US 20120152496A1

(19) **United States**

(12) **Patent Application Publication**

LIU et al.

(10) **Pub. No.: US 2012/0152496 A1**

(43) **Pub. Date: Jun. 21, 2012**

(54) **HEAT DISSIPATION DEVICE AND METHOD OF MANUFACTURING SAME**

(75) Inventors: **JIAN LIU**, Shenzhen City (CN); **JING ZHANG**, Shenzhen City (CN)

(73) Assignees: **FOXCONN TECHNOLOGY CO., LTD.**, Tu-Cheng (TW); **FU ZHUN PRECISION INDUSTRY (SHEN ZHEN) CO., LTD.**, Shenzhen City (CN)

(21) Appl. No.: **13/209,443**

(22) Filed: **Aug. 15, 2011**

(30) **Foreign Application Priority Data**

Dec. 20, 2010 (CN) 201010596695.6

Publication Classification

(51) **Int. Cl.**

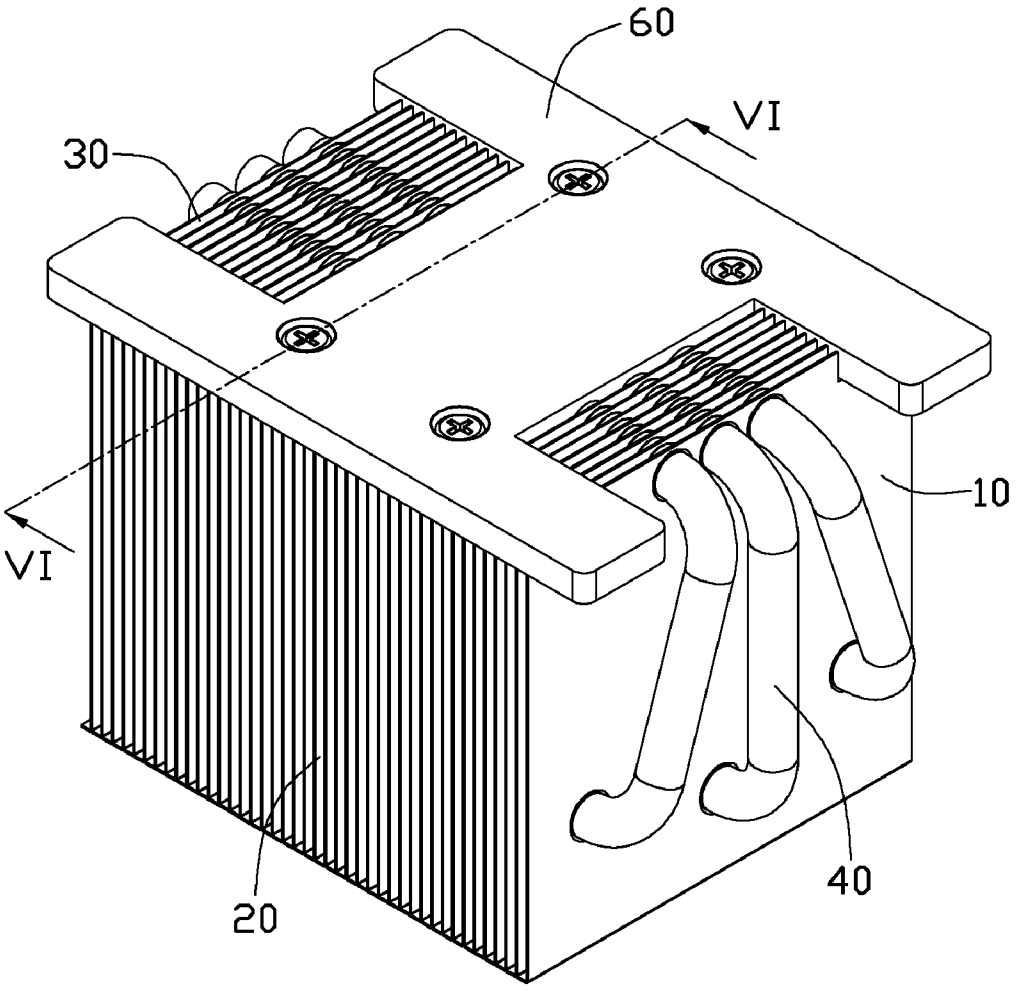
F28D 15/04 (2006.01)

B21D 53/02 (2006.01)

(52) **U.S. Cl.** **165/104.26**; 29/890.046

(57) **ABSTRACT**

An exemplary heat dissipation device includes a first fin unit, a second fin unit, a heat pipe, a first base and a second base. The heat pipe includes a condensing section extended through the first fin unit and the second fin unit and an evaporating section extending from the condensing section. The evaporating section includes a first heat absorbing portion extended through the first fin unit and a second heat absorbing portion spaced from the second fin unit. The first base is located at one side of the second fin unit and supports the second heat absorbing portion thereon. The second base is covered on the first base. The first and second bases sandwich the second heat absorbing portion therebetween.



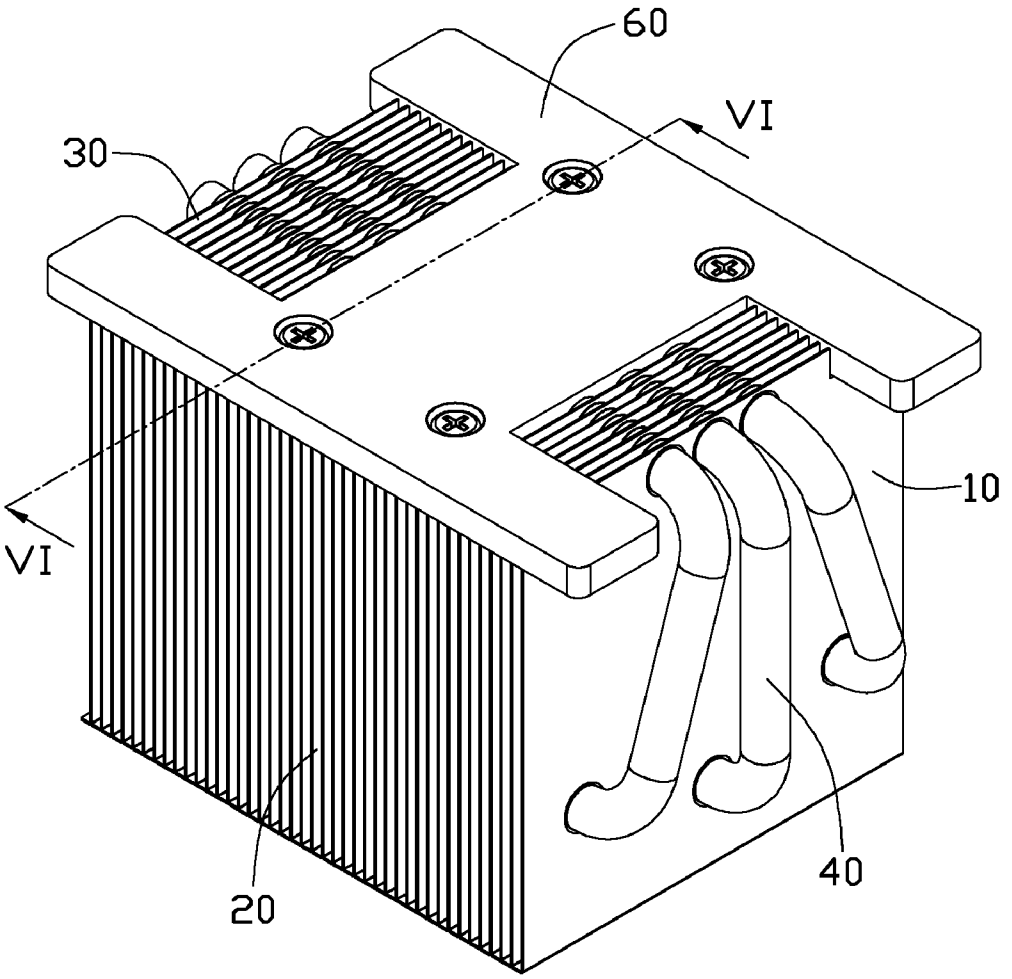


FIG. 1

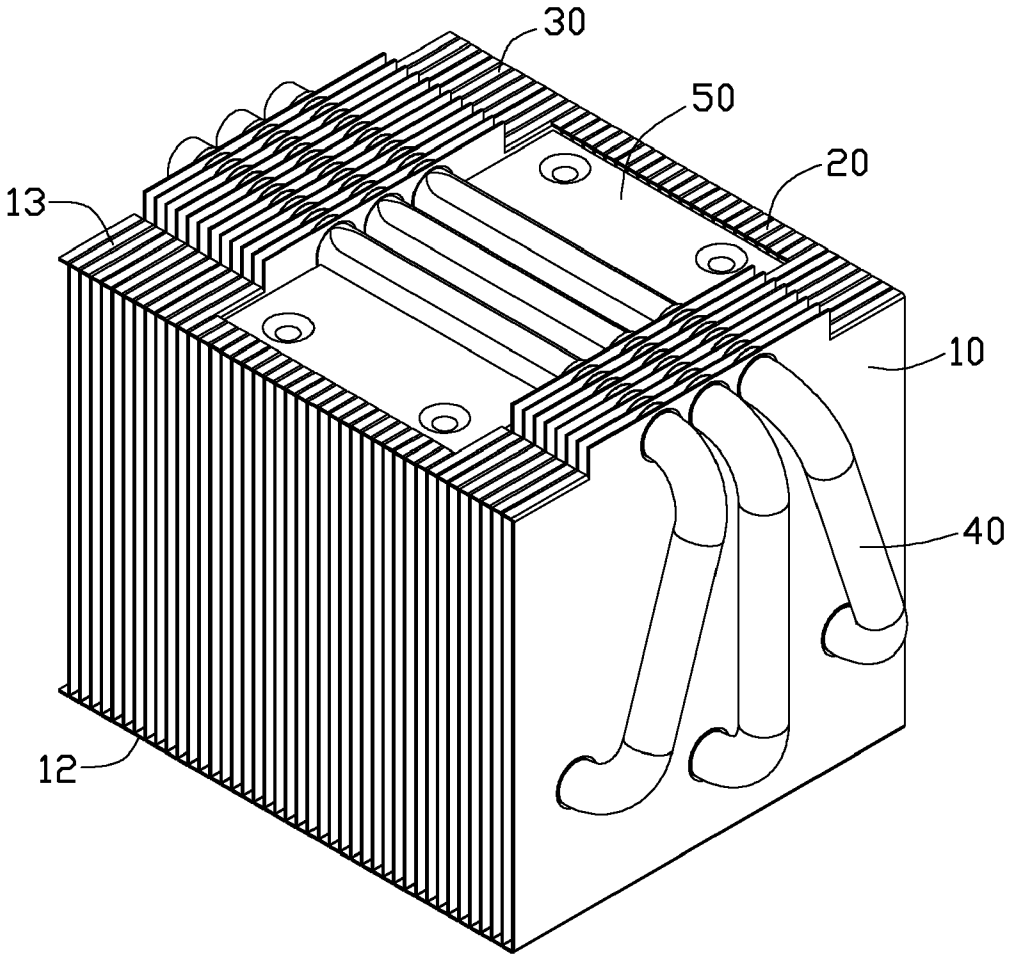


FIG. 2

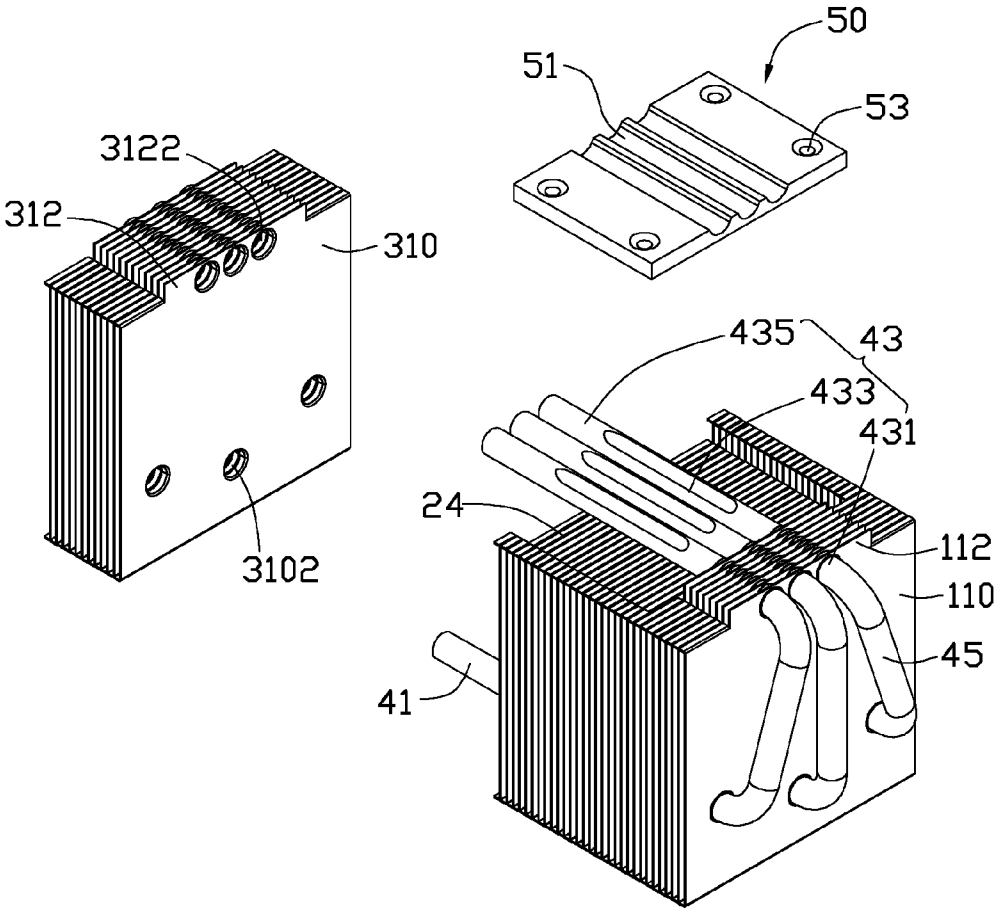


FIG. 3

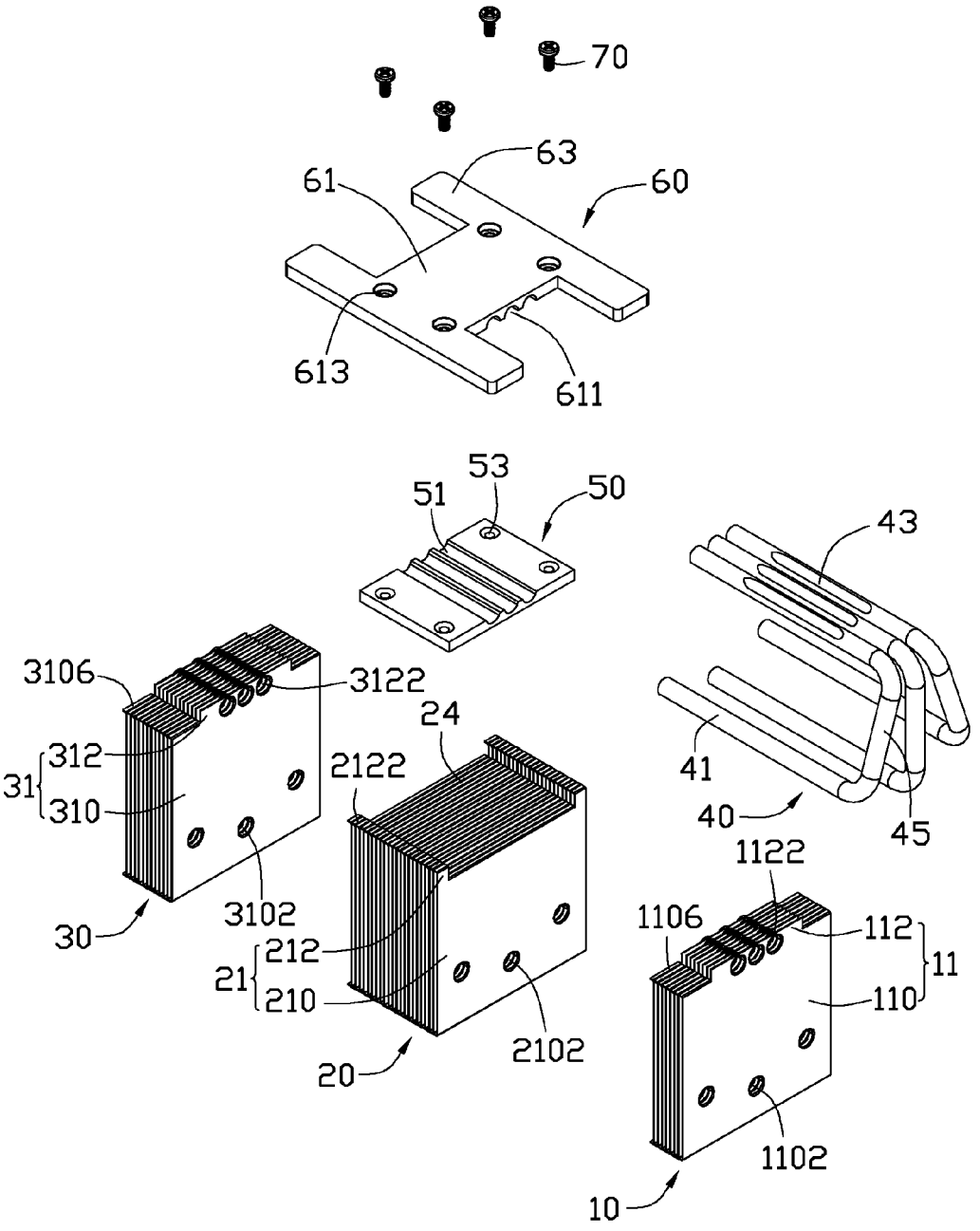

70
63
61
60
613
611
53
51
50
43
3106
3122
24
312
2122
31
310
41
40
45
1122
3102
1106
112
11
212
21
210
110
30
2102
20
1102
10

FIG. 4

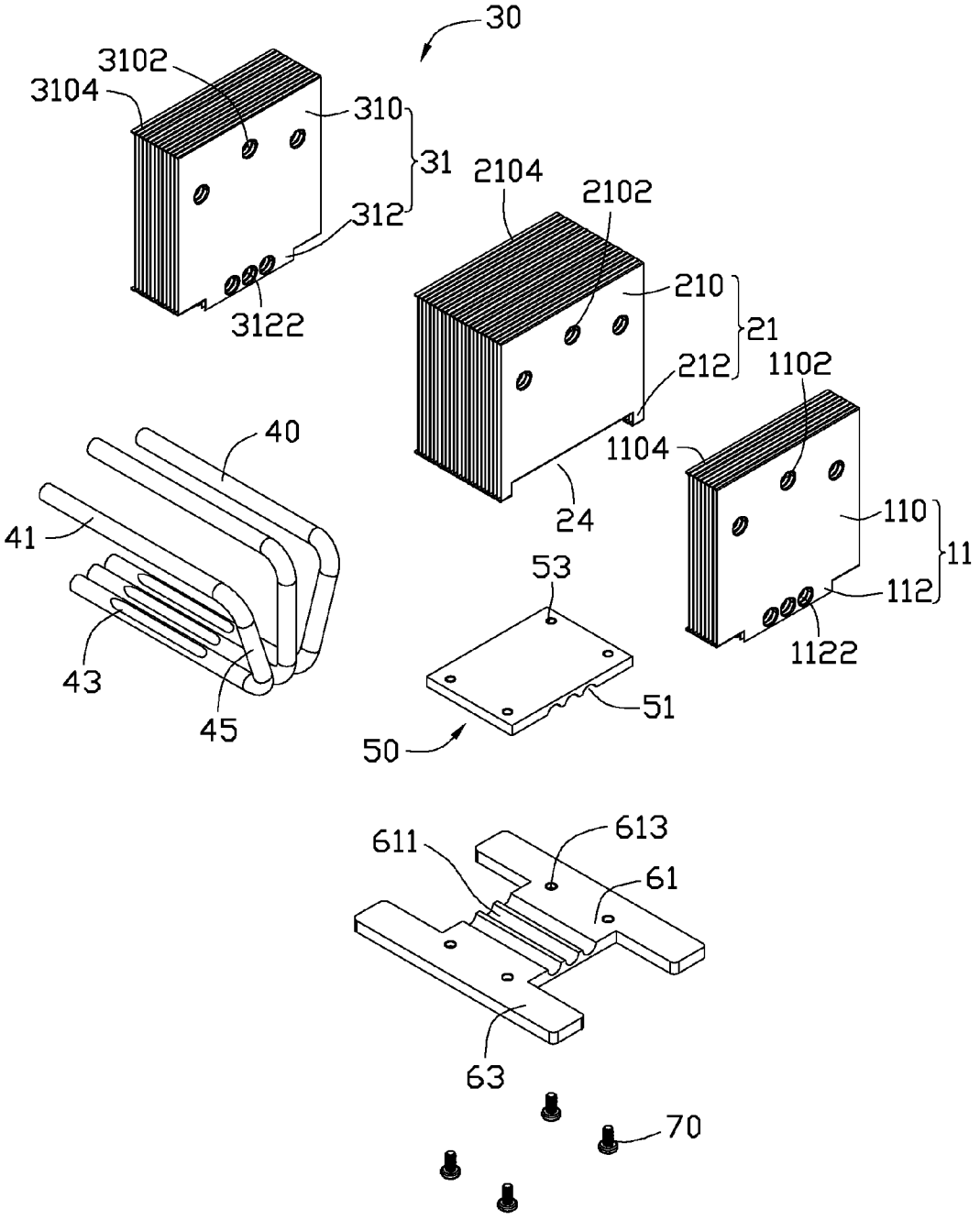

30
3102
3104
310
31
312
3122
2104
2102
210
21
212
1102
1104
110
11
112
1122
40
41
43
45
24
53
51
50
611
613
61
63
70

FIG. 5

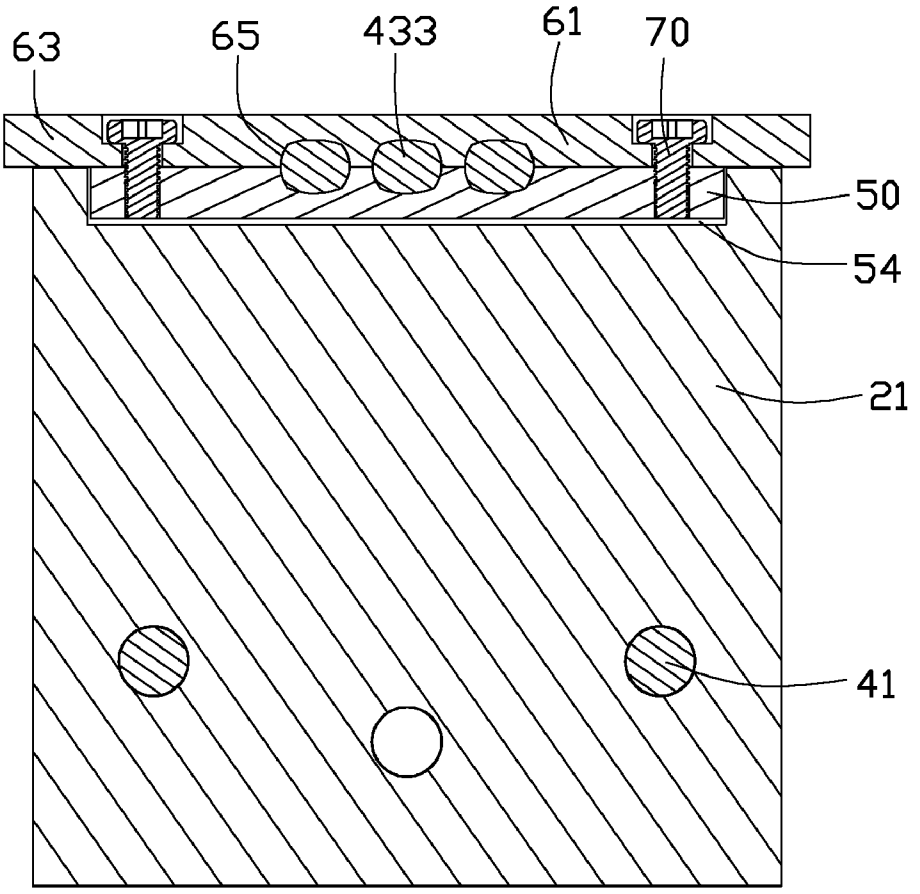


FIG. 6

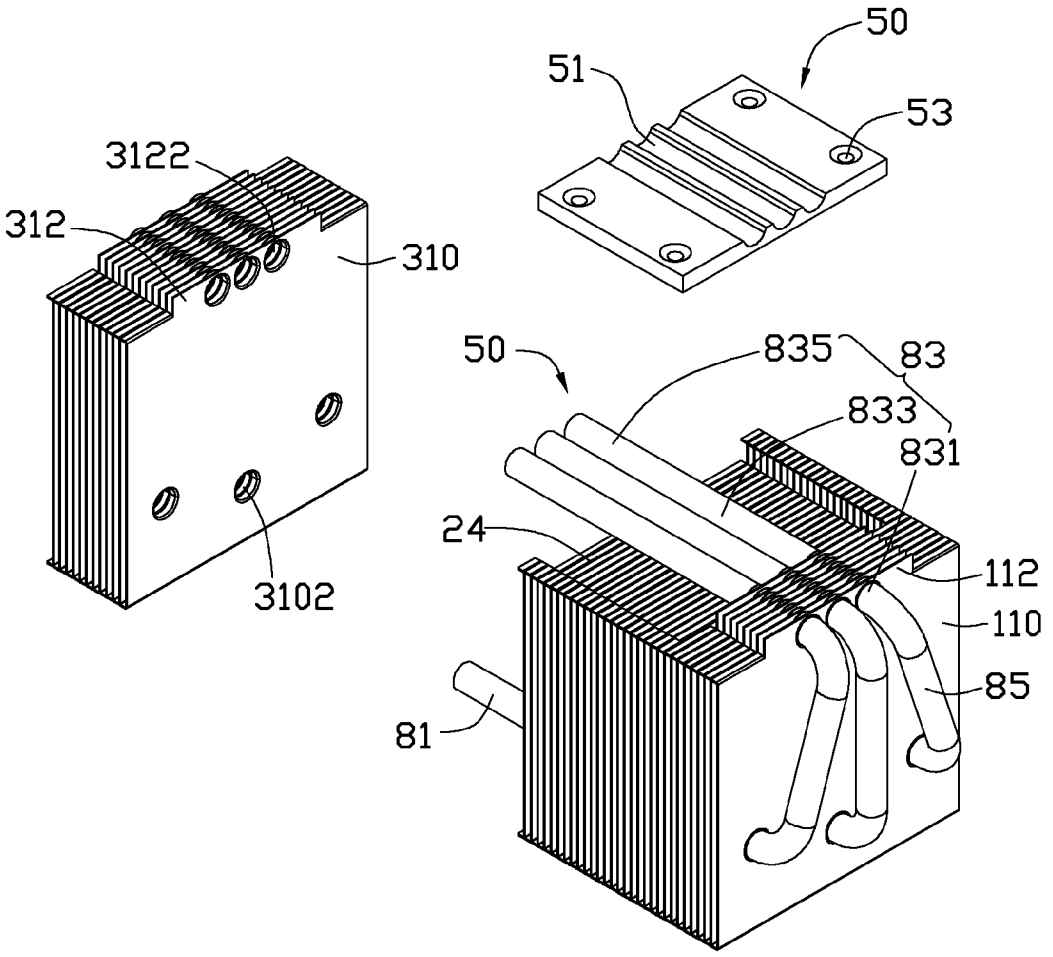


FIG. 7

HEAT DISSIPATION DEVICE AND METHOD OF MANUFACTURING SAME

BACKGROUND

[0001] 1. Technical Field

[0002] The disclosure generally relates to device cooling, and more particularly to a heat dissipation device and a method of manufacturing the heat dissipation device.

[0003] 2. Description of the Related Art

[0004] Heat dissipation devices are used to remove heat from heat-generating electronic components such as central processing units (CPUs) and others, keeping the electronic components within safe working temperature limits, and enabling stable operation. A typical heat dissipation device includes a base contacting an electronic component and absorbing heat therefrom, a number of fins, and a heat pipe. The heat pipe has one end connected to the base by solder and the other end connected to the fins. The fins dissipate the heat to the ambient environment.

[0005] When the heat dissipation device is manufactured, soldering flux must be added between the heat pipe and the base for soldering the heat pipe and the base together. Furthermore, since the heat pipe and the base are usually made of different materials, a nickel-plating process may be required before soldering. Such process materials and manufacturing procedures render assembly of the heat dissipation device somewhat costly and complicated.

[0006] What is called for, then, is a heat dissipation device which can overcome the limitations described.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is an isometric, assembled view of a heat dissipation device according to an exemplary embodiment of the present disclosure, wherein the heat dissipation device includes a first fin unit, a second fin unit, a third fin unit, a first base, a second base and three heat pipes.

[0008] FIG. **2** is similar to FIG. **1**, but with the second base omitted.

[0009] FIG. **3** is an exploded view of the parts shown in FIG. **2**.

[0010] FIG. **4** is an exploded view of the heat dissipation device of FIG. **1**.

[0011] FIG. **5** is similar to FIG. **4**, but viewed from another aspect.

[0012] FIG. **6** is a cross-section of the heat dissipation device of FIG. **1**, taken along a line VI-VI thereof.

[0013] FIG. **7** is a schematic view showing one stage in an exemplary method of manufacturing the heat dissipation device of FIG. **1**.

DETAILED DESCRIPTION

[0014] Reference will now be made to the figures to describe the present heat dissipation device and method in detail.

[0015] Referring to FIGS. **1** and **2**, a heat dissipation device according to an exemplary embodiment of the present disclosure includes a first fin unit **10**, a second fin unit **20**, a third fin unit **30**, three heat pipes **40**, a first base **50** and a second base **60**. In alternative embodiments, the number of heat pipes **40** can vary according to particular requirements.

[0016] Referring also to FIGS. **3-5**, the first fin unit **10** includes a plurality of first fins **11** stacked together. Each of the first fins **11** is almost rectangular, and includes a rectangular main body **110**, an extending portion **112** extending upward from a middle portion of a top side of the main body **110**, a first flange **1104** extending perpendicularly from a bottom side of the main body **110**, and a pair of second flanges **1106** extending perpendicularly from end portions of the top side of the main body **110** (i.e., portions of the top side of the main body **110** other than where the extending portion **112** is formed). Thus the extending portion **112** is narrower than the main body **110**. Three first through holes **1102** are defined in a bottom end of the main body **110** of each of the first fins **11**. Three second through holes **1122** arranged side by side are defined in the extending portion **112** of each of the first fins **11**. The first flanges **1104** of each two neighboring first fins **11** are connected to each other, and regularly space the main bodies **110** of the first fins **11** from each other.

[0017] The second fin unit **20** includes a plurality of second fins **21** stacked together. Each of the second fins **21** includes a rectangular main body **210**, a pair of ears **212** extending upward from two opposite ends of a top side of the main body **210**, respectively, a first flange **2104** extending perpendicularly from a bottom side of the main body **210**, and a pair of second flanges **2122** extending perpendicularly from top sides of the ears **212**, respectively. The main body **210** of each of the second fins **21** is shorter than the main body **110** of each of the first fins **11**. Three first through holes **2102** are defined in a bottom end of the main body **210** of each of the second fins **21**. The first flanges **2104** of each two neighboring second fins **21** are connected to each other, and regularly space the main bodies **210** of the second fins **21** from each other. A receiving room **24** enclosed by the ears **212** and the top sides of the main bodies **210** is defined in a middle portion of a top side of the second fin unit **20**.

[0018] The third fin unit **30** includes a plurality of third fins **31** stacked together. Each of the third fins **31** has the same configuration as each of the first fins **11**. More specifically, each of the third fins **31** is almost rectangular, and includes a rectangular main body **310**, an extending portion **312** extending upward from a middle portion of a top side of the main body **310**, a first flange **3104** extending perpendicularly from a bottom side of the main body **310**, and a pair of second flanges **3106** extending perpendicularly from end portions of the top side of the main body **310** (i.e., portions of the top side of the main body **310** other than where the extending portion **312** is formed). Alternatively, the configuration of each of the third fins **31** can be different from that of each of the first fins **11**.

[0019] Each of the heat pipes **40** is U-shaped, and includes a condensing section **41**, an evaporating section **43** parallel to and spaced from the condensing section **41**, and a connecting portion **45** connected between the condensing section **41** and the evaporating section **43**. The evaporating section **43** includes a first absorbing portion **431** connected with the connecting portion **45**, a second absorbing portion **433** extending from a distal end of the first absorbing portion **431**, and a third absorbing portion **435** extending from a distal end of the second absorbing portion **433**. Each of the heat pipes **40** has a circular transverse cross-section, except that the second absorbing portion **433** has a transverse cross-section generally in the shape of a flattened ellipse. An outer diameter of the condensing section **41** exceeds a diameter of the first through holes **1101** of the first fins **11**. An outer diameter of the first absorbing portion **431** of the evaporating section **43** exceeds a diameter of the second through holes **1122** of the first fins **11**.

[0020] The first base **50** is metal, and is configured for holding the evaporating sections **43** of the heat pipes **40** in position. Three first receiving grooves **51** arranged side by side are defined in a top surface of a middle portion of the first base **50**. A length of each of the first receiving grooves **51** is substantially equal to that of the second absorbing portions **433** of the heat pipes **40**. Four mounting holes **53** are defined in four corners of the first base **50**, respectively. A depth of each of the first receiving grooves **51** is substantially equal to half a thickness of each of the second absorbing sections **433** of the evaporating sections **43**.

[0021] The second base **60** is approximately H-shaped, and includes an elongated main plate **61** and two aliform plates **63** extending outward from two opposite sides of the main plate **61**, respectively. The alifrom plates **63** are longer than the main plate **61**, with the main plate **61** interconnected between middle portions of the two alifrom plates **63**. The main plate **61** has substantially the same configuration as the first base **50**. Three second receiving grooves **611** corresponding to the first receiving grooves **51** of the first base **50** are defined in a bottom surface of a middle portion of the main plate **61**. Four locating holes **613** are defined in four corners of the main plate **61**, respectively. A depth of each of the second receiving grooves **611** is substantially equal to half the thickness of each of the second absorbing sections **433** of the evaporating sections **43**.

[0022] Referring to FIGS. **2** and **3** together, when the heat dissipation device is assembled, the first fin unit **10**, the second fin unit **20** and the third fin unit **30** are arranged side by side, with the first flanges **1104** of the first fins **11**, the first flanges **2104** of the second fins **21** and the first flanges **3104** of the third fins **31** coplanar with each other to cooperatively define a planar bottom surface **12** of the heat dissipation device. The second fin unit **20** is located between the first fin unit **10** and the third fin unit **30**. The second flanges **1106** of the first fins **11**, the second flanges **2122** of the second fins **21** and the second flanges **3106** of the third fins **31** are coplanar with each other to cooperatively define a frame-shaped top surface **13** of the heat dissipation device. The receiving room **24** is enclosed by the top surface **13** of the heat dissipation device. The extending portions **112** of the first fins **11** and the extending portions **312** of the third fins **31** are located at left and right sides of the receiving room **24**, respectively, and above the receiving room **24**. Thus, the second through holes **1122** of the first fins **11** and the second through holes **3122** of the third fins **31** are higher than the receiving room **24**.

[0023] The first through holes **1102** of the first fins **11**, the first through holes **2104** of the second fins **21**, and the first through holes **3102** of the third fins **31** are communicated with each other. The second through holes **1106** of the first fins **11** and the second through holes **3122** of the third fins **31** are aligned with each other. The first base **50** is received in the receiving room **24**, with the first receiving grooves **51** of the first base **50** collinear with the second through holes **1122** of the first fin unit **10**, respectively. The heat pipes **40** connect the first fin unit **10**, the second fin unit **20** and the third fin unit **30** via the condensing sections **41** being interference fitted in the first through holes **1102**, **2102**, **3102**, and the evaporating sections **45** being interference fitted in the second through holes **1122**, **2122**, **3122**.

[0024] Referring to FIGS. **1** and **6** together, the second base **60** covers the first base **50**, with the second receiving grooves **611** communicated with the first receiving grooves **51** of the first base **50**, respectively. The second base **60** and the first base **50** cooperatively define three receiving holes **65** for the second absorbing portions **433** of the evaporating sections **43** to be interference fitted therein, respectively. The locating holes **53** of the second base **50** are coaxial with the mounting holes **613** of the first base **50**, respectively. A plurality of fasteners **70** are respectively extended through the locating holes **53** of the second base **50** and screwed onto the mounting holes **613** of the first base **60** to fixedly connect the first base **50** and the second base **60** together. Thereby, the evaporation sections **43** of the heat pipes **40** are further held in position via the first base **50** and second base **60**.

[0025] When the heat dissipation device is used, the second base **60** directly contacts an electronic component to absorb heat generated therefrom. Due to the second absorbing sections **433** of the evaporating sections **43** being interference fitted between the first base **50** and the second base **60**, the heat absorbed by the second base **60** can be quickly conducted to the evaporating sections **43** of the heat pipes **40**. Thus, the heat generated by the electronic component can be quickly conducted to the first fin unit **10**, the second fin unit **20**, and the third fin unit **30** via the heat pipes **40**, to further dissipate the heat into the ambient environment in a timely manner.

[0026] An exemplary method of manufacturing the heat dissipation device includes following steps:

[0027] Referring to FIG. **7**, the first step is to provide the first fin unit **10**, the second fin unit **20**, the third fin unit **30**, three rough heat pipes **80**, and the plurality of fasteners **70**. The rough heat pipes **80** are different from the heat pipes **40** only in that the second absorbing sections **433** of the rough heat pipes **80** have a circular transverse cross-section.

[0028] The rough heat pipes **80** are firstly connected with the first fin unit **10**, with the condensing sections **81** interference fitted in the first through holes **1102** of the first fins **11**, and the first absorbing portions **431** of the evaporating sections **83** interference fitted in the second through holes **1122** of the first fins **11**.

[0029] Then the rough heat pipes **80** are connected with the second fin unit **20**, with the condensing sections **81** interference fitted in the first through holes **2102** of the second fins **21**. The second heat absorbing portions **833** of the evaporating sections **83** of the rough heat pipes **80** are located above the receiving room **24** of the second fin unit **20**.

[0030] The first base **50** is put in the receiving room **24**, with the first receiving grooves **1102** collinear with the second through holes **1122** of the first fin unit **10**, respectively. The depth of each of the first receiving grooves **1102** is slightly smaller than half a thickness of each of the second heat absorbing portions **833**. A part of each of the second absorbing portions **833** is received in a corresponding first receiving groove **1102** of the first base **11**, and another part of each of the second absorbing portions **833** is exposed outside of the corresponding first receiving groove **1102**.

[0031] Then the rough heat pipes **80** are connected with the third fin unit **30**, with the condensing sections **81** interference fitted in the first through holes **3012** of the third fins **31**, and the third absorbing portions **435** of the evaporating sections **835** interference fitted in the second through holes **3122** of the third fins **31**.

[0032] Referring back to FIG. **1**, finally, the second base **60** is covered over the first base **50**, with the second receiving grooves **611** aligned with the first receiving grooves **51** of the first base **50**, respectively. The other part of each of the second absorbing portions **835** which is exposed outside of the corresponding first receiving groove **51** is received in a corre-

sponding second receiving groove **611** of the second base **60**. The depth of each of the second receiving grooves **611** is slightly smaller than half the thickness of each of the second heat absorbing portions **833**. Due to a sum of the depth of any one of the first receiving grooves **51** and the corresponding second receiving groove **611** being smaller than the thickness of the corresponding second heat absorbing portions **833**, the second base **60** is spaced from the first base **50**, with a clearance defined between the top surface of the first base **50** and the bottom surface of the second base **60**.

[0033] The fasteners **70** are respectively extended through the locating holes **613** of the second base **60** and further screwed into the mounting holes **53** of the first base **50**, to fixedly connect the first base **50** and the second base **60** together. During this process, the second base **60** presses the second evaporating sections **835** of the rough heat pipes **80** until the bottom surface of the second base **60** contacts the top surface of the first base **50**, such that the second evaporating sections **835** are deformed slightly to form the heat pipes **40**.

[0034] In the process of manufacturing the heat dissipation device, neither soldering flux nor nickel plating is required during assembly of the heat pipes **40** to the fin units **10**, **20**, **30** and the bases **50**, **60**. The manufacturing cost of the heat dissipation device is thus minimized, and the manufacturing of the heat dissipation device is simple and convenient.

[0035] It is to be further understood that even though numerous characteristics and advantages have been set forth in the foregoing description of embodiments, together with details of the structures and functions of the embodiments, the disclosure is illustrative only; and that 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 heat dissipation device, comprising:

a first fin unit comprising a plurality of first fins stacked together;

a second fin unit located at one side of the first fin unit and comprising a plurality of second fins stacked together;

a heat pipe comprising a condensing section extended through the first fin unit and the second fin unit and an evaporating section extending from the condensing section, the evaporating section comprising a first heat absorbing portion extended through the first fin unit and a second heat absorbing portion spaced from the second fin unit;

a first base located at one side of the second fin unit and supporting the second heat absorbing portion thereon; and

a second base covering the first base, the first and second bases clamping the second heat absorbing portion therebetween.

2. The heat dissipation device of claim **1**, wherein the first base and the second base cooperatively defines a through hole for interference receiving the second heat absorbing portion therein.

3. The heat dissipation device of claim **2**, wherein the first base comprises a first receiving groove for receiving a part of the second heat absorbing portion therein, and the second base comprises a second receiving groove for receiving another part of the second heat absorbing portion therein.

4. The heat dissipation device of claim **2**, wherein the second heat absorbing portion has an ellipse transverse cross-section.

5. The heat dissipation device of claim **1**, wherein the second fin unit defines a receiving a receiving room at a top side thereof, the first base being received in the receiving room.

6. The heat dissipation device of claim **5**, wherein the first fin unit defines a first through hole for the condensing section of the heat pipe interference fitted therein and a second through hole higher than the receiving room, the first heat absorbing portion interference fitted in the second through hole of the first fin unit.

7. The heat dissipation device of claim **6**, further comprising a third fin unit located at one side of the second fin unit which is away from the first fin unit, the third fin unit defining a first through hole for condensing section of the heat pipe interference fitted therein and a second through hole higher than the receiving room, wherein the evaporating section of the heat pipe further comprises a third absorbing portion extending from the second absorbing portion and interference fitted in the second through hole of the third fin unit.

8. The heat dissipation device of claim **1**, wherein the condensing section is parallel to the evaporating section, the heat pipe further comprising a connecting section connected between the condensing section and the evaporating section.

9. The heat dissipation device of claim **1**, wherein each of the first fins comprises a main body, an extending portion extending upward from a middle portion of a top side of the main body, a first flange extending perpendicularly from a bottom side of the main body and a second flange extending perpendicularly from other portion of the top side of the main body except where the extending portion is formed.

10. The heat dissipation device of claim **9**, wherein each of the second fins comprises a main body, a pair of ears extending upward from two opposite ends of a top side of the main body, respectively, a first flange extending perpendicularly from a bottom side of the main body and a pair of second flanges extending perpendicularly from top sides of the ears, respectively.

11. A method of manufacturing a heat dissipation device, the method comprising:

providing a heat pipe comprising an evaporating section and a condensing section, the evaporating section comprising a first heat absorbing portion and a second heat absorbing portion, the second heat absorbing portion having a circular transverse cross section;

providing a first fin unit comprising a plurality of first fins stacked together and cooperatively defining a first through hole and a second through hole therein, the heat pipe connected to the first fin unit with the condensing section interference fitted in the first through hole and the first absorbing portion interference fitted in the second through hole;

providing a second fin unit comprising a plurality of second fins stacked together and cooperatively defining a first through hole for the condensing section of the heat pipe to be interference fitted therein;

providing a first base, mounting the first base on one side of the second fin unit, and supporting the second heat absorbing portion on the first base, with the second absorbing portion of the heat pipe being located above the second fin unit;

providing a second base, and covering the second base over the first base to sandwich the second heat absorbing portion between the first base and the second base; and

connecting the first and second bases together with a plurality of fasteners, such that the second heat absorbing portion is deformed and clamped between the first base and the second base.

12. The method of claim **11**, wherein the second heat absorbing portion has an ellipse transverse cross section after deformed.

13. The method of claim **11**, wherein the first base and the second base cooperatively defines a through hole for interference receiving the second heat absorbing portion therein.

14. The method of claim **13**, wherein the first base comprises a first receiving groove for receiving a part of the second heat absorbing portion therein, the second base comprises a second receiving groove for receiving another part of the second heat absorbing portion therein, and a sum of depths of the first receiving groove and the second receiving groove is smaller than an outer diameter of the second heat absorbing portion before the second heat absorbing portion is deformed.

15. The method of claim **11**, wherein the second fin unit defines a receiving a receiving room at a top side thereof, the first base being received in the receiving room.

16. The method of claim **15**, wherein the second through hole is higher than the receiving room.

17. The method of claim **16**, further comprising: providing a third fin unit, the third fin unit defining a first through hole and a second through hole higher than the receiving room, wherein the evaporating section of the heat pipe further comprises a third absorbing portion extending from the second absorbing portion; positioning the third fin unit at one side of the second fin unit which is away from the first fin unit; interference fitting the condensing section of the heat pipe in the first through hole of the third fin unit; and interference fitting the third absorbing portion of the heat pipe in the second through hole of the third fin unit.

18. The method of claim **11**, wherein the condensing section is parallel to the evaporating section, the heat pipe further comprising a connecting section connected between the condensing section and the evaporating section.

19. The method of claim **18**, wherein the heat pipe is U-shaped.

20. The method of claim **11**, wherein a plurality of mounting holes are defined in the first base, and a plurality of locating holes are defined in the second base, the fasteners respectively extended through the locating holes and further screwed into the mounting holes for connecting the first base and the second base together.

* * * * *