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(54) **HEAT SPREADER WITH VAPOR CHAMBER AND METHOD FOR MANUFACTURING THE SAME**

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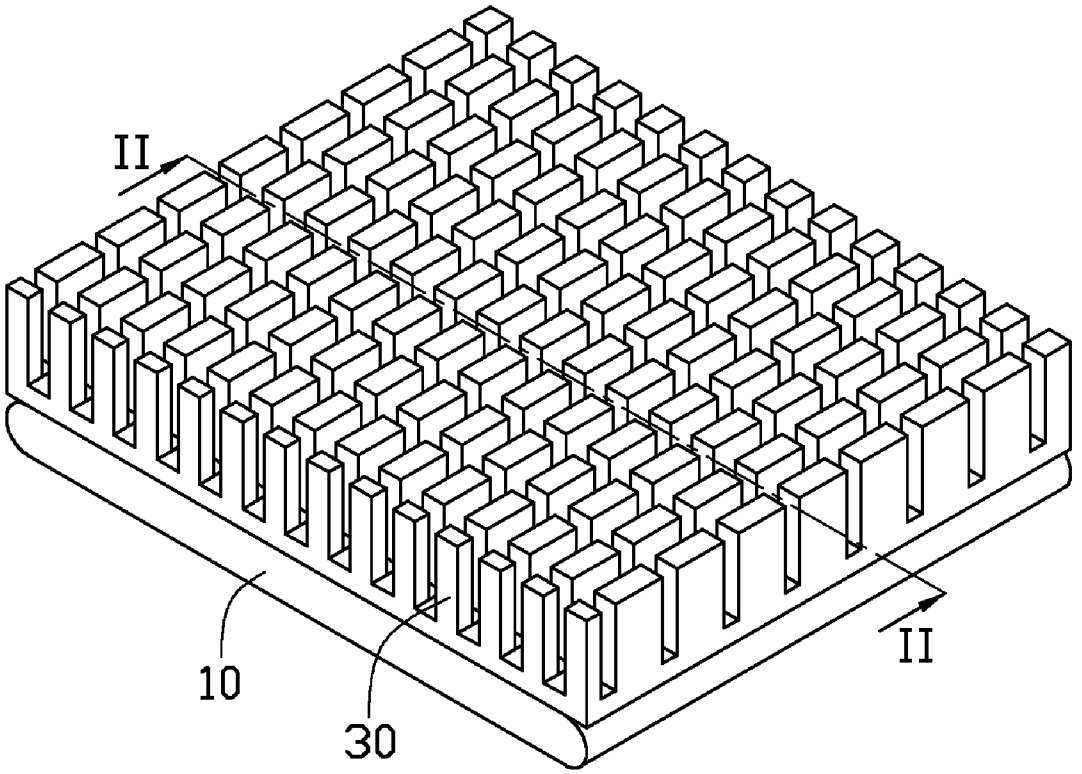
(57) **ABSTRACT**

A method for manufacturing a heat spreader includes steps of: providing an elongated and flat sectional material with a through hole defined therein; cutting the sectional material into a plurality of parts each in a predetermined length to form a plurality of casings, wherein each of the casings defines a vapor chamber therein and has at least an opening in a side thereof; forming a wick structure on an inner face of the casing; providing a plurality of supporting members; placing and fixing the supporting members into the vapor chamber of the casing; and injecting working liquid into the vapor chamber and sealing the casing.



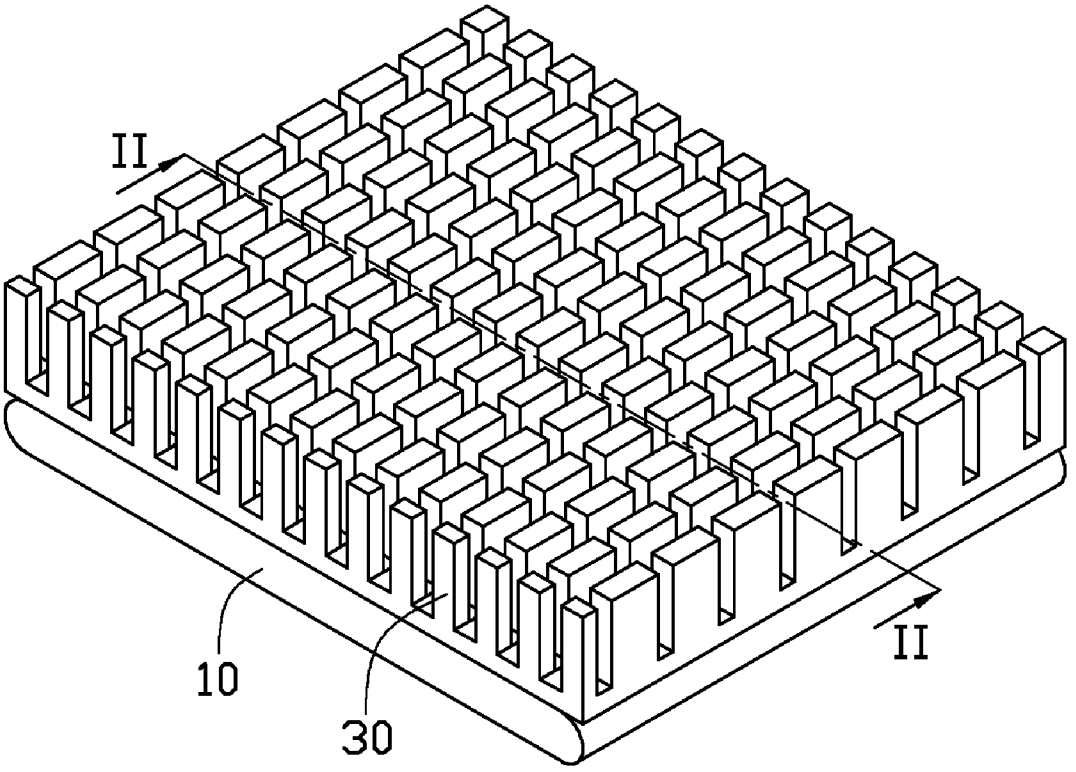


FIG. 1

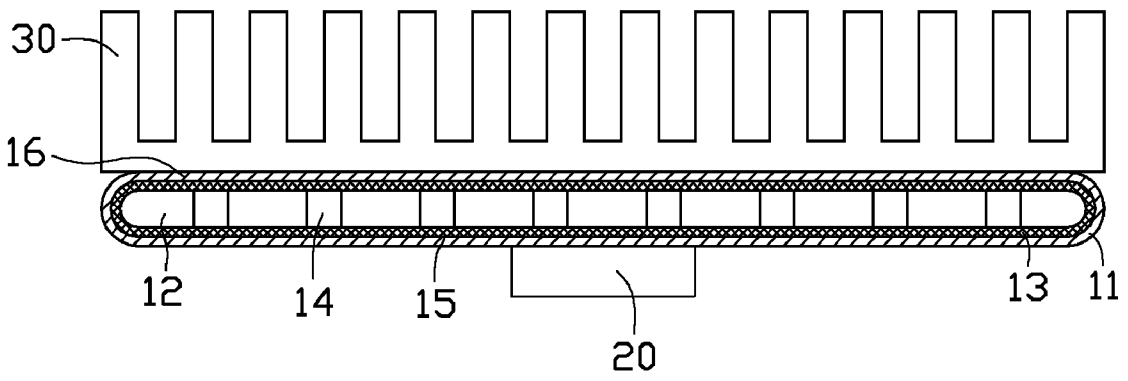


FIG. 2

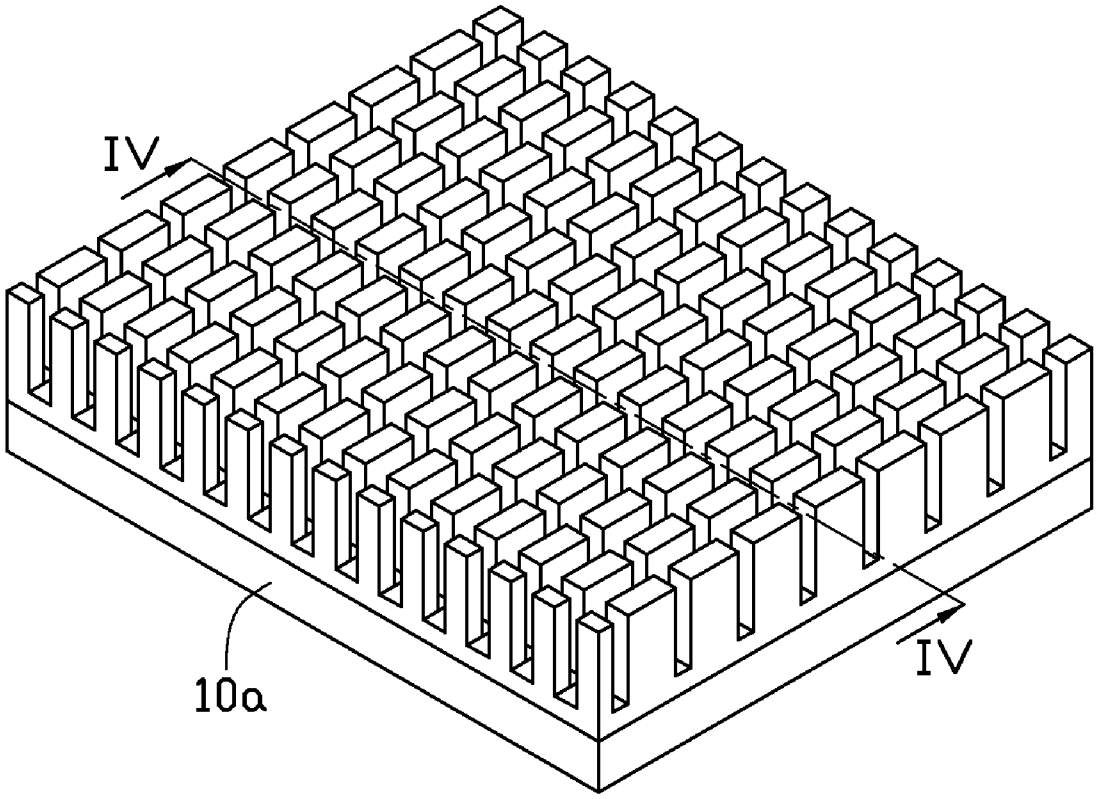


FIG. 3

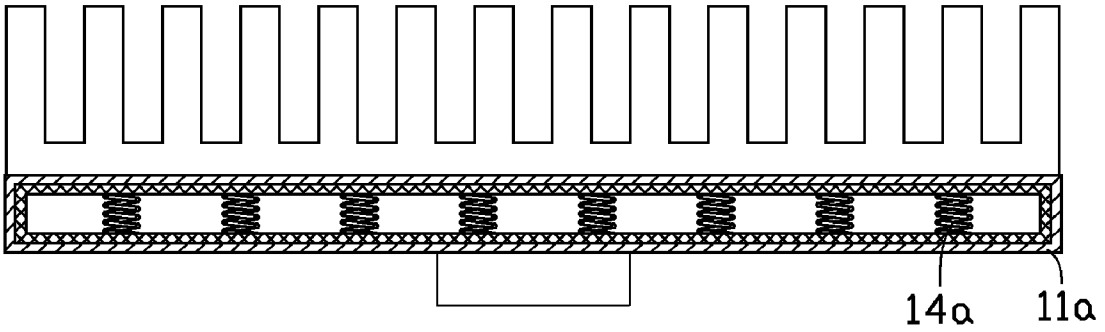


FIG. 4

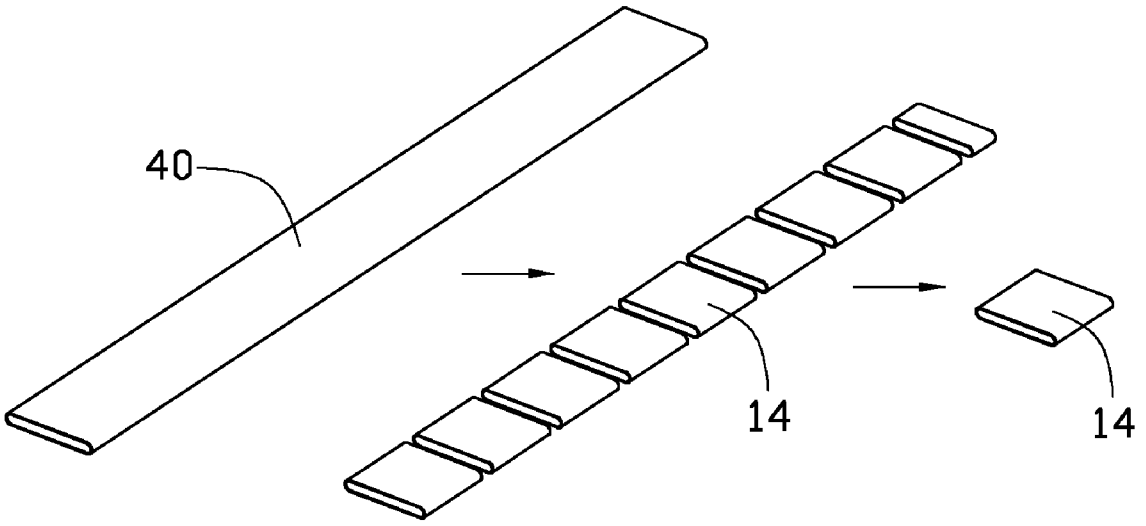


FIG. 5

HEAT SPREADER WITH VAPOR CHAMBER AND METHOD FOR MANUFACTURING THE SAME

BACKGROUND

[0001] 1. Technical Field

[0002] The disclosure generally relates to heat spreaders and, more particularly, to a heat spreader with a vapor chamber having a plurality of supporting members received in the vapor chamber and a method for manufacturing the heat spreader.

[0003] 2. Description of Related Art

[0004] Electronic components, such as central processing units (CPUs) comprise numerous circuits operating at high speeds and generating substantial heat. Under most circumstances, it is necessary to cool the CPUs to maintain safe operating conditions and assure that the CPUs function properly and reliably. In the past, various approaches have been used to cool electronic components.

[0005] A heat spreader with a vapor chamber is usually used to help heat dissipation for electronic components. The heat spreader generally includes a base, a cover mounted on the base and a sealed chamber defined between the base and the cover. Moderate working liquid is contained in the chamber. The base has a wick structure spreading on a whole inner face thereof, and the cover has a wick structure spreading on a whole inner face thereof, too. During operation, the base absorbs heat from an electronic component, and the working liquid is heated into vapor in the chamber. The vapor flows towards the cover and dissipates the heat to the cover, then condenses into liquid and returns back to the base by capillary force generated by the wick structures to continue a next phase-change cycle.

[0006] However, since the heat spreader is a hollow plate-shaped structure, it is prone to be deformed when subjected to a large pressure. Such deformation of the heat spreader may result in the wick structures disengaged from the inner faces of the heat spreader, thus adversely affecting heat transfer efficiency of the heat spreader.

[0007] What is needed, therefore, is a heat spreader with a vapor chamber which can overcome the above problems.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] 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.

[0009] FIG. **1** is an assembled, isometric view of a heat spreader in accordance with a first embodiment of the disclosure, with a heat sink positioned thereon and an electronic component positioned therebelow.

[0010] FIG. **2** is a cross-sectional view of FIG. **1**, taken along a line II-II thereof.

[0011] FIG. **3** is an assembled, isometric view of a heat spreader in accordance with a second embodiment of the disclosure, with a heat sink positioned thereon and an electronic component positioned therebelow.

[0012] FIG. **4** is a cross-sectional view of FIG. **3**, taken along a line IV-IV thereof.

[0013] FIG. **5** is a schematic view showing a manufacturing process of a casing of the heat spreader of FIG. **1**.

DETAILED DESCRIPTION

[0014] Referring to FIGS. **1-2**, a heat spreader **10** in accordance with a first embodiment of the disclosure absorbs heat generated by an electronic component **20** mounted below the heat spreader **10**. Typically, a finned metal heat sink **30** is attached to a top face of the heat spreader **10** to remove the heat therefrom. The heat absorbed by the heat sink **30** is then dissipated to ambient air.

[0015] The heat spreader **10** comprises a hollow casing **11** which defines a vapor chamber **12** therein, a wick structure **13** formed on an inner face of the casing **11**, and a plurality of supporting members **14** received in the vapor chamber **12**. A predetermined quantity of working liquid, such as water, alcohol, olefin and so on, is contained in the vapor chamber **12** for transferring heat by phase change. The vapor chamber **12** is evacuated for facilitating evaporation of the working liquid.

[0016] The casing **11** is a hollow rectangular plate and integrally made of a metal with good heat conductivity, such as aluminum, copper, or an alloy thereof. The casing **11** comprises a base **15** thermally attached to the electronic component **20**, a cover **16** located above and parallel to the base **15** and a sidewall (not labeled) interconnecting the base **15** and the cover **16**. As best seen in FIG. **2**, the sidewall has two opposite lateral sides each of which has a curved profile protruding outwardly. The heat sink **30** is thermally disposed on the cover **16**.

[0017] The wick structure **13** spreads on the whole inner face of the casing **11** and surrounds the vapor chamber **12**. The wick structure **13** can be selected from some suitable materials, such as sintered metal powder, metal mesh, carbon nanotube array, bundle of fibers and so on.

[0018] The supporting members **14** each are integrally made of a metal with good heat conductivity, such as aluminum, copper, or an alloy thereof. Each of the supporting members **14** has a column configuration. The supporting members **14** are sandwiched between the base **15** and the cover **16** of the casing **11**. An axis of each supporting member **14** is perpendicular to the base **15** and the cover **16** of the casing **11**. Opposite bottom and top ends of each supporting member **14** are attached to the wick structure **13** formed on the base **15** and the cover **16**, respectively. The supporting members **14** are evenly arranged in the vapor chamber **12** and spaced from each other.

[0019] Referring to FIGS. **3-4** also, a heat spreader **10***a* of a second embodiment of the disclosure is similar to that of the previous embodiment, excepting a casing **11***a* and a plurality of supporting members **14***a* received in the casing **11***a*. The differences between the two embodiments are that two opposite lateral sides of the sidewall of the casing **11***a* are planar and perpendicular to the base **15** of the casing **11***a*, whereby the casing **11***a* has a rectangular parallelepiped profile, and each of the supporting members **14***a* has a column-spiral configuration similar to a helical spring. An axis of each supporting member **14***a* is perpendicular to the base **15** and the cover **16** of the casing **11***a*. Opposite bottom and top ends of each supporting member **14***a* are attached to the wick structure **13** formed on the base **15** and the cover **16**, respectively.

[0020] Referring to FIG. **5** also, a method for manufacturing the heat spreader **10**, **10***a* of the disclosure comprises steps described below. Firstly, a metallic elongated and flat tube is

provided. The tube is then cut into a plurality of similar semifinished parts each having a predetermined length in order to form the casing **11**, **11***a*, wherein each semifinished part has two openings at two opposite sides thereof. An insert (not shown) is inserted into the semifinished part through one of the openings thereof, with a gap defined between the insert and top and bottom of the semifinished part. Metal powder is then filled into the gap between the insert and the semifinished part and then sintered onto the inner face of the semifinished part by heating the metal powder, to thereby form the wick structure **13** over the inner face of the semifinished part. The insert according to the preferred embodiment is a solid metallic block which is withdrawn from the semifinished part after the powder is sintered onto the inner face of the semifinished part. Alternatively, the insert can be a hollow block formed by woven meshes which is able to be sintered onto the inner face of the semifinished part as a part of the wick structure **13** when sintering the powder. Thereafter, the supporting members **14**, **14***a* are placed into the semifinished part, and the supporting members **14**, **14***a* are fixed on the wick structure **13** formed in the semifinished part by sintering or soldering. Finally, two opposite opening ends of the semifinished part are punched to be sealed for sealing the vapor chamber **12**, in which an injection hole is formed in one of the two sealed opposite sides so that work liquid can be injected into the vapor chamber **12** via the injection hole and the vapor chamber can be vacuumed via the injection hole. Finally, the injection hole is sealed, whereby the casing **11**, **11***a*, is formed by the semifinished part and the manufacturing of the heat spreader **10** is finished, which incorporates the supporting members **14**, **14***a* therein.

[0021] During use of the heat spreader **10**, the electronic component **20** is attached to the base **15**, and the base **15** absorbs the heat produced by the electronic component **20**. The working liquid saturated in the wick structure **13** formed on the base **15** is heated into vapor. The vapor is quickly diffused into the whole vapor chamber **12** of the heat spreader **10**. When the vapor contacts the wick structure **13** formed on the cover **16** and the cover **16**, it gives out heat and condenses into liquid. The condensed working liquid then flows back to the base **15** through the wick structure **13**. The supporting members **14**, **14***a* which are received in the vapor chamber **12** prevent the casing **11**, **11***a*, from being deformed when the casing **11**, **11***a*, is subject to pressure acting thereon. Additionally, since the casing **11**, **11***a* is likely to expand when subject to heat, the spring-like supporting members **14***a* of the second embodiment could pull the base **15** and the cover **16** together by resilient force, to thereby limit the casing **11***a* to deform within a reasonable scale.

[0022] It is to be understood, however, that even though numerous characteristics and advantages of the present embodiments have been set fourth in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the disclosure to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A method for manufacturing a heat spreader comprising:
providing an elongated and flat sectional material with a through hole defined therein;
cutting the sectional material into a plurality of parts each in a predetermined length to form a plurality of casings, and each of the casings defining a vapor chamber therein and having at least an opening in a side thereof;
forming a wick structure on an inner face of the casing;
providing a plurality of supporting members;
placing and fixing the supporting members into the vapor chamber of the casing; and
injecting working liquid into the vapor chamber and sealing the casing.

2. The method as claimed in claim **1**, wherein the casing comprises a base and a cover located above the base, and the supporting members are sandwiched between the base and the cover.

3. The method as claimed in claim **2**, wherein each of the supporting members has a column configuration and made of a metal with good heat conductivity.

4. The method as claimed in claim **2**, wherein two opposite ends of each supporting member are attached to the wick structure formed on the base and the cover of the casing.

5. The method as claimed in claim **2**, wherein each supporting member has a configuration of a helical spring.

6. The method as claimed in claim **5**, wherein an axis of each supporting member is perpendicular to the base and the cover of the casing.

7. The method as claimed in claim **2**, wherein the supporting members are sintered with the base and the cover of the casing.

8. The method as claimed in claim **2**, wherein the supporting members are soldered with the base and the cover of the casing.

9. A heat spreader comprising:
a plate-shaped casing defining a vapor chamber therein;
a working liquid contained in the vapor chamber;
a wick structure formed on an inner face of the casing and correspondingly surrounding the vapor chamber; and
a plurality of supporting members received in the vapor chamber of the casing.

10. The heat spreader as claimed in claim **9**, wherein the casing comprises a base and a cover located above the base, the supporting members are sandwiched between the base and the cover.

11. The heat spreader as claimed in claim **10**, wherein two opposite ends of each supporting member are attached to the wick structure formed on the base and the cover of the casing.

12. The heat spreader as claimed in claim **9**, wherein each of the supporting members has a column configuration and made of a metal with good heat conductivity.

13. The heat spreader as claimed in claim **9**, wherein each supporting member has a configuration of a helical spring.

14. The heat spreader as claimed in claim **13**, wherein the supporting members are disposed vertically in the vapor chamber of the casing.

15. The heat spreader as claimed in claim **9**, wherein the wick structure is selected from one of sintered metal powder, metal mesh, carbon nanotube array and bundle of fibers.

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