



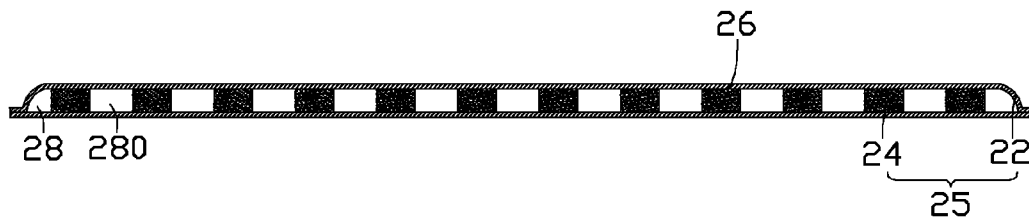
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(19) **United States**(12) **Patent Application Publication****YAN et al.**(10) **Pub. No.: US 2012/0111541 A1**(43) **Pub. Date: May 10, 2012**(54) **PLATE TYPE HEAT PIPE AND HEAT SINK
USING THE SAME**(30) **Foreign Application Priority Data**

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F28D 15/04 (2006.01)(52) **U.S. Cl.** **165/104.26**(73) Assignees: **FOXCONN TECHNOLOGY
CO., LTD.**, Tucheng City (TW);
**FU ZHUN PRECISION
INDUSTRY (SHEN ZHEN) CO.,
LTD.**, Shenzhen City (CN)(57) **ABSTRACT**

A plate-type heat pipe includes a sealed shell containing working liquid therein, and elongated wick structures arranged in the shell in a spaced manner. Channels are formed between the wick structures. The heat pipe has an evaporating section and a condensing section. Two ends of each wick structure are respectively located at the evaporating section and the condensing section. Top and bottom faces of each wick structure respectively contact top and bottom inner faces of the shell.

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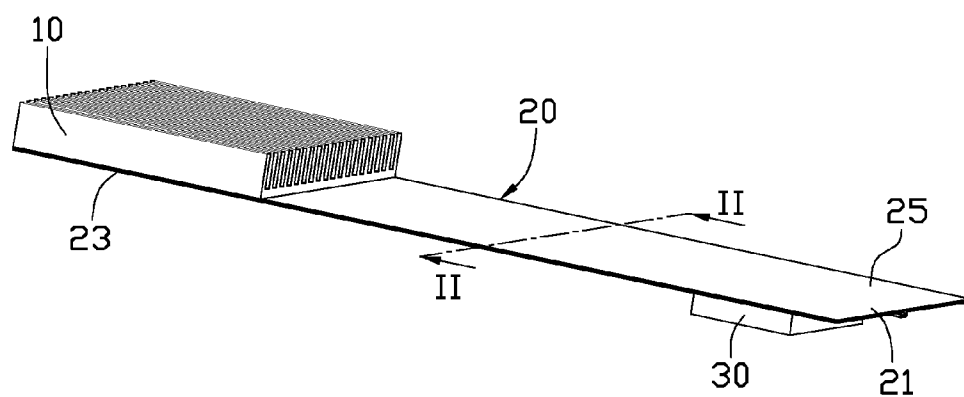


FIG. 1

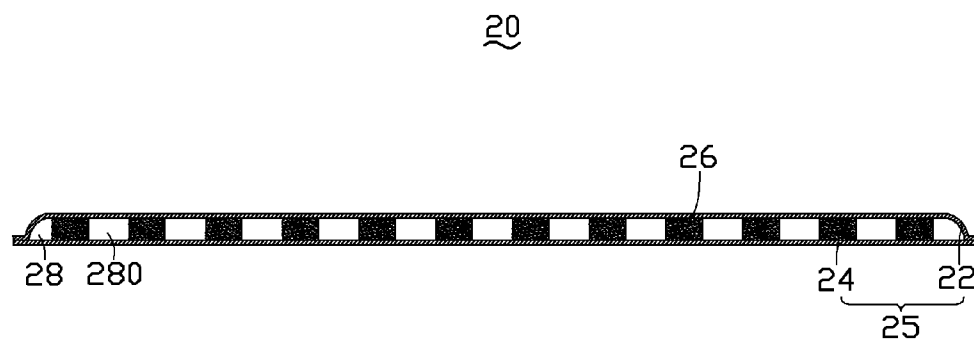


FIG. 2

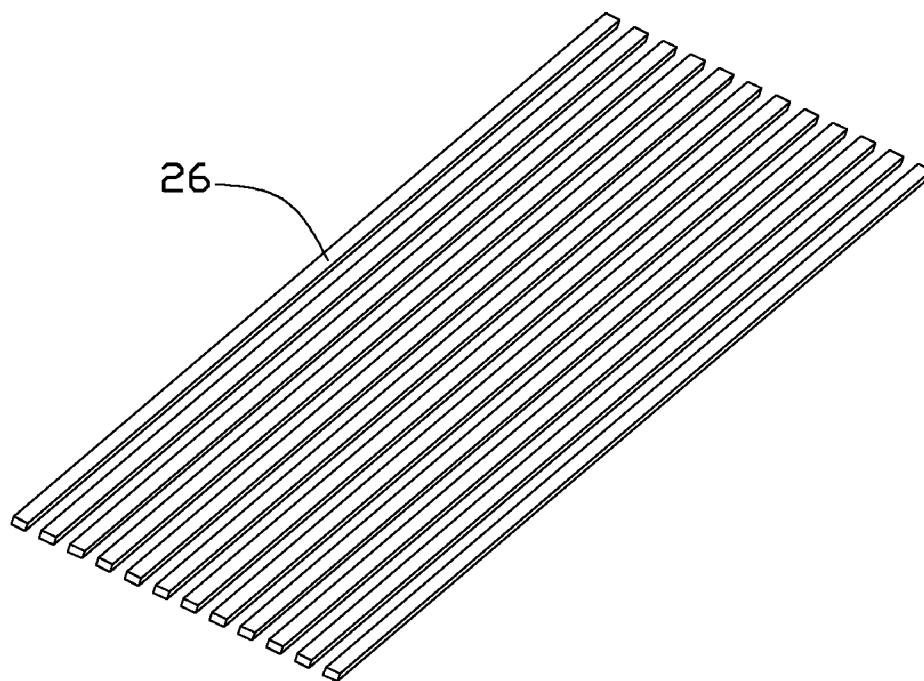


FIG. 3

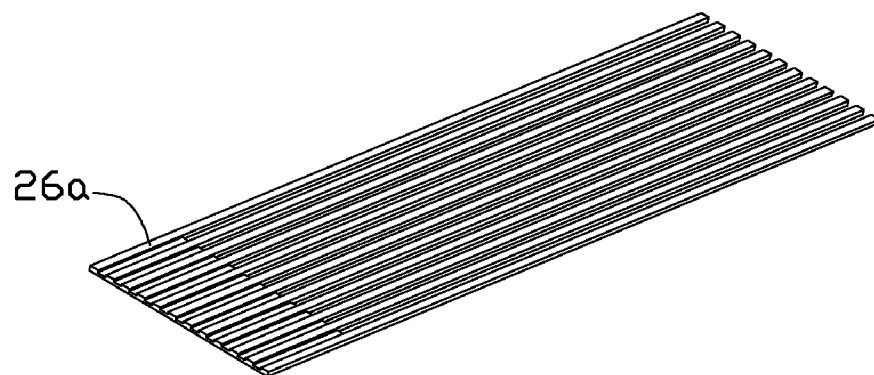


FIG. 4

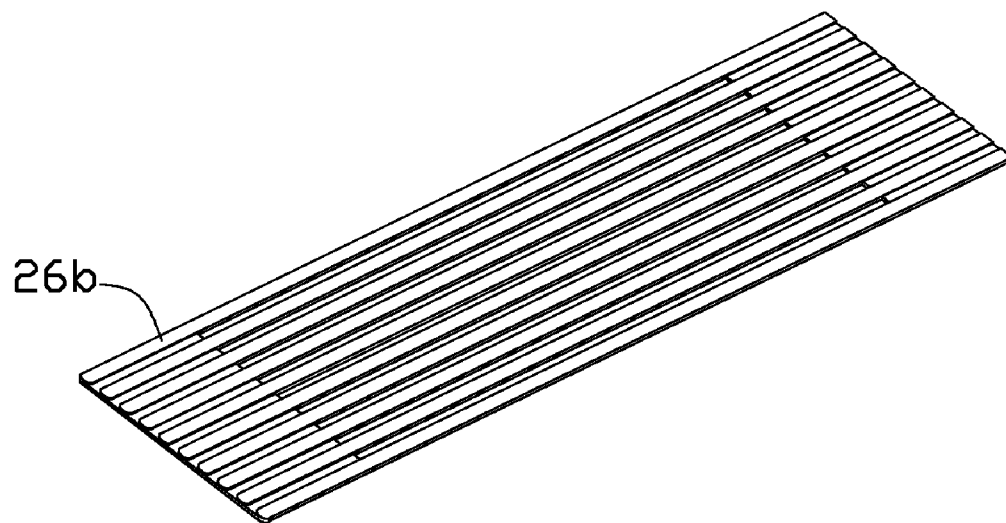


FIG. 5

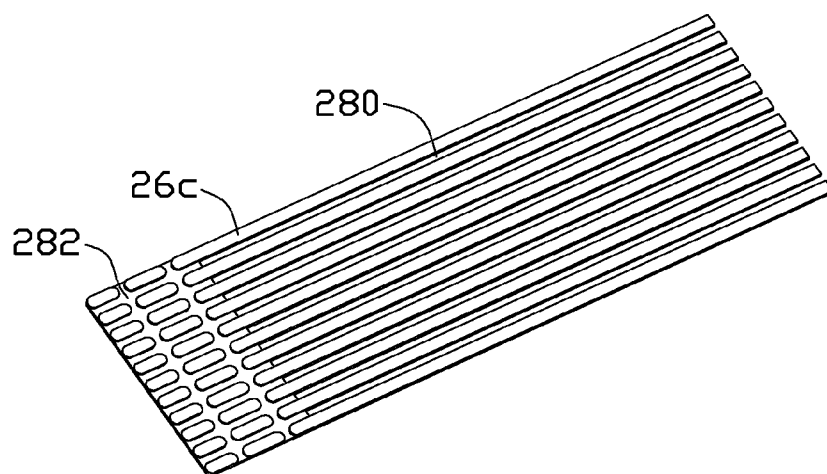


FIG. 6

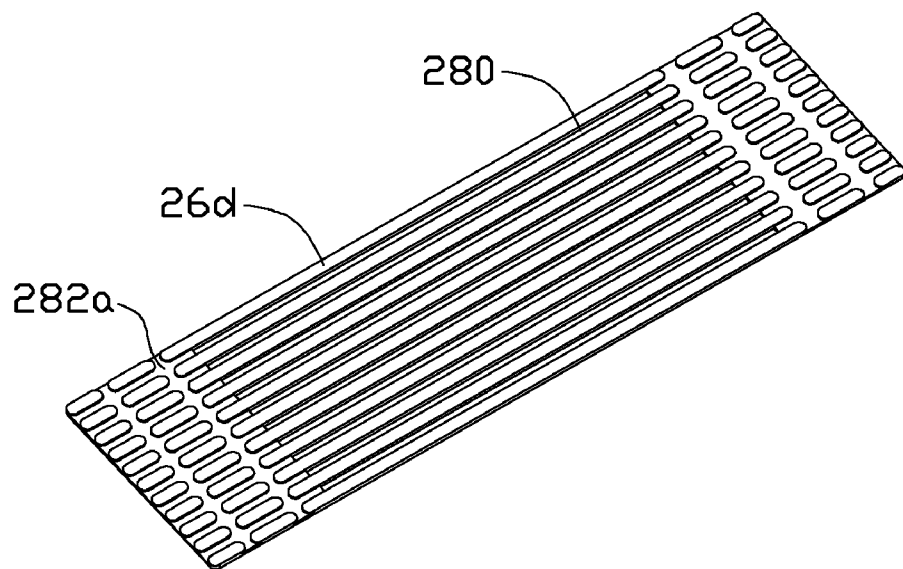


FIG. 7

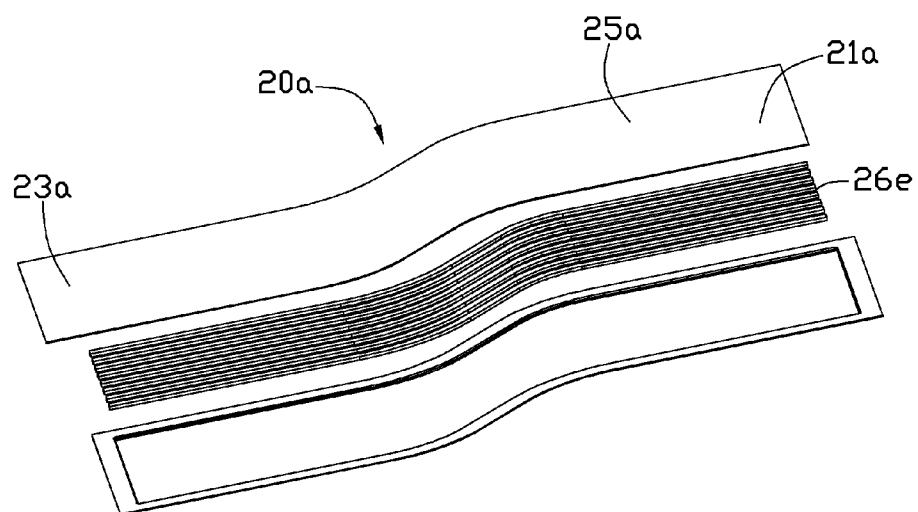


FIG. 8

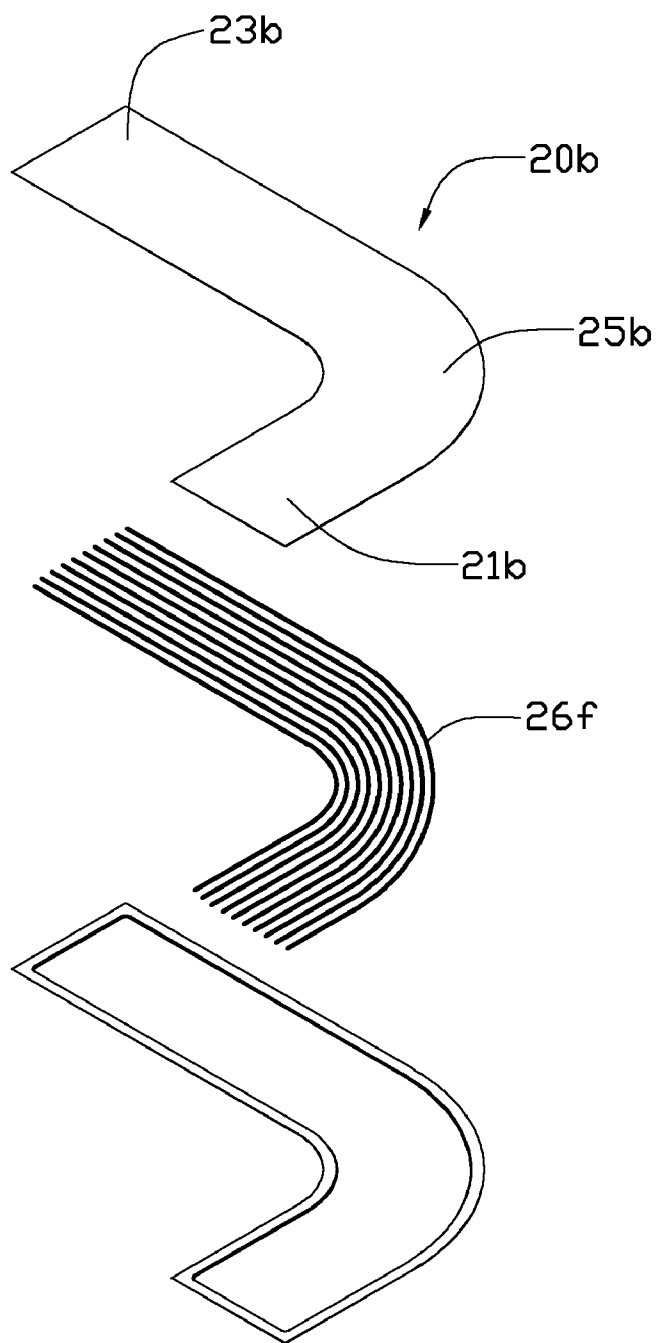


FIG. 9

PLATE TYPE HEAT PIPE AND HEAT SINK USING THE SAME

BACKGROUND

[0001] 1. Technical Field

[0002] The disclosure relates to heat dissipation and, more particularly, to a plate type heat pipe and a heat sink using the plate type heat pipe.

[0003] 2. Description of Related Art

[0004] Nowadays, numerous types of heat sinks are used to dissipate heat generated by electronic devices. A plate type heat pipe with dissipating fins mounted thereon is a common type of heat sink. The heat pipe is a hollow tube receiving working fluid therein, and has a wick structure formed on an inner face thereof for drawing back the working fluid. When the heat pipe is maintained in thermal contact with an electronic device, the working fluid contained in the heat pipe at a hotter section of the heat pipe vaporizes into vapor. The vapor moves to a cooler section of the heat pipe, and releases its latent heat and condenses to fluid again. The condensate returns to the hotter section via capillary force provided by the wick structure. Thereafter, the fluid repeatedly vaporizes and condenses to form a circulation system which continually removes the heat generated by the electronic device.

[0005] However, the plate type heat pipe of the heat sink is prone to deformation when subjected to an inner or an outer pressure during use. For example, internal vapor pressure or accidental impact may distort the heat pipe. Such deformation may result in disengagement of the wick structure from the inner face of the heat pipe, adversely affecting the performance of the heat pipe.

[0006] What is needed, therefore, is a plate type heat pipe and a heat sink using the plate type heat pipe which can overcome the limitations described.

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, and all the views are schematic.

[0008] FIG. 1 is a perspective view of a heat sink in accordance with an embodiment of the disclosure, together with a heat source, the heat sink including a plate type heat pipe in accordance with a first embodiment of the disclosure.

[0009] FIG. 2 is a cross sectional view of the plate type heat pipe of the heat sink of FIG. 1, taken along line II-II thereof.

[0010] FIG. 3 is a perspective view of a plurality of wick structures of the plate type heat pipe of FIG. 2.

[0011] FIGS. 4-7 are views similar to FIG. 3, showing alternative wick structures which can replace the wick structures of FIG. 3.

[0012] FIG. 8 is an exploded, perspective view of a plate type heat pipe in accordance with a second embodiment of the disclosure.

[0013] FIG. 9 is an exploded, perspective view of a plate type heat pipe in accordance with a third embodiment of the disclosure.

DETAILED DESCRIPTION

[0014] FIG. 1 shows a heat sink in accordance with an embodiment of the disclosure. The heat sink includes a plate type heat pipe 20, and a fin assembly 10 thermally attached to the heat pipe 20. The heat pipe 20 is elongated. A length of the heat pipe 20 is much greater than a width of the heat pipe 20, and a height of the heat pipe 20 is much less than the width of the heat pipe 20. Along a longitudinal direction of the heat pipe 20, the heat pipe 20 includes an evaporating section 21 thermally contacting a heat source 30, an intermediate section (not labeled), and a condensing section 23 thermally contacting the fin assembly 10. The fin assembly 10 includes a plurality of spaced fins (not labeled).

[0015] Also referring to FIGS. 2-3, the plate type heat pipe 20 includes a sealed, elongated shell 25, and a plurality of elongated wick structures 26 each disposed on opposite inner faces of the shell 25. The shell 25 includes a substrate 24, and a cover 22 covering the substrate 24. An edge of the cover 22 hermetically engages an edge of the substrate 24, thereby forming a vapor chamber 28 between the substrate 24 and the cover 22. A working fluid (not labeled) is filled in the vapor chamber 28, and can flow from the condensing section 23 to the evaporating section 21 via capillary force provided by the wick structures 26. The wick structures 26 are arranged in the shell 25 in a parallel and spaced manner. Each wick structure 26 extends from the condensing section 23 to the evaporating section 21, and two opposite ends of each wick structure 26 are respectively located at the evaporating section 21 and the condensing section 23. Top and bottom faces of each wick structure 26 respectively contact inner faces of the substrate 24 and the cover 22 of the shell 25. Thereby, a plurality of channels 280 for vapor flow are formed between the wick structures 26, each channel 280 extending along the longitudinal direction of the heat pipe 20. The wick structures 26 are made of sintered metal powder or sintered ceramic powder, and have a high strength to support the substrate 24 and the cover 22 of the shell 25 and prevent the shell 25 from deforming.

[0016] In use, the evaporating section 21 of the plate type heat pipe 20 thermally contacts the heat source 30 to absorb heat generated therefrom. The working fluid at the evaporating section 21 is heated and vaporized to flow through the channels 280 to the condensing section 23. The vaporized working fluid exchanges heat with the fin assembly 10 at the condensing section 23 and is condensed to liquid. The condensed working fluid returns to the evaporating section 21 via the wick structures 26.

[0017] FIG. 4 shows a plurality of alternative wick structures 26a, which can replace the above-described wick structures 26. The wick structures 26a are similar to the wick structures 26, except for the following. Ends of the wick structures 26a corresponding to the condensing section of the heat pipe 20 are connected with each other, by sintered metal powder when the wick structures 26a are made of sintered metal powder, or by sintered ceramic powder when the wick structures 26a are made of sintered ceramic powder. Thus, the condensed working fluid can flow from one wick structure 26a to another.

[0018] FIG. 5 shows a plurality of alternative wick structures 26b, which can replace the above-described wick struc-

tures **26a**. The difference between the two wick structures **26b**, **26a** is as follows. Not only are ends of the wick structures **26b** corresponding to the condensing section **23** of the heat pipe **20** connected with each other by sintered metal powder or sintered ceramic powder, but also ends of the wick structures **26b** corresponding to the evaporating section **21** of the heat pipe **20** are connected with each other by sintered metal powder or sintered ceramic powder.

[0019] FIG. 6 shows a plurality of alternative wick structures **26c**, which can replace the above-described wick structures **26a**. The wick structures **26c** are similar to the wick structures **26a**, except for the following. Besides being connected with each other by sintered metal powder or sintered ceramic powder, ends of the wick structures **26c** corresponding to the condensing section of the heat pipe **20** define two passages **282** along the width direction of the heat pipe **20**. That is, each of the passages **282** is substantially perpendicular to the channels **280**, and communicates with the channels **280**. Thereby, not only can the condensed working fluid flow from one wick structure **26c** to another, but also the vaporized working fluid can flow from one channel **280** to another to cause heat to be more evenly distributed at the condensing section.

[0020] FIG. 7 shows a plurality of alternative wick structures **26d**, which can replace the above-described wick structures **26b**. The wick structures **26d** are similar to the wick structures **26b**, except for the following. Besides being connected with each other by sintered metal powder or sintered ceramic powder, ends of the wick structures **26d** corresponding to each of the evaporating section **21** and the condensing section **23** of the heat pipe **20** define two passages **282a** along the width direction of the heat pipe **20**. That is, each of the passages **282a** is substantially perpendicular to the channels **280**, and communicates with the channels **280**.

[0021] FIG. 8 shows a plate type heat pipe **20a** in accordance with a second embodiment of the disclosure. The heat pipe **20a** of the second embodiment is similar to the heat pipe **20** of the first embodiment, except for the following. The heat pipe **20a** is bent at an intermediate section thereof, so that an evaporating section **21a** and a condensing section **23a** are respectively located at different levels. In this embodiment, wick structures **26e** each have a profile similar to a profile of a shell **25a**. A middle portion of each wick structure **26e** is curved, such that an end of the wick structure **26e** at the evaporating section **21a** is higher than an end of the wick structure **26e** at the condensing section **23a**.

[0022] FIG. 9 shows a plate type heat pipe **20b** in accordance with a third embodiment of the disclosure. The heat pipe **20b** of the third embodiment is similar to the heat pipe **20** of the first embodiment, except for the following. The heat pipe **20a** is bent at an intermediate section thereof, so that an evaporating section **21b** and a condensing section **23b** are perpendicular to each other and at the same level. In this embodiment, wick structures **26f** each have a profile similar to a profile of a shell **25b**. A middle portion of each wick structure **26f** is curved, and an end of the wick structure **26f** at the evaporating section **21b** is perpendicular to an end of the wick structure **26f** at the condensing section **23b**.

[0023] According to the disclosure, the wick structures disposed in the plate type heat pipes **20**, **20a**, **20b** are able to not only provide capillary force acting on the working fluid, but also can support the shells **25**, **25a**, **25b** to prevent the shells **25**, **25a**, **25b** from deforming when subjected to internal vapor pressure or external impact or vibration.

[0024] It is believed that the disclosure 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 plate type heat pipe comprising:

a sealed shell;

a working fluid filled in the shell; and

a plurality of elongated wick structures arranged in the shell in a spaced manner, a plurality of channels being defined between the wick structures, the heat pipe having an evaporating section and a condensing section, two ends of each wick structure being respectively located at the evaporating section and the condensing section, and top and bottom faces of each wick structure respectively contacting top and bottom inner faces of the shell.

2. The plate type heat pipe of claim 1, wherein the wick structures are sintered metal powder.

3. The plate type heat pipe of claim 1, wherein the wick structures are sintered ceramic powder.

4. The plate type heat pipe of claim 1, wherein portions of the wick structures corresponding to the condensing section of the heat pipe are connected each other by sintered metal powder or ceramic powder.

5. The plate type heat pipe of claim 4, wherein the portions of the wick structures corresponding to the condensing section of the heat pipe define a passage, the passage being substantially perpendicular to and communicating with the channels.

6. The plate type heat pipe of claim 1, wherein portions of the wick structures corresponding to the condensing section of the heat pipe define a passage, the passage being substantially perpendicular to and communicating with the channels.

7. The plate type heat pipe of claim 1, wherein portions of the wick structures corresponding to each of the evaporating section and the condensing section of the heat pipe are connected each other by sintered metal powder or ceramic powder.

8. The plate type heat pipe of claim 7, wherein the portions of the wick structures corresponding to each of the evaporating section and the condensing section of the heat pipe define a vapor passage, the passage being substantially perpendicular to and communicating with the channels.

9. The plate type heat pipe of claim 1, wherein portions of the wick structures corresponding to each of the evaporating section and the condensing section of the heat pipe define a vapor passage, the passage being substantially perpendicular to and communicating with the channels.

10. The plate type heat pipe of claim 1, wherein the evaporating section and the condensing section are respectively located at different levels.

11. The plate type heat pipe of claim 1, wherein the evaporating section and the condensing section are perpendicular to each other and at the same level.

12. A heat sink adapted for cooling a heat source, the heat sink comprising:

a fin assembly comprising a plurality of fins; and
a plate type heat pipe comprising:

a sealed shell;

a working fluid filled in the shell; and

a plurality of elongated wick structures arranged in the shell in a spaced manner, a plurality of channels being defined between the wick structures, the heat pipe having an evaporating section adapted for thermally contacting the heat source and a condensing section thermally contacting the fin assembly, two ends of each wick structure being respectively located at the evaporating section and the condensing section, and top and bottom faces of each wick structure respectively contacting top and bottom inner faces of the shell.

13. The heat sink of claim **12**, wherein the wick structures are sintered metal powder.

14. The heat sink of claim **12**, wherein the wick structures are sintered ceramic powder.

15. The heat sink of claim **12**, wherein portions of the wick structures corresponding to the condensing section of the heat pipe are connected each other by sintered metal powder or ceramic powder.

16. The heat sink of claim **15**, wherein the portions of the wick structures corresponding to the condensing section of the heat pipe define a passage, the passage being substantially perpendicular to and communicating with the channels.

17. The heat sink of claim **12**, wherein portions of the wick structures corresponding to the condensing section of the heat pipe define a passage, the passage being substantially perpendicular to and communicating with the channels.

18. The heat sink of claim **12**, wherein portions of the wick structures corresponding to each of the evaporating section and the condensing section of the heat pipe are connected each other by sintered metal powder or ceramic powder.

19. The heat sink of claim **18**, wherein the portions of the wick structures corresponding to each of the evaporating section and the condensing section of the heat pipe define a vapor passage, the passage being substantially perpendicular to and communicating with the channels.

20. The heat sink of claim **12**, wherein portions of the wick structures corresponding to each of the evaporating section and the condensing section of the heat pipe define a vapor passage, the passage being substantially perpendicular to and communicating with the channels.

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