FLAT HEAT PIPE

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Related U.S. Application Data

Division of application No. 12/489,418, filed on Jun. 22, 2009.

A flat heat pipe includes a casing, a wick structure received in the casing, and a working medium contained in the casing and saturated in the wick structure. The casing has an upper plate and a bottom plate opposite to the upper plate. The wick structure is attached only to the bottom plate of the casing. The wick structure spaces from the upper plate with a vapor channel defined between the upper plate and the wick structure.
FIG. 1
FLAT HEAT PIPE
CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application is a divisional application of U.S. patent application Ser. No. 12/489,418 filed on Jun. 22, 2009, having an attorney docket number of US23104 and entitled “FLAT HEAT PIPE”. The disclosure of such parent application is incorporated herein by reference.

BACKGROUND

[0002] 1. Technical Field
[0003] The present invention relates generally to an apparatus for transfer or dissipation of heat from heat-generating components, and more particularly to a heat pipe applicable in electronic products such as personal computers for removing heat from electronic components installed therein.

[0004] 2. Description of Related Art
[0005] Heat pipes have excellent heat transfer performance due to their low thermal resistance, and are therefore an effective means for transfer or dissipation of heat from heat sources. Currently, flat heat pipes are widely used for removing heat from heat-generating components such as central processing units (CPUs) of computers, especially in a notebook computer having a smaller inner space therein. Preferably, a wick structure is attached to an inner surface of the heat pipe for drawing the working medium back to the evaporator section after it is condensed at the condenser section. An inner surface of the wick structure defines a vapor channel through which vapor moves from the evaporator section toward the condenser section. With the notebook computer becoming smaller and smaller, the flat heat pipe becomes flatter and flatter and a size of the vapor channel is greatly reduced. Thus, the vapor can not flow fluidly from the evaporator section toward the condenser section via the vapor channel, thereby decreasing the heat transfer capability of the flat heat pipe.

[0006] Therefore, it is desirable to provide a flat heat pipe with an improved heat transfer capability to overcome the above mentioned shortcoming.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Many aspects of the present embodiments 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 embodiments. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0008] FIG. 1 is a front view of a heat pipe in accordance with a first embodiment of the present invention.

[0009] FIG. 2 is a transverse cross-sectional view of the heat pipe of FIG. 1.

[0010] FIG. 3 is a transverse cross-sectional view of a heat pipe in accordance with a second embodiment of the present invention.

DETAILED DESCRIPTION

[0011] Referring to FIGS. 1 and 2, a flat heat pipe 10 includes an elongated, flat casing 12, and a wick structure 15 received in the casing 12, wherein the wick structure 15 has a plurality of pores therein and is saturated with a working medium. The flat heat pipe 10 is typically suitable for use in portable electronic devices such as notebook computers which have a limited space therein for accommodating heat dissipation devices.

[0012] The casing 12 is made of a highly thermally conductive material such as copper or aluminum. The casing 12 includes an evaporator section 121 and a condenser section 122 at two opposite sides thereof along a longitudinal direction thereof.

[0013] A height h of the casing 12 is below 1.2 millimeters. The casing 12 has a first lateral portion 13 at a left lateral side thereof and a second lateral portion 14 at a right lateral side thereof along a transverse direction. The first lateral portion 13 is C-shaped in profile and includes an upper plate 131 at a top side thereof, a bottom plate 132 at a bottom side thereof and opposite to the upper plate 131, and an outwardly curved side plate 133 connecting the upper plate 131 with the bottom plate 132. The second lateral portion 14 is C-shaped, with an opening of the second lateral portion 14 facing an opening of the first lateral portion 13. The second lateral portion 14 includes an upper plate 141 at a top side thereof, a bottom plate 142 at a bottom side thereof and opposite to the upper plate 141, and an outwardly curved side plate 143 connecting the upper plate 141 with the bottom plate 142. The upper plate 131 of the first lateral portion 13 and the upper plate 141 of the second lateral portion 14 cooperatively form an upper plate 124 of the casing 12, and the bottom plate 132 of the first lateral portion 13 and the bottom plate 142 of the second lateral portion 14 cooperatively form a bottom plate 125 of the casing 12.

[0014] In the embodiment, the wick structure 15 is a single-layered mesh-type structure, which is formed by weaving a plurality of metal wires, such as copper, or stainless steel wires. A plurality of pores is formed in the mesh wick structure 15, which provides a capillary action to the working medium.

[0015] The mesh wick structure 15 is received in the casing 12 and extends along the longitudinal direction of the casing 12. The mesh wick structure 15 has a C-shaped transverse cross section, with an opening of the mesh wick structure 15 facing the opening of the first lateral portion 13 of the casing 12. The mesh wick structure 15 includes a first upper section 151 parallel to the upper plate 141 of the second lateral portion 14 of the casing 12, a second bottom section 152 opposite to the first upper section 151, and a curved side section 153 connecting the upper section 151 with the second bottom portion 152. The mesh wick structure 15 is attached to an inner surface of the second lateral portion 14 of the casing 12, with the first upper section 151 being attached to the upper plate 141 of the second lateral portion 14 of the casing 12, the second bottom section 152 being attached to the bottom plate 142 of the second lateral portion 14 of the casing 12, the curved side section 153 being attached to the side plate 143 of the second lateral portion 14 of the casing 12. No wick structure is attached to an inner surface of the first lateral portion 13 of the casing 12. The inner surface of the first lateral portion 13 defines a first vapor channel 16 in the heat pipe 10, and an inner surface of the mesh wick structure 15 defines a second vapor channel 17 in the heat pipe 10. The first vapor channel 16 and the second vapor channel 17 communicate with each other at a joint between the first and the second lateral portions 13, 14 of the casing 12. The first vapor channel 16 has a height greater than the second vapor channel 17.
In an alternative embodiment, the C-shaped mesh wick structure 15 is attached to the inner surface of the first lateral portion 13 of the casing 12, with an opening of the mesh wick structure 15 facing the opening of the second lateral portion 14, and no wick structure is attached to the inner surface of the second lateral portion 14 of the casing 12.

The working medium is saturated in the vapor phase in the mesh wick structure 15 and is usually selected from a liquid such as water, methanol, or alcohol, which has a low boiling point and is compatible with the mesh wick structure 15. Thus, the working medium can easily evaporate to vapor when it receives heat at the evaporator section 121 of the heat pipe 10.

In operation, the evaporator section 121 of the heat pipe 10 is placed in thermal contact with a heat source, for example, a central processing unit (CPU) of a computer, which needs to be cooled. The working medium contained in the evaporator section 121 of the heat pipe 10 is vaporized into vapor upon receiving the heat generated by the heat source. Then, the generated vapor moves via the vapor channels 16, 17 towards the condenser section 122 of the heat pipe 10. After the vapor releases the heat carried thereby and is condensed into the liquid in the condenser section 122, the liquid is brought back by the mesh wick structure 15 to the evaporator section 121 of the heat pipe 10 for being available again for evaporation.

Since the mesh wick structure 15 is only attached to the second lateral portion 14 of the casing 12, the first vapor channel 16 has a height greater than the second vapor channel 17, whereby the first vapor channel 16 is very unlikely to be blocked when the heat pipe 10 is flattened. Even if the second vapor channel 17 is somewhat blocked by the first upper section 151 and the second bottom section 152 of the mesh wick structure 15, the vapor can also flow freely through the first vapor channel 16 from the evaporator section 121 toward the condenser section 122. Thus, the height of the casing 12 can be reduced to be less than 1.2 millimeters, such as 1.0 millimeter or 0.8 millimeter, while the heat pipe 10 still can function normally. Compared with a typical conventional heat pipe, the heat pipe 10 of the first embodiment can be made thinner and therefore is more suitable to be used in compact electronic devices, such as notebook computers.

FIG. 3 shows a flat heat pipe 30 in accordance with a second embodiment of the present invention. The difference of this embodiment over the previous embodiment is as follows. The wick structure 35 is flat and attached only to an inner surface of the bottom plate 312 of the casing 31 and spaced from the upper plate 311 of the casing 31.

It is believed that the present embodiments and their 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 hereinafter described merely being preferred or exemplary embodiments of the invention.

What is claimed is:

1. A flat heat pipe comprising:
   a casing having an upper plate and a bottom plate opposite to the upper plate;
   a wick structure received in the casing and attached only to the bottom plate of the casing, the wick structure spacing from the upper plate with a vapor channel defined between the upper plate and the wick structure; and
   a working medium contained in the casing and saturated in the wick structure.

2. The flat heat pipe as claimed in claim 1, wherein the wick structure is a single-layered mesh structure formed by weaving a plurality of wires.

3. The flat heat pipe as claimed in claim 1, wherein a height of the casing is below 1.2 millimeters.

4. A flat heat pipe comprising:
   a metal casing having a flat upper plate and a flat lower plate and defining an evaporator section for absorbing heat and a condenser section for releasing heat, wherein the evaporator section and the condenser section are located at opposite ends of the metal casing, a transverse section of the metal casing having an outer surface and an inner surface;
   a wick structure made of a mesh attached to a partial portion of the inner surface of the transverse section of the metal casing and extending from the evaporator section to the condenser section; and
   a working fluid received in the casing and saturated in the wick structure.

5. The heat pipe as claimed in claim 4, wherein the wick structure has a flat configuration and attached to a bottom of the inner surface of the transverse section of the casing.

6. The heat pipe as claimed in claim 5, wherein the casing has a height no more than 1.2 millimeters.

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