(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 528 349 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
14.05.2008 Bulletin 2008/20

(51) Int Cl.:
F28D 15/04 *(2006.01)*

(21) Application number: **04025179.5**

(22) Date of filing: **22.10.2004**

(54) **Method for manufacturing a heat transfer device**

Verfahren zur Herstellung einer Wärmetauschervorrichtung

Méthode de production d'un dispositif de transfert de chaleur

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR

(30) Priority: **27.10.2003 CN 200310102364**

(43) Date of publication of application:
04.05.2005 Bulletin 2005/18

(60) Divisional application:
07024250.8 / 1 906 128

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention generally relates to a method thereof, and more particularly to a heat transfer device and manufacturing method of a heat transfer device to simplify the manufacturing process, 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 a 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 form 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] FIGs. 2A - 2C show the manufacturing process of the conventional heat transfer device. Referring to the FIGs. 2A-2C, the manufacturing method of the conventional heat transfer device 100 directly fuses a porous core 114 inside a hollow metal tube 112 (as shown in FIG. 2A). Then the two caps 140 are welded at the two ends of the hollow metal tube 112 (as shown in FIG. 2B). Then the loop heat pipe 120 is welded on the caps 140. A heat conducting platform 150 is welded at the bottom if the hollow metal tube 112 so that the high heat of the heating device 10 can be transferred from the heat conducting platform 150 to the evaporator 110 (as shown in FIG. 2C). It should be noted that the manufacturing method of the conventional heat transfer device has the following disadvantages:

[0007] 1. The porous core is directly fused inside the hollow metal tube, which is costly and very difficult to implement and to control the quality.

[0008] 2. Two caps, the loop heat pipe, and the heat conducting platform are fixed by welding, which is difficult to implement because there several welding points. Further, the porous core is easy to be damaged during the welding process.

[0009] 3. The heat conducting platform can only conduct the heat to the lower part of the evaporator. Hence the heat conductance is too low.

[0010] Further, there is another manufacturing method for the conventional heat transfer device. This method is very similar to the first conventional method. The difference is that the porous core is fused by using the module and is embedded into the hollow metal tube by thermal connecting technology. However, this method also has the above disadvantages. Further, because the end of the porous core providing the working fluid is difficult to be tightly connected to the hollow metal tube by thermal connecting technology, the working fluid is easy to leak.

[0011] US Patent Publication No. 2003/0178184 also describes an evaporator of a heat transfer device that includes a first hollow tube, a porous core inserted in the first hollow tube through one open end thereof, and a second hollow tube having one open end formed contiguous with the one open end of the first hollow tube. To form a heat transfer device a connecting pipe is disposed in fluid communication with the other end of each of the tubes and and a condenser mounted on the connecting pipe. In addition, a heat conductor is disposed between the heat source and the evaporator.

SUMMARY OF THE INVENTION

[0012] The present invention provides a method for manufacturing a heat transfer device, comprising: mortising a porous core into a first hollow tube; mortising a second hollow tube on the first hollow tube; covering a heat conductor on the first hollow tube; and connecting a connecting pipe to the first hollow tube and the second hollow tube.

[0013] In a preferred embodiment of the present invention, the heat conductor includes a first heat conducting block and a second heat conducting block, and the first heat conducting block and the second heat conducting

block are mortised together to cover the first hollow tube.

[0014] In a preferred embodiment of the present invention, the first hollow tube has a closed end; the closed end has a first surface; before the step of mortising the porous core into the first hollow tube, the method further comprises hole-punching to form a first hole. The second hollow tube has a closed end, and the closed end has a second surface; before the step of mortising the porous core into the second hollow tube, the method further comprises hole-punching to form a second hole. It further comprises hole-widening at an opposite end of the second hollow tube at the same time of performing the step of hole-punching to form the second hole, in order to facilitate mortising the second hollow tube to the first hollow tube.

[0015] In a preferred embodiment of the present invention, the connecting pipe and the first hollow tube are connected by mortising an end of the connecting pipe to the first hole and welding; the connecting pipe and the second hollow tube are connected by mortising an end of the connecting pipe to the second hole and welding.

[0016] In a preferred embodiment of the present invention, it further uses a press module having a sealing function to press an area where the first hollow tube and the first hollow tube are mortised together, so that the mortised area will be deformed and the first hollow tube and the second hollow tube can contact tightly the porous core to prevent the working fluid from leakage into the vapor channel.

[0017] In a preferred embodiment of the present invention, it further disposes a condenser on the connecting pipe after the step of connecting the connecting pipe to the first hollow tube and the second hollow tube.

[0018] The elements of the heat transfer device (such as the porous core, the first and second hollow tube, and the heat conductor) of the present invention are mortised together so as to simplify the manufacturing process, reduce the cost and enhance the heat conductivity.

[0019] 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

[0020] FIG. 1 is a conventional heat transfer device.

[0021] FIGs. 2A - 2C show the manufacturing process of the conventional heat transfer device.

[0022] FIG. 3 is a manufacturing process of the heat transfer device in accordance with a preferred embodiment of the present invention.

[0023] FIGs 4A-4F show a detailed manufacturing process of the heat transfer device in accordance with a preferred embodiment of the present invention.

[0024] FIG. 5 is the structure of the heat transfer device in accordance with a preferred embodiment of the present invention.

[0025] FIG. 6 is a cross-sectional view of FIG. 5 along the A-A line.

[0026] FIGs. 7A-7D show the structure of the heat conductor device in accordance with another preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] FIG. 3 is a manufacturing process of the heat transfer device in accordance with a preferred embodiment of the present invention. The manufacturing process includes: mortising a porous core into a first hollow tube (S1); mortising a second hollow tube on the first hollow tube (S2); covering a heat conductor on the first hollow tube (S3); connecting a connecting pipe to the first hollow tube and the second hollow tube (S4); and disposing a condenser on the connecting pipe (S5). The detailed manufacturing process will be illustrated as follows.

[0028] FIGs 4A-4F show a detailed manufacturing process of the heat transfer device in accordance with a preferred embodiment of the present invention. Referring to FIG. 4A, a first hollow tube 212 is provided. The first hollow tube 212 in this embodiment is a hollow tube with a closed end. The closed end of the first hollow tube 212 has a first surface 212a. A hole-punching is performed to form a first hole 212b.

[0029] Referring to FIG. 4B, the porous core 214 is mortised into the first hollow tube 212. The porous core 214 has a fluid channel 214a therein for injecting a working fluid therein. The outer surface of the porous core 214 for example has one or more trenches so that after the porous core 214 is mortised to the first hollow tube 212 the one or more trenches can form one or more vapor channels 214b with the inner surface of the first hollow tube 212.

[0030] Referring to FIG. 4C, a second hollow tube 216 is provided. The second hollow tube 216 in this embodiment is a hollow tube with a closed end. The closed end of the second hollow tube 216 has a second surface 216a. A hole-punching is performed to form a second hole 216b. Further, a hole-widening step can be performed at the opposite end of the second hollow tube 216 to facilitate mortising the second hollow tube 216 to the first hollow tube 212.

[0031] Referring to FIG. 4D, a heat conductor 220 is covered on the first hollow tube 212 to form an evaporator 210. In this embodiment, the heat conductor 220 includes a first heat conducting block 222 and a second heat conducting block 224. The evaporator 210 is covered by mortising the first heat conducting block 222 and the second heat conducting block 224.

[0032] Referring to FIG. 4E, a press module 250 with a sealing function is used to press the mortised area where the second hollow tube 216 and the porous core 214 are mortised, so that the mortised area is deformed and the second hollow tube 216 can tightly contact the

porous core 214 to prevent the working fluid from directly flowing into the vapor channel 214b. Hence, there is no concern of internal leakage inside the evaporator.

[0033] Referring to FIG. 4F, a connecting pipe 230 is connected to the first hollow tube 212 and the second hollow tube 216. The connecting pipe 230 and the first hollow tube 212 are connected by mortising an end of the connecting pipe 230 to the first hole 212b and welding; the connecting pipe 230 and the second hollow tube 216 are connected by mortising an end of the connecting pipe 230 to the second hole 216b and welding. Finally, a condenser 240 is disposed on the connecting pipe 230 to form the heat transfer device 200 of the present invention.

[0034] In light of the above, because the porous core is mortised into the first hollow tube, then the second hollow tube is mortised on the first hollow tube, the porous core is fixed by tightening up the first hollow tube, the second hollow tube, and the porous core. Hence, the present invention does not require the fusing or fusing and thermal connecting technology like the conventional manufacturing methods.

Therefore, the present invention can simplify the manufacturing process and reduce the cost. Further, the first and second hollow tubes of the present invention use a thinner metal shell. By pressing an area where the first hollow tube and the first hollow tube are mortised together, the mortised area will be deformed and the first hollow tube and the second hollow tube can contact tightly the porous core to prevent the working fluid from leakage into the vapor channel. Further, the first and second hollow tubes of the present invention are closed ended tube, a cap is not required to be welded to the closed end (the welding step is required only at the connection to the connecting pipe). Hence, the present invention can reduce the number of the welding steps to prevent the porous core from damaged due to the welding step.

[0035] FIG. 5 is the structure of the heat transfer device manufactured in accordance with a preferred embodiment of the present invention. FIG. 6 is a cross-sectional view of FIG. 5 along the A-A line. Referring to FIGs. 5 and 6, the heat transfer device 200 for transferring a heating source from a heating device 20. The heat transfer device 200 at least comprises: an evaporator 210, a heat conductor 220 and a connecting pipe 230. The evaporator 210 comprises: a first hollow tube 212; a porous core 214 mortised inside the first hollow tube 212; a second hollow tube 216 mortised on the first hollow tube 212.

[0036] 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 210 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.

[0037] 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.5) 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.

[0038] Referring to FIG. 6, 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 tenon222a 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.

[0039] 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 present 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.

[0040] FIGs. 7A-7D show the structure of the heat conductor device manufactured in accordance with another preferred embodiment of the present invention. Referring to FIGs. 7A and 7B, 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. 7C and 7D, 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.

[0041] 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.

[0042] 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 method for manufacturing a heat transfer device, comprising:

   mortising a porous core into a first hollow tube;
   mortising a second hollow tube on said first hollow tube;
   forming an evaporator (210) including a porous core (214), a first hollow tube (212) and a second hollow tube (216), said porous core (214) being in said first hollow tube (212), said first hollow tube (212) having one open end, and said second hollow tube (216) having one open end connected with said one open end of said first hollow tube (212);
   covering a heat conductor (220) on said first hollow tube (212); and
   connecting a connecting pipe (230) to said first hollow tube (212) and said second hollow tube (216), wherein a first end of said connecting pipe (230) is in fluid communication with the other end of said first hollow tube (212) and a second end of said connecting pipe (230) in fluid communication with the other end of said second hollow tube (216),
   wherein the step of forming the evaporator (210) comprises:

      mortising the porous core (214) into said first hollow tube (212) through said one open end of said first hollow tube (212); and
      mortising said one open end of the second hollow tube (216) on said one open end of said first hollow tube (212).

2. The method of claim 1, wherein said first hollow tube (212) has a closed end, said closed end having a first surface (212a), before said step of mortising said porous core (214) into said first hollow tube (212), further comprising hole-punching to form a first hole (212b).

3. The method of claim 2, wherein said connecting pipe (230) and said first hollow tube (212) are connected by mortising an end of said connecting pipe (230) to said first hole (212b) and welding.

4. The method of claim 1, wherein said second hollow tube (216) has a closed end, said closed end having a second surface (216a), before said step of mortising said porous core (214) into said second hollow tube (216), further comprising hole-punching to form a second hole (216b).

5. The method of claim 4, further comprising hole-widening at an opposite end of said second hollow tube (216) at the same time of performing said step of hole-punching to form said second hole (216b).

6. The method of claim 4, wherein said connecting pipe (230) and said second hollow tube (216) are connected by mortising an end of said connecting pipe (230) to said second hole (216b) and welding.

7. The method of claim 1, further using a press module (250) having a sealing function to press an area where said second hollow tube (216) and said porous core (214) are mortised together.

8. The method of claim 1, further disposing a condenser (240) on said connecting pipe (230) after said step of connecting said connecting pipe (230) to said first hollow tube (212) and said second hollow tube (216).

9. The method of claim 1, wherein said heat conductor includes a first heat conducting block (222) and a second heat conducting block (224), said first heat conducting block (222) and said second heat conducting block (224) being mortised together to cover said first hollow tube (212).

Patentansprüche

1. Verfahren zur Herstellung einer Wärmetransfervorrichtung, umfassend:

   Einzapfen eines porösen Kerns in ein erstes hohles Rohr;
   Aufzapfen eines zweiten hohlen Rohres auf das erste hohle Rohr;
   Bilden eines Verdampfers (210), der einen porösen Kern (214), ein erstes hohles Rohr (212) und ein zweites hohles Rohr (216) beinhaltet,

wobei der poröse Kern (214) sich in dem ersten hohlen Rohr (212) befindet, das erste hohle Rohr (212) ein offenes Ende hat, und das zweite hohle Rohr (216) ein offenes Ende hat, das mit dem einen offenen Ende des ersten hohlen Rohres (212) verbunden ist;
Bedecken des ersten hohlen Rohres (212) mit einem Wärmeleiter (220); und
Verbinden einer Verbindungsleitung (230) mit dem ersten hohlen Rohr (212) und dem zweiten hohlen Rohr (216), wobei ein erstes Ende der Verbindungsleitung (230) in Fluidverbindung mit dem anderen Ende des ersten hohlen Rohres (212) und ein zweite Ende der Verbindungsleitung (230) steht in Fluidverbindung mit dem anderen Ende des zweiten hohlen Rohres (216) ist, wobei der Schritt des Bildens des Verdampfers (210) umfasst:

Einzapfen des porösen Kerns (214) in das erste hohle Rohr (212) durch das eine offene Ende des ersten hohlen Rohrs (212); und Aufzapfen des einen offenen Endes des zweiten hohlen Rohres (216) auf das offene Ende des ersten hohlen Rohres (212).

2. Verfahren gemäß Anspruch 1, wobei das erste hohle Rohr (212) ein geschlossenes Ende hat und das erste geschlossene Ende vor dem Schritt des Einzapfens des porösen Kerns (214) in das erste hohle Rohr (212) eine erste Fläche (212a) aufweist, des Weiteren umfassend Lochstanzen, um ein erstes Loch (212b) zu bilden.

3. Verfahren gemäß Anspruch 2, wobei die Verbindungsleitung (230) und das erste hohle Rohr (212) durch Verzapfen und Schweißen eines Endes der ersten Verbindungsleitung (230) mit dem ersten Loch (212b) verbunden sind.

4. Verfahren gemäß Anspruch 1, wobei das zweite hohle Rohr (216) ein geschlossenes Ende hat, wobei das geschlossene Ende vor dem Schritt des Einzapfens des porösen Kerns (214) in das zweite hohle Rohr (216) eine zweite Fläche (216a) aufweist, des Weiteren umfassend Lochstanzen, um ein zweites Loch (216b) zu bilden.

5. Verfahren gemäß Anspruch 4, weiter umfassend Lochaufweiten an dem gegenüberliegenden Ende des zweiten hohlen Rohres (216) gleichzeitig mit der Durchführung des Schrittes des Lochstanzens, um das zweite Loch (216b) zu bilden.

6. Verfahren gemäß Anspruch 4, wobei die Verbindungsleitung (230) und das zweite hohle Rohr (216) durch Verzapfen eines Endes der Verbindungsleitung (230) mit dem zweiten Loch (216b) und Schweißen verbunden sind.

7. Verfahren gemäß Anspruch 1, das weiter ein Pressmodul (250) mit einer Dichtfunktion verwendet, um einen Bereich zu pressen, in dem das zweite hohle Rohr (216) und der poröse Kern (214) zusammenverzapft sind.

8. Verfahren gemäß Anspruch 1, das weiter einen Dampfkondensator (240) auf die Verbindungsleitung (230) nach dem Schritt des Verbindens der Verbindungsleitung (230) mit dem ersten hohlen Rohr (212) und dem zweiten hohlen Rohr (216) platziert.

9. Verfahren gemäß Anspruch 1, wobei der Wärmeleiter einen ersten Wärmeleitungsblock (222) und einen zweiten Wärmeleitungsblock (224) beinhaltet, wobei der erste Wärmeleitungsblock (222) und der zweite Wärmeleitungsblock (224) zusammenverzapft sind, um das erste hohle Rohr (212) zu überdecken.

Revendications

1. Procédé pour fabriquer un dispositif de transfert de chaleur, comprenant les étapes consistant à :

mortaiser un noyau poreux dans un premier tube creux ;
mortaiser un second tube creux sur ledit premier tube creux ;
former un évaporateur (210) comprenant un noyau poreux (214), un premier tube creux (212) et un second tube creux (216), ledit noyau poreux (214) étant dans ledit premier tube creux (212), ledit premier tube creux (212) ayant une extrémité ouverte, et ledit second tube creux (216) ayant une extrémité ouverte raccordée à ladite une extrémité ouverte dudit premier tube creux (212) ;
appliquer un conducteur de chaleur (220) sur ledit premier tube creux (212) ; et
raccorder un tuyau de raccordement (230) audit premier tube creux (212) et audit second tube creux (216), dans lequel une première extrémité dudit tuyau de raccordement (230) est en communication de fluide avec l'autre extrémité du premier tube creux (212) et une seconde extrémité dudit tuyau de raccordement (230) en communication de fluide avec l'autre extrémité dudit second tube creux (216),

dans lequel l'étape consistant à former l'évaporateur (210) comprend les étapes consistant à :

mortaiser le noyau poreux (214) dans ledit premier tube creux (212) par le biais de ladite une

extrémité ouverte dudit premier tube creux (212) ; et

mortaiser ladite une extrémité ouverte dudit second tube creux (216) sur ladite une extrémité ouverte dudit premier tube creux (212).

2. Procédé selon la revendication 1, dans lequel ledit premier tube creux (212) a une extrémité fermée, ladite extrémité fermée ayant une première surface (212a), avant ladite étape consistant à mortaiser ledit noyau poreux (214) dans ledit premier tube creux (212), comprenant en outre la perforation à l'emporte-pièce pour former un premier trou (212b).

3. Procédé selon la revendication 2, dans lequel ledit tuyau de raccordement (230) et ledit premier tube creux (212) sont raccordés en mortaisant une extrémité dudit tuyau de raccordement (230) dans ledit premier trou (212b) et en soudant.

4. Procédé selon la revendication 1, dans lequel ledit second tube creux (216) a une extrémité fermée, ladite extrémité fermée ayant une seconde surface (216a), avant l'étape consistant à mortaiser ledit noyau poreux (214) dans ledit second tube creux (216), comprenant en outre la perforation à l'emporte-pièce pour former un second trou (216b).

5. Procédé selon la revendication 4, comprenant en outre l'élargissement du trou au niveau d'une extrémité opposée dudit second tube creux (216) en même temps que l'on réalise ladite étape de perforation à l'emporte-pièce pour former ledit second trou (216b).

6. Procédé selon la revendication 4, dans lequel ledit tuyau de raccordement (230) et ledit second tube creux (216) sont raccordés en mortaisant une extrémité dudit tuyau de raccordement (230) dans ledit second trou (216b) et en soudant.

7. Procédé selon la revendication 1, comprenant en outre un module de presse (250) ayant une fonction d'étanchéité afin de comprimer une zone où ledit second tube creux (216) et ledit noyau poreux (214) sont mortaisés ensemble.

8. Procédé selon la revendication 1, comprenant en outre l'étape consistant à disposer un condenseur (240) sur ledit tuyau de raccordement (230) après ladite étape consistant à raccorder ledit tuyau de raccordement (230) audit premier tube creux (212) et audit second tube creux (216).

9. Procédé selon la revendication 1, dans lequel ledit conducteur de chaleur comprend :

un premier bloc de conduction de chaleur (222) et un second bloc de conduction de chaleur (224), ledit premier bloc de conduction de chaleur (222) et ledit second bloc de conduction de chaleur (224) étant mortaisés ensemble pour recouvrir ledit premier tube creux (212).

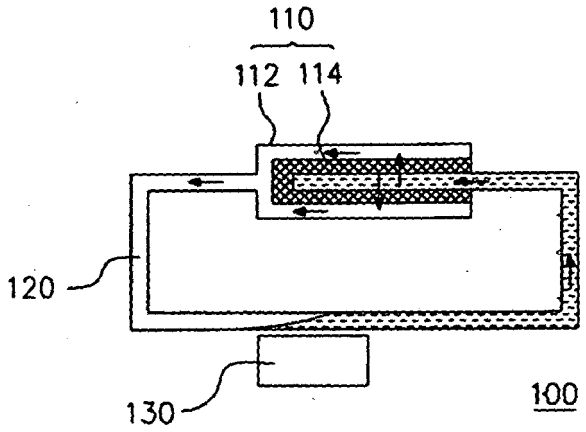

FIG. 1 (PRIOR ART)

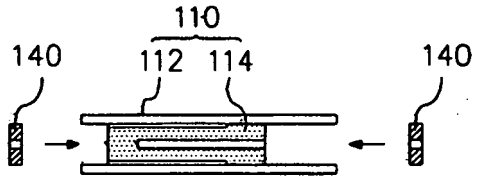

FIG. 2A (PRIOR ART)

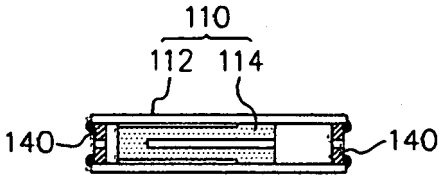

FIG. 2B (PRIOR ART)

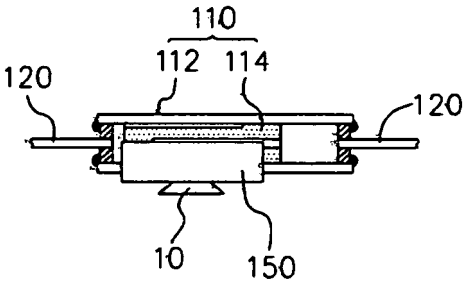

FIG. 2C (PRIOR ART)

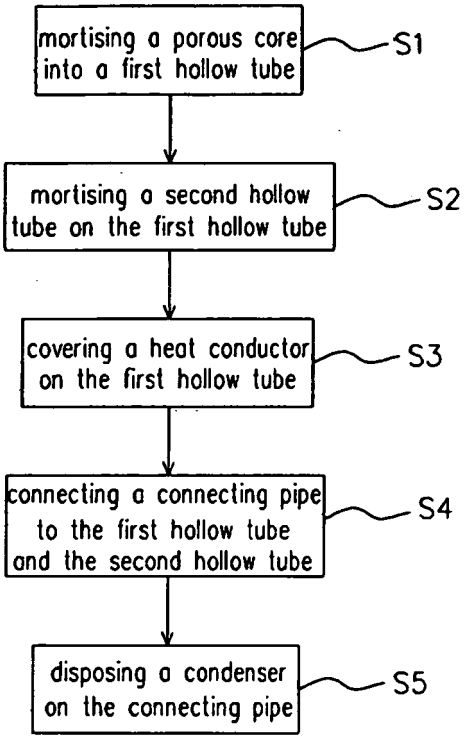
mortising a porous core into a first hollow tube
S1
mortising a second hollow tube on the first hollow tube
S2
covering a heat conductor on the first hollow tube
S3
connecting a connecting pipe to the first hollow tube and the second hollow tube
S4
disposing a condenser on the connecting pipe
S5

FIG. 3

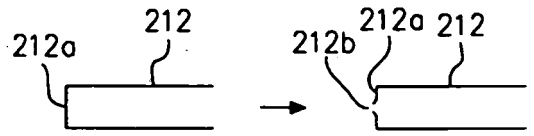

FIG. 4A

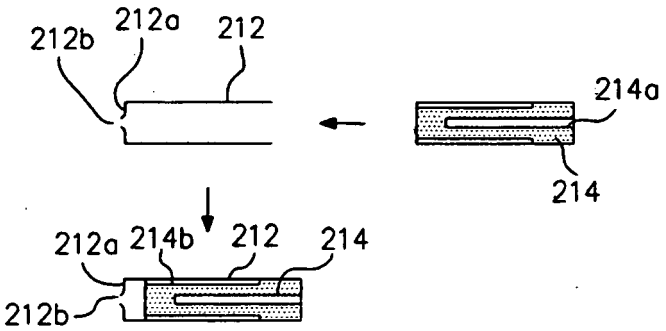

FIG. 4B

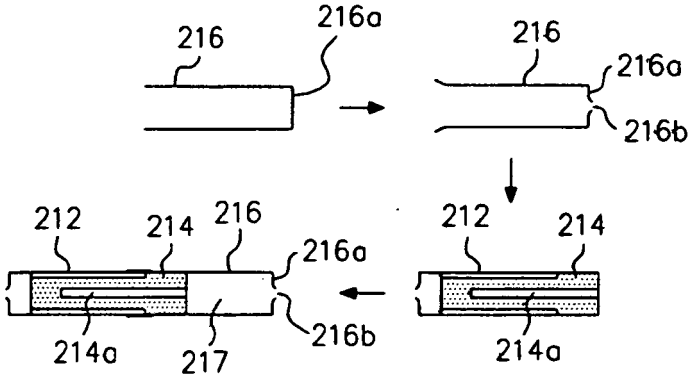

FIG. 4C

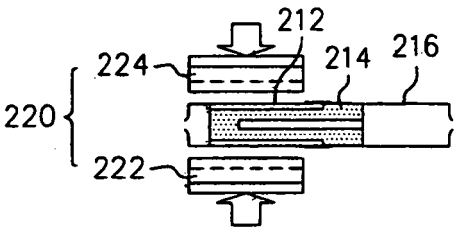

FIG. 4D

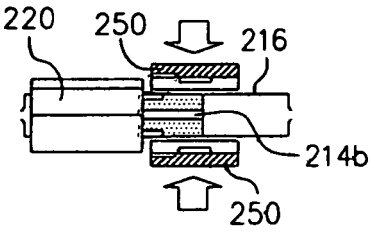

FIG. 4E

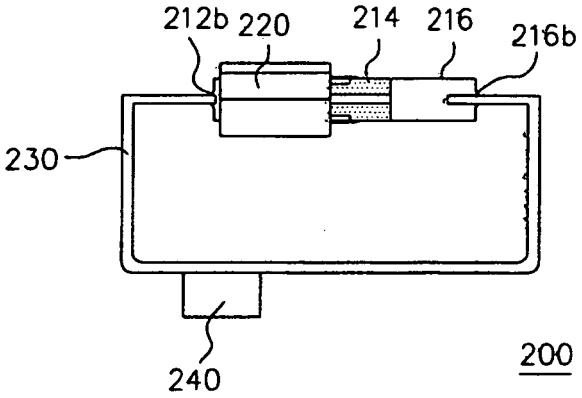

FIG. 4F

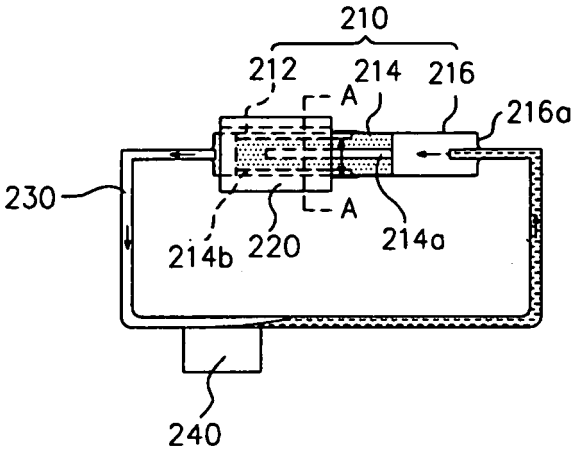
210
212
214
216
A
216a
230
A
214b
220
214a
240

FIG. 5

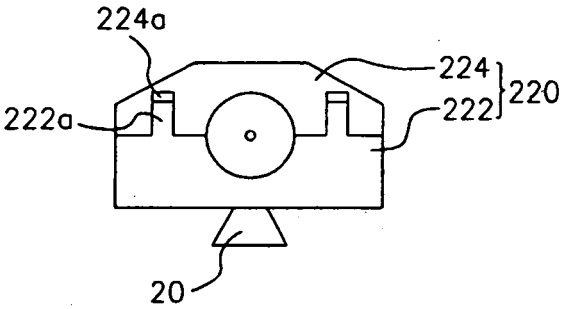
224a
224
220
222a
222
20

FIG. 6

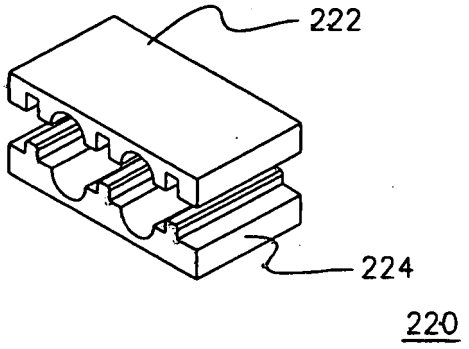

FIG. 7A

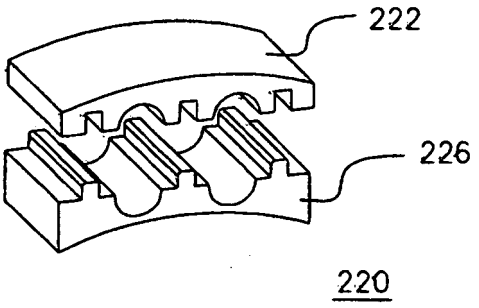

FIG. 7B

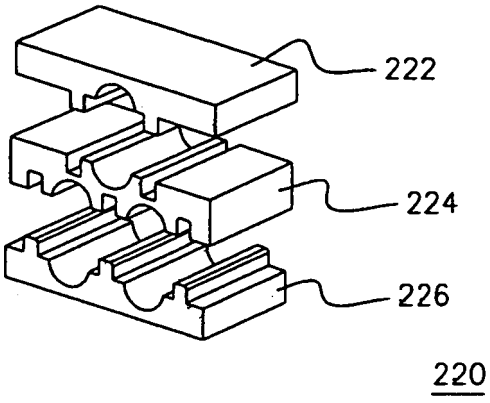

FIG. 7C

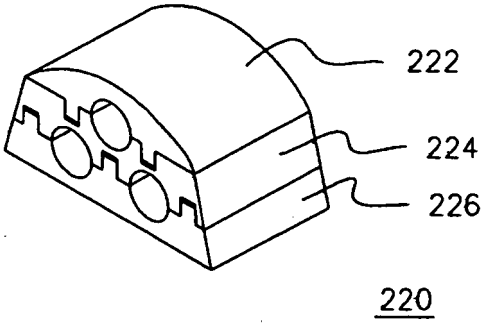

FIG. 7D

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20030178184 A **[0011]**