TITLE: Heat-liberating heat sink for electronics component

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to heat sinks, and more particularly to a heat sink having a plurality of fins to remove heat from an electronic heat-generating components, wherein the fins have an improved structure.

2. Description of Related Art

Heat sinks are usually used to remove heat from electronic heat-generating components, such as central processing units (CPU), Light Emitting Diode (LED) etc., to keep the components in stable operation. Air, or other forms of fluid, flows over the surfaces of the heat sink to remove the heat, and thus cooling the heat-generating components. A typical heat sink comprises a base for contacting with the heat-generating component and a plurality of parallel planar fins attached to the base. The fins are used for dissipating the heat to ambient air. For enhancing heat dissipation efficiency, a fan is usually mounted on a top or a side of the heat sink to impel air to flow between the fins.

To meet a requirement of heat removal from the heat-generating component which generates more and more heat, it is current way to enlarge the total surface area of the fins by increasing the number of the fins or enlarging a dimension of each fin. However, such thermal resolutions have their limitations as the space available for the heat sink cannot be readily increased and an increase of the size of the fins is not feasible. Furthermore, the larger number the fins have, the denser the fins are, and further the narrower the spacing between the fins are. If the spacing are too narrow, the increase in flow resistance would impedes the heat dissipation of the heat sink even if the number of the fins is increased.

A heat sink with a higher heat dissipating efficiency need to be developed by means of improving heat exchange between the fins and air flowing through the heat sink under a condition that the size and number of the fins are not necessary to be increased.

SUMMARY OF THE INVENTION

This invention discloses a heat sink which includes a base adapted for absorbing heat from electronic heat-generating component, a plurality of radial fins having channels defined therebetween. Each of the fins, which includes a main body standing on the base, has opening at the base and side of the fins to facilitate natural or forced air flow upwardly or downwardly through the fins.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is an isometric view of a heat sink in accordance with a preferred embodiment to the present invention.

FIG. 2a-2d are a cross-sectional views of an alternate embodiment of the fin according to the present invention.

FIG. 3 is a top view of the heat sink according to embodiments of the invention, showing the air flow through the rows of radial fins.

FIG. 4a-4d are schematics of varying shapes of heat sink base in accordance to embodiments of the present invention.

FIG. 5a-5e are schematics of cross-sectional views of the various hollow fin shapes according to embodiments of the invention.

FIG. 6a-6e are schematics of side view of the heat sink illustrating varying fin and base configurations in accordance to embodiments of the present invention.

FIG. 7 is an isometric view of a heat sink with a preferred embodiment to the present invention adapted into a LED lamp.

DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description of the embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. These

embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that structural, logical and electrical changes may be made without departing from the spirit and scope of the present inventions. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present inventions is defined only by the appended claims.

Referring to FIG. 1, a heat sink in accordance with a preferred embodiment of the invention comprises a base **100** and a plurality of hollow fins **300** which are attached to the base **100**. The base **100** is a heat conducting plate with through hole openings **130**, and comprises a bottom surface (not shown) for absorbing heat from the heat generating component (not shown) and a top surface **110**. The heat sink comprises at least one heat-generating component mounted on the bottom surface of the base **100**. The heat-generating component is thermally coupled to the bottom surface of the base **100**. The heat produced by the component is spread through conduction from the base **100** to rows of radial fins **300**, where the heat is delivered to the ambient air by natural or forced convection. Each of the fins **300** comprises a side wall, a channel, an outlet **320** and at least one air flow inlet. Each fin can have an opening **310** through the bottom surface of the plate and at least one opening **330** at the side wall of the fin, constituting as air flow inlet. The bottom openings **310** can be of different cross-sections (such as polygon, circular, or elliptical, etc.). Lower-density air next to the vertical hot surface moves upward because of the buoyant force of higher-density cooler air farther away from the vertical surface. Movement of the air adjacent the vertical surface increases in velocity from zero at the vertical surface to a maximum velocity from zero at the vertical surface to a maximum velocity at a distance from the vertical surface and then decreases back to a velocity of zero as ambient surrounding conditions are reached. In the preferred embodiment, the air flow inlet creates a flow of air over a top side **110** of the heat sink and the heated air flows upward, driven by buoyancy force, draws cooler air inwards through the air flow inlets to cool the inner side walls of the fins **300** and exits out through the outlet **320** at the top of each fins. The top side and bottom of the heat sink can be properly sealed to make the heat sink water-tight.

FIG. 2a-2d are the cross-sectional views of the fin **300**, showing a portion of the fin perpendicularly attached to the base **100** . Depending on the air flow surrounding the application, the air inflow can start from the bottom opening **310** of the base plate **100**, right through the channel of the fin **300** and to the top **320** as shown for example in FIG. 2a; or the air inflow can start from the side **330** of the fin **300** and up through the channel of the fin **300** as shown for example in FIG. 2b; or both the side **330** and bottom

310 of the heats sink and up through the channel of the fin **300** as shown for example in FIG. 2c. In free or natural convection, a high aspect ratio heat sink design tends to mix air inadequately with the surroundings resulting in the local ambient temperature around the heat sink to be hotter at the top **110** of the heat sink as compared to the bottom **120** of the heat sink, especially in laminar flow regimes. Thus, the fin can have a wider bottom opening **310** and tapered channel, which extend upwardly to a narrower fin opening **320** as shown for example in FIG. 2d. Reduction of pressure drop can be achieved by having such opening configuration. The lower pressure drop created by the wider bottom openings **310** will facilitate natural or forced air flow.

FIG. 3 shows the sectional top view of the heat sink, showing staggered rows of radial fins **300**. The outer row of radial fins **300** is staggered relative to the inner row of radial fins **300** such that it does not obstruct the air flow to the inner row of radial fins **300**. The bottom openings **130** between the outer row of radial fins **300** are spaced in a manner whereby the outer side walls of the fins **300** would always be exposed to adequate amount of air flow. The arrangement of the base openings **130**, which located between two adjacent radial fins **300**, would facilitate air flow from the bottom **120** of the base **100** to the side walls of the outer row of fins **300**. The bottom openings **130** can be of various cross-sections (such as polygon, circular, or elliptical, etc.). In certain applications, where there are low air flow rate from the side of the heat sink, the bottom openings **130** will provide added air flow from the bottom **120** of the heat sink to the top **110**.

FIG. 4a-4d are schematics of varying shapes of heat sink base **100** in accordance to embodiments of the present invention. The base **100** of the heat sink according to the invention may be shaped in any of a variety of ways. Some such shapes may be readily manufacturable, and some may provide other fabrication process advantages. For example, the heat sink base **100** may be a polygon with a minimum of three sides as shown for example in FIGS. 4a and 4b; or it may be generally round, either circular or elliptical, as shown for example in FIGS. 4c and 4d.

FIG. 5a-5e are schematics of cross-sectional views of the various hollow fin **300** configurations according to embodiments of the invention. The cross-section of the fin **300** according to the invention may be shaped in any of a variety of ways. Some such configuration may be readily manufacturable, and some may provide other fabrication process advantages. For example, the cross-section of the fin **300** may be a polygon with a minimum of three sides as shown for example in FIGS. 5a and 5b; or it may be generally round, either circular or elliptical, as shown for example in FIGS. 5c

and 5d. Other configurations may be employed; one particularly useful configuration is shown by way of example in FIG. 5e, which has a combination of a semicircular shape and a rectangular shape.

FIG. 6a-6d are schematics of side view of the heat sink illustrating varying fin **300** and base **100** configurations in accordance to embodiments of the present invention. The base **100** and the fins **300** according to the invention may be shaped in any of a variety of ways. Some such configurations may be readily manufacturable, and some may provide other fabrication process advantages. For example, the envelope configuration of the fins **300** may be of tapered, concave or convex shape, as shown for example in FIGS. 6a and 6b; or the base **100** configuration can be of tapered, concave or convex shape, as shown for example in FIGS. 6c and 6d. Other configurations may be employed; one particularly useful configuration is shown by way of example in FIG. 6e, which has a tapered base **100** and a convex fin envelope.

FIG. 7 is the isometric view of the heat sink integrated into a LED lamp. The LED module (not shown) is seated in the recessed of the central body of the heat sink and thermally connected to the central body of the heat sink. A plastic lens **510** is adapted to provide optical dispersion. The heat sink can be enclosed with a cover at the front **520** and back **530** to make the heat sink water-tight.

CLAIMS

What I claim is:

1. A heat sink for cooling heat generating component, comprising:

   a base, the base having a predetermined thickness to absorb the spread the heat produced by the heat generating component; and at least one opening to form at least one air flow channel from the bottom to the top of the heat sink;

   a plurality of hollow fins, wherein the fin can be deployed over the opening on the base, comprises a side wall, an opening at the top, the fin having material removed from the side wall only near the base to form at least one air flow inlet so that when the heat sink is coupled to the heat generating component, the heat is dissipated by air flow.

2. The heat sink as claimed in claim 1, wherein the bottom opening can be tapered or parallel so as to allow heated air from the area adjacent to said bottom surface of said plate to flow to the area adjacent to said top surface.

3. The heat sink as described in claim 1, wherein each of the said fins has a wider bottom opening and tapered channel, which extend upwardly to a narrower top opening.

4. The heat sink as described in claim 1, wherein said fins are selected from the group consisting of plate fin, straight pin fin, conical pin fin, and polygonal pin fin.

5. The heat sink as described in claim 1, wherein said base plate can be of polygonal or circular shapes, wherein a layer of thermally conductive material is deployed at the interface between said base and the said heat generating component.

6. An LED lamp comprising:

   a heat sink having a base adapted for absorbing heat from a heat-generating component, a plurality of hollow fins mounted on the base and extending vertically upward from the base, opening from the bottom of the base between two adjacent fins and within each fin, and opening on the side walls of the fins; and

   an LED module having a printed circuit board and a plurality of LEDs mounted to the printed circuit board, wherein the printed circuit board is seated in the recessed of the central body and thermally connected to the central body; and a plastic lens adapted to provide optical dispersion.