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(54) **Heat transfer device**

(57) A heat transfer device for transferring a heating source from a heating device comprises an evaporator, said evaporator comprising a first hollow tube having one open end, a porous core in said first hollow tube, and a second hollow tube having one open end in connection with said one open end of said first hollow tube, a heat conductor covering said evaporator, said heat conductor being on said heating device, a connecting pipe having a first end connected to in fluid communication with the other end of said first hollow tube and a second end in

fluid communication with the other end of said second hollow tube, said connecting pipe being used for containing a working fluid and a condenser (240) on said connecting pipe, the heat transfer device being characterized in that said one open end of said second hollow tube is in tenon-mortise connection with said one open end of said first hollow tube. Said heat transfer device reduces costs, and enhances heat conductivity.

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention generally relates to a heat transfer device, and more particularly to a heat transfer device to reduce costs, and enhance heat conductivity.

Description of Related Art

[0002] To fast dissipate the heat generated from operation of the electronic devices, conventionally a radiator will be disposed on the heating element of the electronic device provide a larger area for heat dissipation. Further, a cooling fan will be used to provide a cool air current to further dissipate the heat. Hence, the electronic device can keep within the range of the operational temperature. For example, the radiator and the cooling fan are used in the CPU, North Bridge, and graphic chip of the personal computer, which can generate high heat.

[0003] It should be noted that recently a heat transfer device is developed by using transformation between liquid state and gaseous state. This heat transfer device has the advantages of high conductance (30-6000W), long distance (0.3-10m) and single directional transferability, and flexibility, and is not affected by the gravity. Hence, it gradually replaces the conventional radiator.

[0004] FIG. 1 is a conventional heat transfer device. Referring to FIG. 1, the conventional heat transfer device 100 comprises an evaporator 110, a loop heat pipe 120, and a condenser 130. The evaporator 110 comprises a metal tube 112 and a porous core 114. The porous core 114 is disposed inside the metal tube 112. The evaporator 110 is disposed on the heating device such as CPU. The loop heat pipe 120 is connected to the evaporator 110 and has a proper amount of working fluid therein. The condenser 130 is disposed on the loop heat pipe 120 to condense the steam in the loop heat pipe to the liquid state.

[0005] When the heating device generates high heat, the evaporator 110 will receives the heat and thus the working fluid in the porous core 114 will be heated up and enter into the loop heat pipe 120 and the condenser 130. The condenser 130 then condenses the steam in the loop heat pipe to the liquid state. The capillarity attraction of the porous core 114 will attract the working fluid in the loop heat pipe 120 back to the evaporator 110 and the porous core 114 therein. Hence, this design forms a loop so that the working fluid can flow circularly in the loop heat pipe 120 and transfer the heat generated by the heating device to the condenser 130.

[0006] In a conventional heat transfer device a heat conducting platform (not shown) is welded at the bottom of the hollow metal tube 112 so that the high heat of a heating device (not shown) can be transferred from the heat conducting platform to the evaporator 110. It should

be noted that the conventional heat transfer device has the following disadvantage: The heat conducting platform can only conduct the heat to the lower part of the evaporator. Hence the heat conductance is too low.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a heat transfer device to transfer the heat out of the heating device in order to effectively dissipate the heat. The heat transfer device is easy to manufacture with low cost.

[0008] The present invention provides a heat transfer device for transferring a heating source from a heating device, the heat transfer device at least comprising: an evaporator, the evaporator comprising: a first hollow tube having one open end; a porous core in the first hollow tube; a second hollow tube having one open end in connection with said one open end of the first hollow tube; a heat conductor covering the evaporator, the heat conductor being on the heating device; a connecting pipe having a first end in fluid communication with the other end of said first hollow tube and a second end in fluid communication with the other end of said second hollow tube, the connecting pipe being used for containing a working fluid; and a condenser on the connecting pipe, the heat transfer device being characterized in that said one open end of said second hollow tube is in tenon-mortise connection with said one open end of said first hollow tube.

[0009] In a preferred embodiment of the present invention, the heat conductor comprises a first heat conducting block having a heat conducting tenon; and a second heat conducting block having a mortise corresponding to the tenon, the heat conducting tenon being inserted into the mortise so that the first and second heat conducting blocks cover the evaporator. The height of the tenon is smaller than the depth of the mortise to enhance the tightness between the tenon and the mortise so that the first and second heat conducting blocks can contact closely the outer wall of the evaporator to obtain good heat conductivity.

[0010] In a preferred embodiment of the present invention, the porous core has a fluid channel therein, the fluid channel being connected to a fluid reservoir. A vapor channel is between the first hollow tube and the porous core, and the vapor channel is connected to the connecting pipe.

[0011] In a preferred embodiment of the present invention, the first hollow tube has a closed end; the closed end has a first surface; the first surface has a first hole; the connecting pipe has an end connected to the first hole to connect the first hollow tube. The second hollow tube has a closed end; the closed end has a second surface; the second surface has a second hole; the connecting pipe has an end connected to the second hole to connect the second hollow tube.

[0012] The above is a brief description of some deficiencies in the prior art and advantages of the present

invention. Other features, advantages and embodiments of the invention will be apparent to those skilled in the art from the following description, accompanying drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a conventional heat transfer device.

[0014] FIG. 2 is the structure of the heat transfer device in accordance with a preferred embodiment of the present invention.

[0015] FIG. 3 is a cross-sectional view of FIG. 5 along the A-A line.

[0016] FIGs. 4A-4D show the structure of the heat conductor device in accordance with another preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] FIG. 2 is the structure of the heat transfer device in accordance with a preferred embodiment of the present invention. FIG. 3 is a cross-sectional view of FIG. 2 along the A-A line. Referring to FIGs. 2 and 3, the heat transfer device 200 for transferring a heating source from a heating device 20 at least comprises: an evaporator 210, a heat conductor 220 and a connecting pipe 230. The evaporator 210 comprises: a first hollow tube 212 having one open end; a porous core 214 in the first hollow tube 212; a second hollow tube 216 having one open end in connection with said one open end of the first hollow tube 212.

[0018] The heat conductor 220 covers the evaporator 210. The heat conductor 220 is on the heating device 20. The connecting pipe 230 is connected to first and second hollow tubes 212 and 216. The connecting pipe 230 is used for containing a working fluid. Further, the porous core 214 has a fluid channel 214a therein. The fluid channel 214a is connected to the fluid reservoir 217. The fluid reservoir 217 is a space inside the second hollow tube 216. There is at least a vapor channel 214b between the first hollow tube 212 and the porous core 214. The vapor channel 214b is connected to the connecting pipe 230. Further a condenser 240 is disposed on the connecting pipe 230.

[0019] When the heating device 20 generates high heat, the working fluid in the porous core 214 will be heated up and becomes vapor. The capillarity attraction of the porous core 214 will attract the working fluid in the connecting pipe 230 back to the fluid channel 214a of the porous core 214. The vapor will go to the connecting pipe 230 via the vapor channel 214b. Further, the vapor entering into the condenser 240 will be condensed to the liquid state and goes back to the evaporator 210. Hence, the working fluid can circularly flow through the connecting pipe 230 (along the direction of the arrow as shown in FIG. 2) by converting the working fluid between the gaseous state and the liquid state, so that the heat generated by the heating device 20 can be transferred out

of the heating device 20.

[0020] Referring to FIG. 3, the heat conductor 220 comprises a first heat conducting block 222 having a heat conducting tenon 222a; and a second heat conducting block 224 having a mortise 224a corresponding to the heat conducting tenon 222a. The heat conducting tenon 222a is inserted into the mortise 224a so that the first and second heat conducting blocks 222 and 224 can cover the evaporator 210. Hence, the high heat generated by the heating device 20 can be uniformly conducted to the evaporator 210 via the heat conductor 220. Further, the height of the tenon 222a is smaller than the depth of the mortise 224a to enhance the tightness between the tenon 222a and the mortise 224a so that the first and second heat conducting blocks 222 and 224 can contact closely the outer wall of the evaporator 210 to obtain good heat conductivity.

[0021] In the above embodiment, the heat conductor 220 comprises a first heat conducting block 222 and a second heat conducting block 224 to cover the evaporator 210. However, one skilled in the art should know that the heat conductor is not limited to two heat conducting blocks. It can be mortised by several heat conducting blocks. Further, it is not limited to one evaporator covered by the heat conducting blocks. The heat conducting blocks also can cover several evaporators. In addition, the shape of the heat conducting blocks can be any shape so long as the heat conducting blocks can cover the evaporator after assembly. An example of the heat conductor will be illustrated as follows.

[0022] FIGs. 4A-4D show the structure of the heat conductor device in accordance with another preferred embodiment of the present invention. Referring to FIGs. 4A and 4B, the heat conductor 220 includes two heat conducting blocks (first heat conducting block 222 and second heat conducting block 224) and covers two evaporators (not shown). Referring to FIGs. 4C and 4D, the heat conductor 220 includes three heat conducting blocks (first heat conducting block 222, second heat conducting block 224, and third heat conducting block 226) and covers two evaporators (not shown). Further, each of the above evaporators can be connected to an independent connecting pipe, or all evaporators can be connected to a single connecting pipe.

[0023] In brief, the elements of the heat transfer device (the porous core, the first and second hollow tube, and the heat conductor) are mortised together so as to simplify the manufacturing process, and reduce the cost. Further, the evaporator is tightly covered and fixed by the heat conductor so that the heat generated by the heating device can be uniformly conducted to the evaporator to enhance the heat conductivity.

[0024] The above description provides a full and complete description of the preferred embodiments of the present invention. Various modifications, alternate construction, and equivalent may be made by those skilled in the art without changing the scope of the invention. Accordingly, the above description and illustrations

should not be construed as limiting the scope of the invention which is defined by the following claims.

Claims

1. A heat transfer device for transferring a heating source from a heating device (20), wherein said heat transfer device comprises:

an evaporator (210), said evaporator (210) comprising:

a first hollow tube (212) having one open end;
a porous core (214) in said first hollow tube (212); and
a second hollow tube (216) having one open end in connection with said one open end of said first hollow tube (212);
a heat conductor (220) covering said evaporator (210), said heat conductor (220) being on said heating device (20);
a connecting pipe (230) having a first end connected to in fluid communication with the other end of said first hollow tube (212) and a second end in fluid communication with the other end of said second hollow tube (216), said connecting pipe (230) being used for containing a working fluid; and
a condenser (240) on said connecting pipe (230),
the heat transfer device being **characterized in that** said one open end of said second hollow tube (216) is in tenon-mortise connection with said one open end of said first hollow tube (212).

2. The device of claim 1, wherein said heat conductor comprises

a first heat conducting block (222) having a heat conducting tenon (222a); and
a second heat conducting block (224) having a mortise (224a) corresponding to said tenon (222a), said heat conducting tenon (222a) being inserted into said mortise (224a) so that said first and second heat conducting blocks (222, 224) cover said evaporator (210).

3. The device of claim 2, wherein the height of said tenon (222a) is smaller than the depth of said mortise (224a).

4. The device of claim 1, wherein said porous core (214) has a fluid channel (214a) therein, said fluid (214a) channel being connected to a fluid reservoir (217).

5. The device of claim 1, further comprising a vapor

channel between said first hollow tube (212) and said porous core (214), said vapor channel being connected to said connecting pipe (230).

6. The device of claim 1, wherein said first hollow tube (212) has a closed end, said closed end having a first surface (212a), said first surface (212a) having a first hole (212b), said connecting pipe (230) having an end connected to said first hole (212b) to connect said first hollow tube (212).

7. The device of claim 1, wherein said second hollow tube (216) has a closed end, said closed end having a second surface (216a), said second surface (216a) having a second hole (216b), said connecting pipe (230) having an end connected to said second hole (216b) to connect said second hollow tube (216).

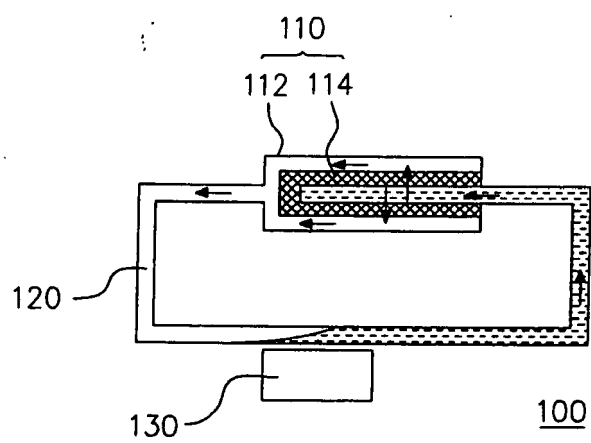


FIG. 1 (PRIOR ART)

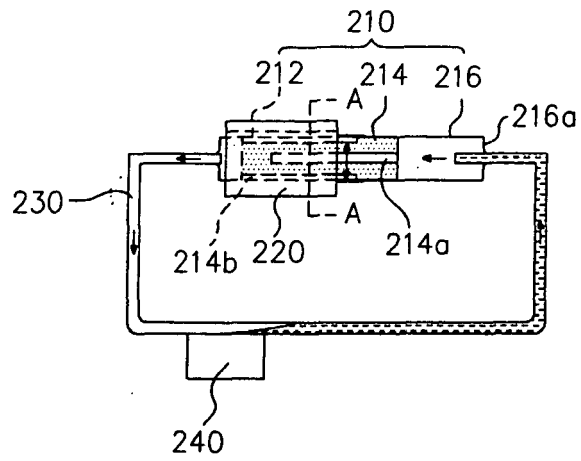


FIG. 2

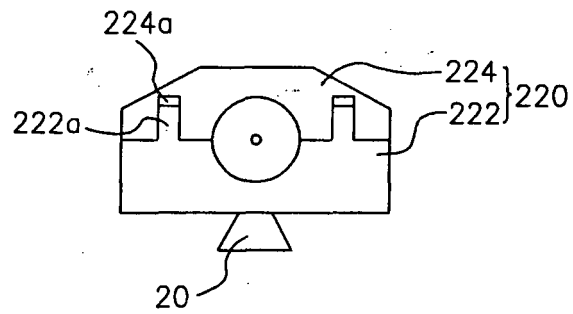


FIG. 3

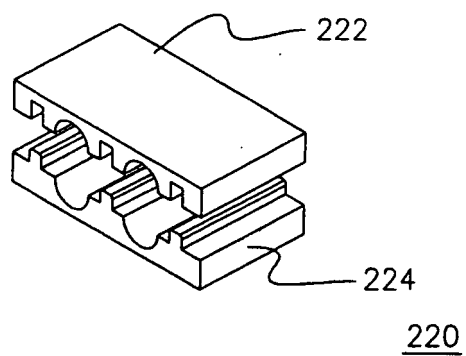


FIG. 4A

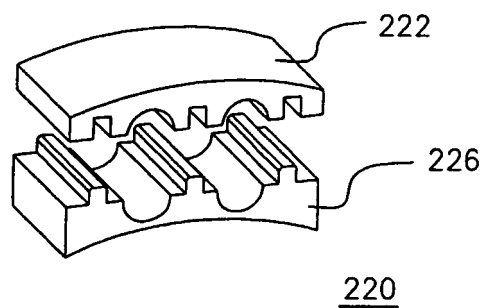


FIG. 4B

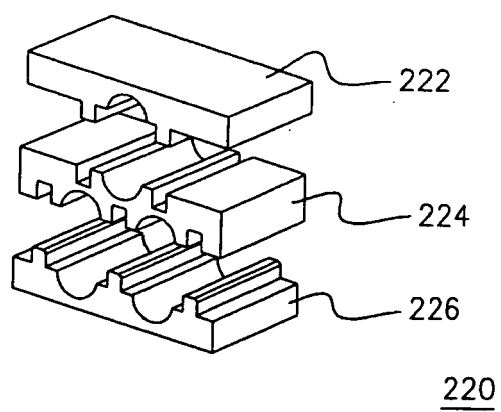


FIG. 4C

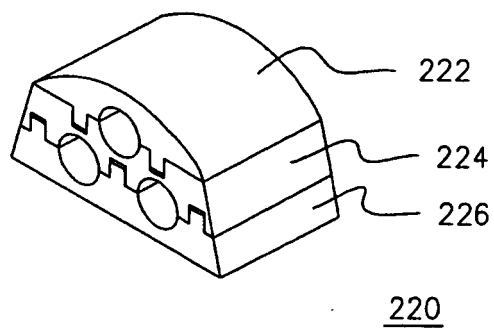


FIG. 4D