot of each said heat dissipation column is chamfered in taperedly chamfered form, convexly chamfered form, or concavely chamfered form.

11. The heat sink as claimed in claim 1, wherein said radiation fins each have a plurality of flanges protruding from a top surface thereof and respectively extending around said mounting through holes.

12. The heat sink as claimed in claim 1, wherein said base panel is extruded from copper or aluminum.

13. The heat sink as claimed in claim 1, wherein said base panel has a metal block embedded in a bottom wall thereof in flush with a bottom surface thereof, said metal block having a heat transfer coefficient higher than the metal material of said base panel.

14. The heat sink as claimed in claim 1, wherein said heat dissipation columns have different heights.

15. The heat sink as claimed in claim 1, wherein said heat dissipation columns are stepped columns.

16. The heat sink as claimed in claim 1, wherein said mounting through holes of said radiation fins are stepped through holes, and the stepped mounting through holes of one said radiation fin are respectively fitted into the stepped mounting through holes of another said radiation fin when said radiation fins are mounted on said heat dissipation columns.

17. The heat sink as claimed in claim 1, wherein said heat dissipation columns each have a chamfered top end.

18. The heat sink as claimed in claim 17, wherein the chamfered top end of each said heat dissipation column is chamfered in taperedly chamfered form, convexly chamfered form, or concavely chamfered form.

19. The heat sink as claimed in claim 1, wherein said base panel has a fan mounting region disposed at one side beyond said heat dissipation columns and said radiation fins for the mounting of a fan.

20. The heat sink as claimed in claim **1**, wherein said base panel has a fan mounting region disposed at the center thereof and surrounded by said heat dissipation columns and said radiation fins for the mounting of a fan.

21. The heat sink as claimed in claim **1**, wherein said base panel has at least one pipe groove on a flat bottom wall thereof, and at least one heat pipe respectively mounted in

said at least one pipe groove, said at least one heat pipe each having a flat bottom wall disposed in flush with the bottom wall of said base panel.

22. The heat sink as claimed in claim **21**, wherein said at least one heat pipe is respectively press-fitted into said at least one pipe groove of said base panel.

* * * * *