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(72) Inventors:

- **Lin, Chia-Yu**
235 New Taipei City (TW)
- **Liu, Lei-Lei**
Hui Zhou City
Guandong (CN)

(71) Applicant: **Cooler Master Co., Ltd.**

New Taipei City 235 (TW)

(74) Representative: **Ter Meer Steinmeister & Partner**

Patentanwlte
Mauerkircherstrasse 45
81679 Mnchen (DE)

(54) **Heat-conducting module and method for manufacturing the same**

(57) The present invention relates to a heat-conducting module and a method for manufacturing the same. A hollow aluminum tube (110) is put on a corresponding heat pipe (111) to form an aluminum-skinned heat pipe (11). Then, one or more aluminum-skinned heat pipes (11) are disposed in a casting space (22) of a die casting

mold (2). Molten aluminum materials are filled in the die casting space (11) of the die casting mold (2) to form a heat-conducting module (1). By using a die casting process, molten aluminum materials are used to cover at least one aluminum-skinned heat pipe (11), thereby finishing the heat-conducting module (1).

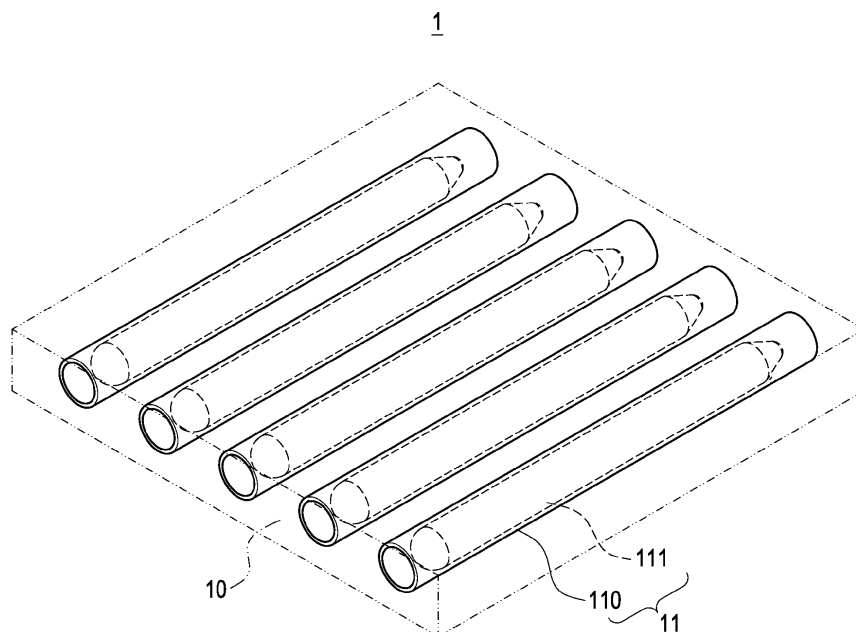


FIG.1

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a heat-conducting module and a method for manufacturing the same. Particularly, the present invention relates to a heat-conducting module, which is made by using molten metallic materials to cover aluminum-skinned heat pipes via a die casting process and a method for manufacturing the same.

Description of Prior Art

[0002] Heat-conducting elements such as heat pipes are used to dissipate heat or transfer heat. The interior of the heat pipe is made to be vacuumed. A working fluid is filled into the heat pipe to generate a phase change therein. When the working fluid is heated, it evaporates to become vapors, thereby carrying away the heat. Then, the vapor phase of the working fluid condenses to return its liquid phase and to circulate in the heat pipe. In order to manufacture a plate-type heat pipe, conventionally, a plurality of heat pipes is disposed in a solid or hollow metallic plate. Alternatively, a tubular heat pipe is rolled or pressed to form a plate-type heat pipe.

[0003] However, the strength of the conventional plate-type heat pipe is insufficient. Further, it is difficult for heat-dissipating elements such as fins to be provided on the conventional plate-type heat pipe. As for the plate-type heat pipe formed by covering heat pipes by a solid or hollow metallic plate, it is an important issue to consider the thermal resistance generated by the gap between the heat pipe and the metallic plate. As for the plate-type heat pipe made by heat pipes penetrating into a solid metallic plate, it is difficult to control the tolerance between the penetrating heat pipe and the metallic plate. If the tolerance is larger, a gap will be formed between the heat pipe and the metallic plate, and thus a heat-conducting medium has to be applied in this gap. If the tolerance is smaller, the penetration of the heat pipe into the metallic plate becomes more difficult. As for the plate-type heat pipe made by embedding heat pipes in a metallic plate, the heat transfer effect between the heat pipe and the metallic plate will be deteriorated because the metallic plate is made of a material (aluminum) different from the material (copper) of the heat pipe.

SUMMARY OF THE INVENTION

[0004] The present invention provides a heat-conducting module and a method for manufacturing the same. The heat-conducting module is made by using molten metallic materials to cover at least one aluminum-skinned heat pipe by a die casting process. More specifically, the heat-conducting module employs the aluminum material

as a heat-conducting medium because the aluminum material can generate a good heat-dissipating effect and a better heat transfer effect. On the other hand, the heat-conducting module of the present invention is chemically stable and thus will not be separated or explored easily. Further, it has a better corrosion resistance.

[0005] In one aspect, the present invention provides a method for manufacturing a heat-conducting module, including steps of:

- a) putting a hollow aluminum tube on a heat pipe to make an aluminum-skinned heat pipe;
 - b) disposing at least one aluminum-skinned heat pipe into a casting space of a die casting mold;
 - c) filling aluminum materials in the casting space of the die casting mold to form a heat-conducting module, wherein the heat-conducting module includes an aluminum base and at least one aluminum-skinned heat pipe, the aluminum base covers the at least one aluminum-skinned heat pipe;
- wherein the aluminum materials are melted to cover the at least one aluminum-skinned heat pipe by a die casting process, thereby obtaining the heat-conducting module.

[0006] In another aspect, the present invention provides a heat-conducting module including an aluminum base and at least one aluminum-skinned heat pipe disposed in the aluminum base, wherein the aluminum-skinned heat pipe comprises a heat pipe and an aluminum tube tightly covering the heat pipe.

BRIEF DESCRIPTION OF DRAWING

[0007]

FIG. 1 is a perspective view showing the external appearance of the final product according to the present invention;

FIG. 2 is a flow chart showing the steps of the method according to the present invention;

FIG. 3 is a schematic view showing the step S1 in the method of the present invention;

FIG. 4 is a schematic view showing that an aluminum-skinned heat pipe is subjected to a draw-forming process in the step S1 of the method according to the present invention;

FIG. 5 is a schematic view showing the state of the aluminum-skinned heat pipe before and after a draw-forming process in the step S1 of the method according to the present invention;

FIG. 6 is a schematic view showing that an aluminum-skinned heat pipe is subjected to a draw-forming process and both ends thereof are sealed in the step S1 of the method according to the present invention;

FIG. 7 is a schematic view showing the step S2 in the method of the present invention;

FIG. 8 is a schematic view showing the step S3 in the method of the present invention;
and
FIG. 9 is a cross-sectional view showing the internal construction of the final product according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0008] In order to make the Examiner to better understand the characteristics and technical contents of the present invention, a detailed description will be made with reference to the accompanying drawings. However, it is noteworthy to point out that the drawings is provided for the illustration purpose only, but not intended for limiting the scope of the present invention.

[0009] Please refer to FIG. 1, which is a perspective view showing the external appearance of the final product according to the present invention. The present invention provides a heat-conducting module and a method for manufacturing the same. The interior of the heat-conducting module 1 is embedded with at least one aluminum-skinned heat pipe 11. Each aluminum-skinned heat pipe 11 comprises a hollow aluminum tube 110 and a heat pipe 111. The hollow aluminum tube 110 is put on the heat pipe 111 to form the aluminum-skinned heat pipe 11. The heat-conducting module 1 includes an aluminum base 10 and at least one aluminum-skinned heat pipe 11, wherein the aluminum heat pipes 11 are provided in the aluminum base 10 at intervals.

[0010] Please also refer to FIGS. 2 and 3. The method of the present invention has steps as follows. First, in the step S1 shown in FIG. 2, at least one heat pipe 111 and a hollow aluminum tube 110 corresponding to the heat pipe 111 are prepared to form an aluminum-skinned heat pipe 11. In the present embodiment, preferably, there is a plurality of aluminum-skinned heat pipes 11. Thus, each heat pipe 111 has a corresponding hollow aluminum tube 110. Further, the inner diameter of each hollow aluminum tube 110 is slightly larger than the outer diameter of the corresponding heat pipe 111, so that the hollow aluminum tube 110 can be put on the heat pipe 111. The hollow aluminum tube 110 may be made of aluminum-based metals or alloys thereof. Alternatively, the hollow aluminum tube 110 may be made of the same material as the aluminum base 10.

[0011] Please also refer to FIGS. 3 to 6. In the steps S1-1 to S1-2 shown in FIG. 2 of the present embodiment, the aluminum-skinned heat pipe 11 can be made by the following process. First, one end of the hollow aluminum tube 110 is fixed onto a mounting base 3, and the other end of the hollow aluminum tube 110 is fixed to a movable stage 4. In the beginning, the movable stage 4 moves in a direction away from the mounting base 3, thereby drawing the hollow aluminum tube 110. In this way, the length "l" of the hollow aluminum tube 110 is increased, and the diameter "d" of the hollow aluminum tube 110 is reduced, so that the hollow aluminum tube 110 can cover

the heat pipe 111 to form the aluminum-skinned heat pipe 11.

[0012] After the drawing process, the aluminum-skinned heat pipe 11 is taken off from the mounting base 3 and the movable stage 4. Then, both ends of the aluminum-skinned heat pipe 11 are sealed. More specifically, two aluminum sealing heads 112 are used to seal two ends 113 of the hollow aluminum tube 110, so that the heat pipe 111 is completely covered by the hollow aluminum tube 110. The aluminum sealing head 112 may be made of the same material as that of the hollow aluminum tube 110 or the aluminum base 10.

[0013] Next, please also refer to FIG. 7. In the step S2 shown in FIG. 2, the at least one aluminum-skinned heat pipe 11 is disposed in a die casting mold 2. In the present embodiment, the die casting mold 2 includes a first mold part 20 and a second mold part 21. After the first mold part 20 and the second mold part 21 are brought into tight contact with each other, the die casting space 22 is formed in the die casting mold 2. In the die casting space 22, the aluminum base 10 of the heat-conducting module 1 is formed.

[0014] Finally, please also refer to FIG. 8. In the step S3 shown in FIG. 2, the aluminum material is filled in the die casting space 22 of the die casting mold 2, thereby forming the aluminum base 10 in the die casting space 22. In this way, the aluminum-skinned heat pipe 11 is covered inside the aluminum base 10 to form the heat-conducting module 1 as shown in FIG. 9. In other words, the heat-conducting module 1 is formed by covering at least one aluminum-skinned heat pipe 11 by a die casting process.

[0015] In the thus-formed heat-conducting module 1 made by covering the aluminum-skinned heat pipe 11 with molten metallic materials, since the hollow aluminum tube 110 acts as an aluminum skin to cover the heat pipe 111, a good heat-dissipating effect and a better heat transfer effect can be achieved between the aluminum-skinned heat pipe 11 and the aluminum base 10. On the other hand, since the heat-conducting module 1 is made by using a die casting process to cover the aluminum-skinned heat pipe 11 with molten metallic materials, the present invention has a better corrosion resistance.

[0016] Therefore, with the above method, the heat-conducting module of the present invention can be obtained.

Claims

1. A method for manufacturing a heat-conducting module, including steps of:
 - a) putting a hollow aluminum tube (110) on a corresponding heat pipe (111) to form an aluminum-skinned heat pipe (11);
 - b) disposing the at least one aluminum-skinned heat pipe (11) into a casting space (22) of a die

- casting mold (2); and
 c) filling aluminum materials into the casting space (22) of the die casting mold (2) to form a heat-conducting module (1), wherein the heat-conducting module (1) comprises an aluminum base (10) and the at least one aluminum-skinned heat pipe (11), and the aluminum base (10) covers the at least one aluminum-skinned heat pipe (11);
 wherein molten aluminum materials cover the at least one aluminum-skinned heat pipe (11) by a die casting process to thereby form the heat-conducting module (1).
2. The method according to claim 1, wherein the aluminum-skinned heat pipe (11) in the step a) is made by drawing the hollow aluminum tube (110) to cover the heat pipe (111).
3. The method according to claim 2, further including a step of sealing both ends of the hollow aluminum tube (110) with two aluminum sealing heads (112).
4. The method according to claim 1, wherein the die casting mold (2) in the step b) comprises a first mold part (20) and a second mold part (21), and the first mold part (20) and the second mold part (21) are brought into tight contact with each other to form the casting space (22), thereby forming the aluminum base (10).
5. A heat-conducting module, including:
 an aluminum base (10); and
 at least one aluminum-skinned heat pipe (11) disposed in the aluminum base (10);
 wherein the aluminum-skinned heat pipe (11) comprises a heat pipe (111) and an aluminum tube (110) covering the heat pipe (111).
6. The heat-conducting module according to claim 5, wherein the aluminum base (10) is made of aluminum-based metals or alloys thereof.
7. The heat-conducting module according to claim 5, wherein a plurality of aluminum-skinned heat pipes (11) are disposed in the aluminum base (10) at intervals.
8. The heat-conducting module according to claim 5, wherein the aluminum-skinned heat pipe (11) is sealed by aluminum sealing heads (112) at both ends (113) of the aluminum tube (110).
9. The heat-conducting module according to claim 8, wherein the aluminum sealing heads (112) are made of aluminum-based metals or alloys.
10. The heat-conducting module according to claim 5, wherein the aluminum tube (110) is made of aluminum-based metals or alloys.
11. The heat-conducting module according to claim 5, wherein the aluminum pipe (110) is a hollow tube to be put on the heat pipe (111).

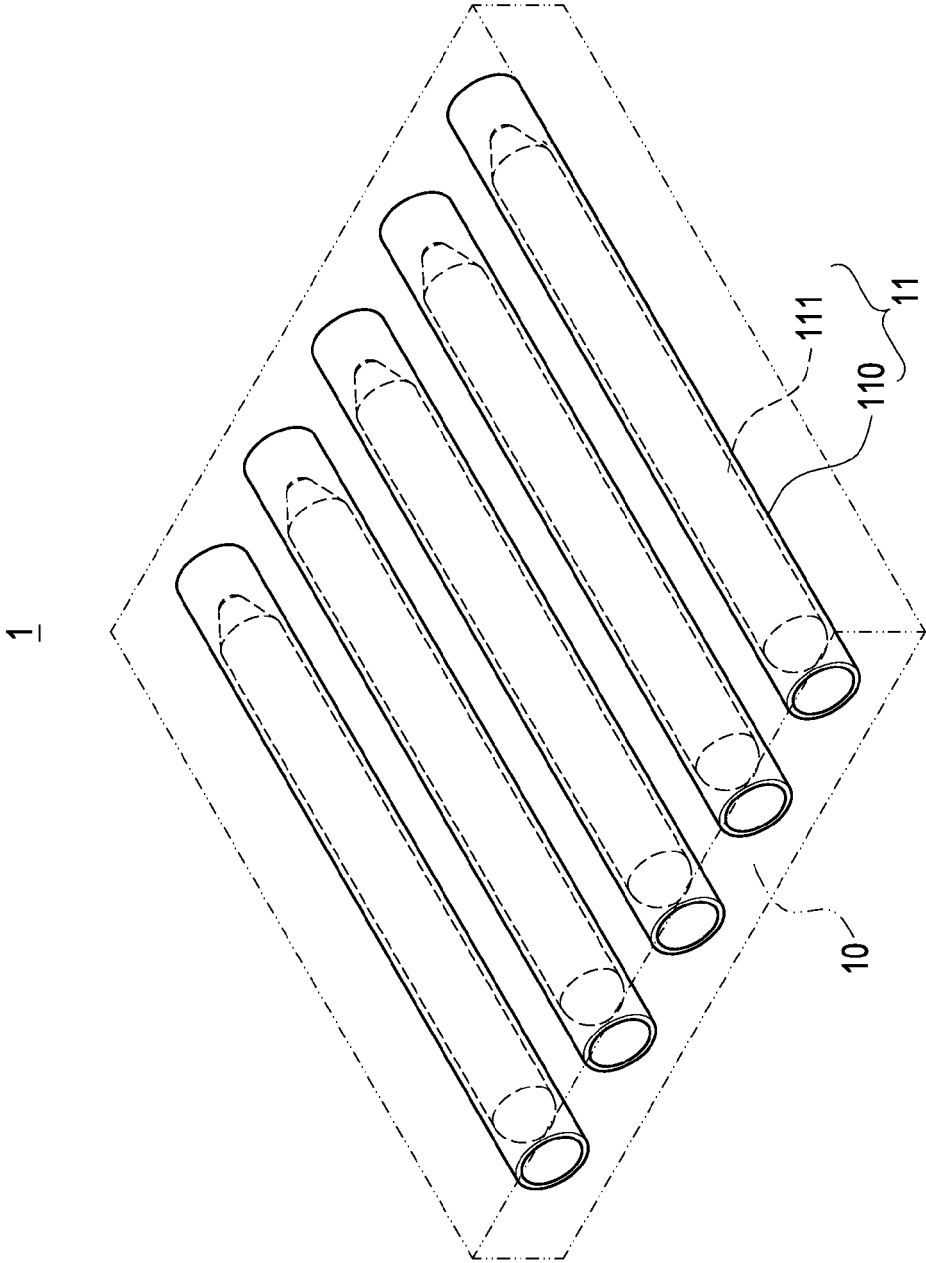


FIG.1

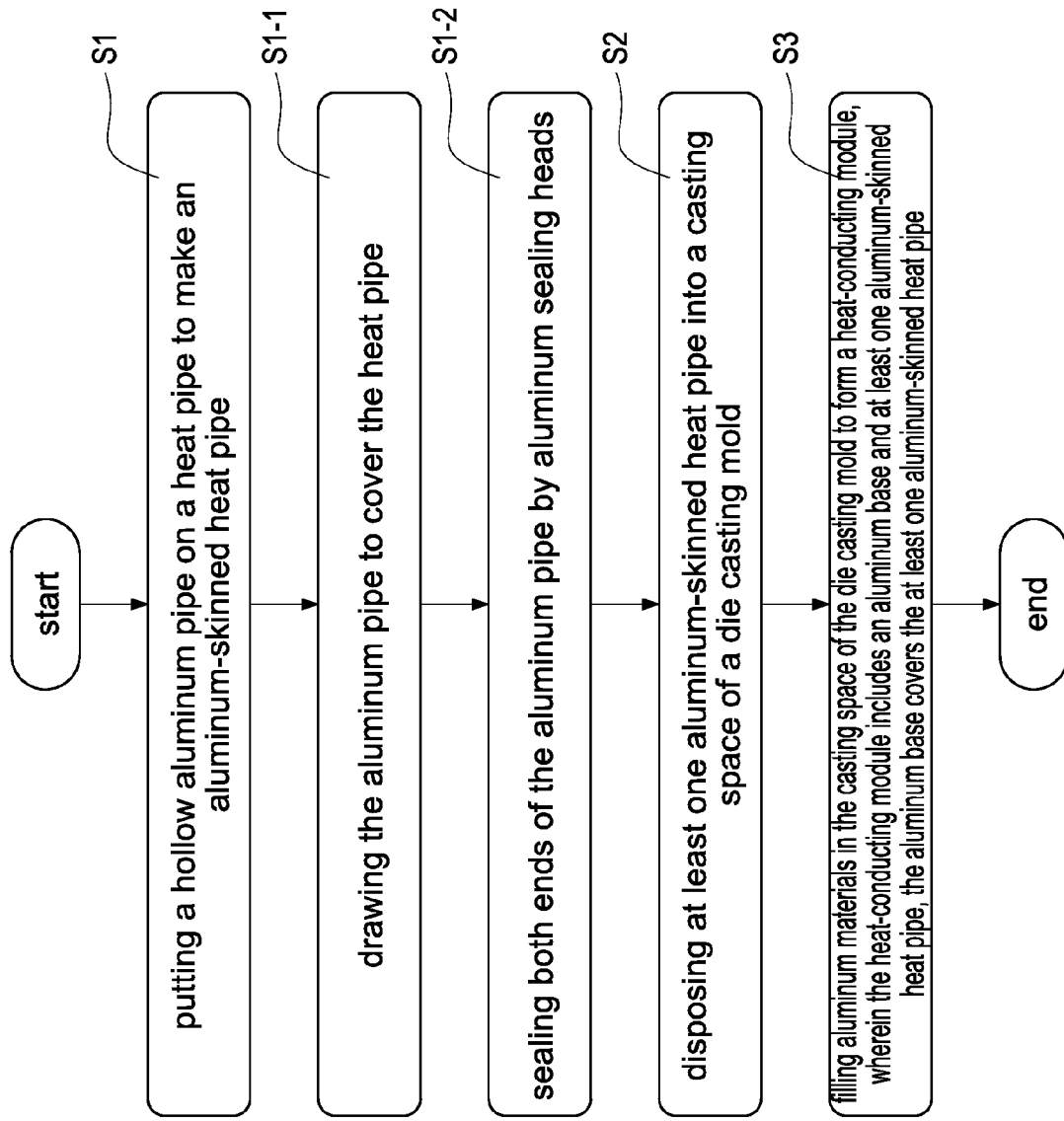


FIG.2

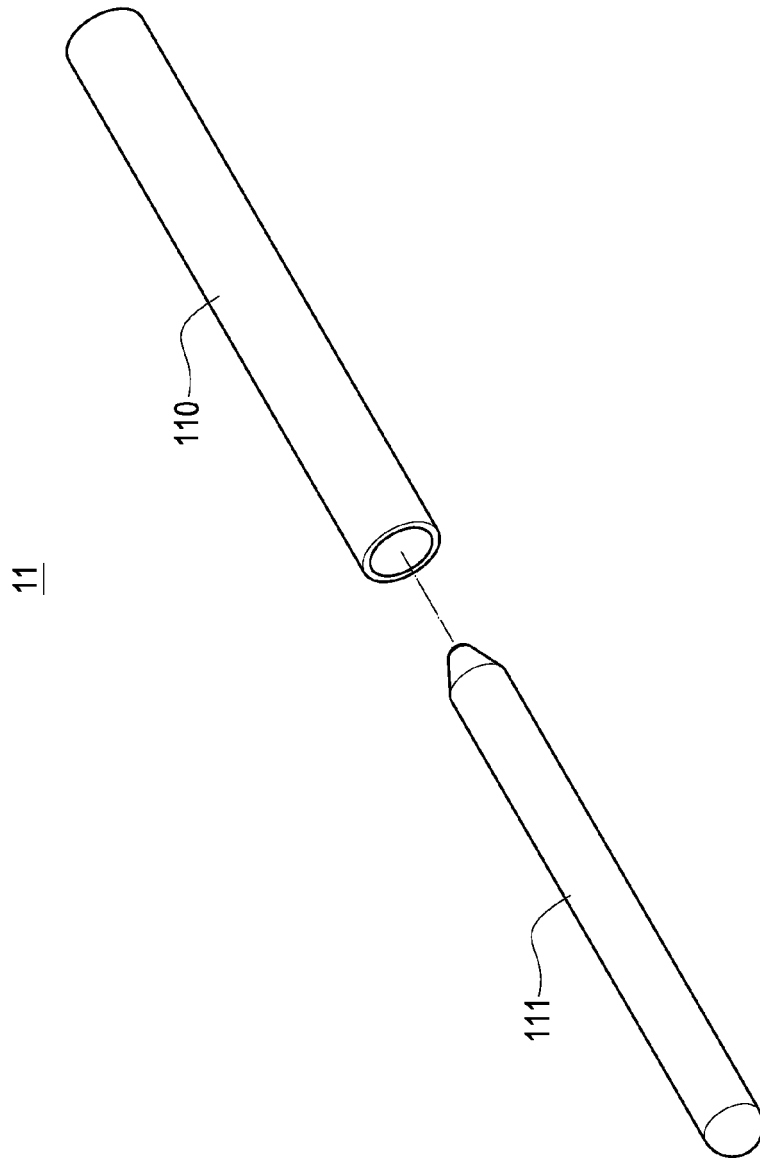


FIG.3

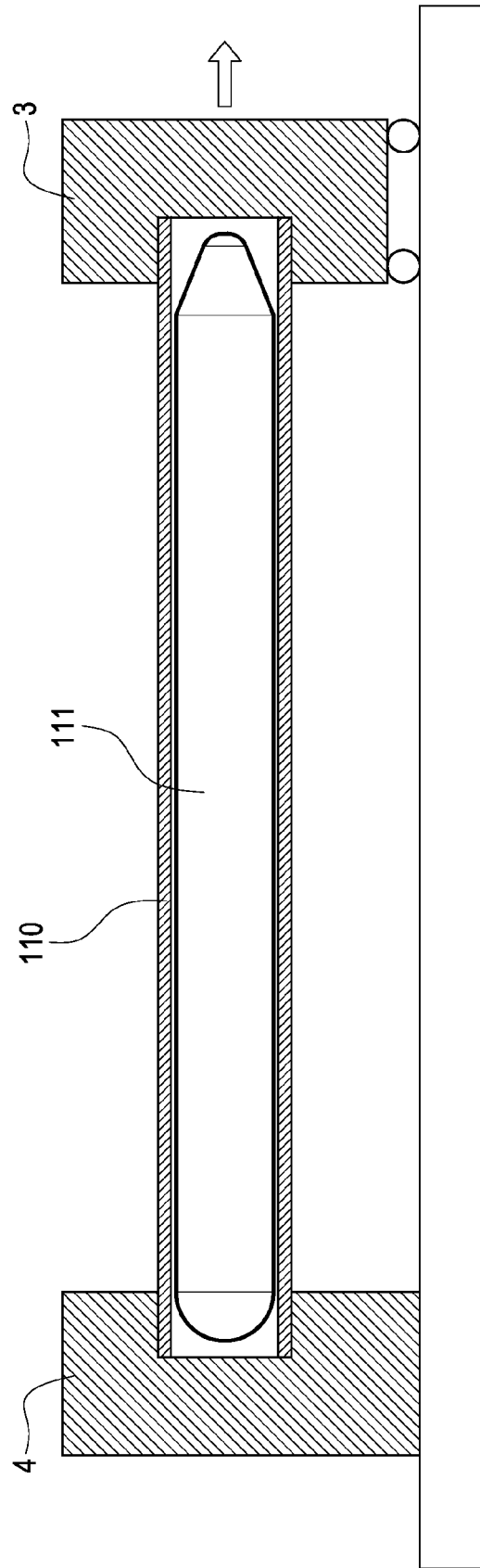


FIG.4

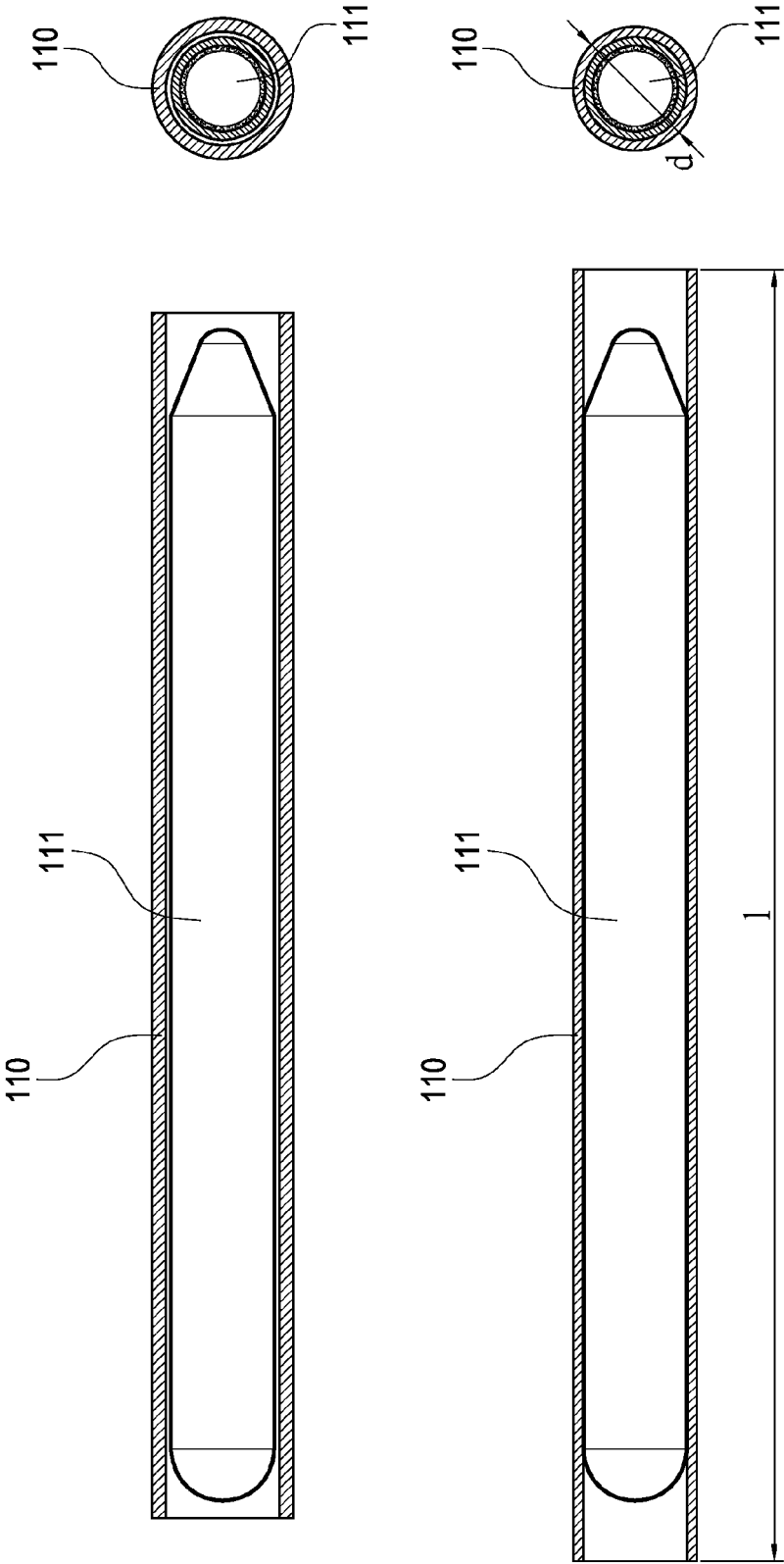


FIG.5

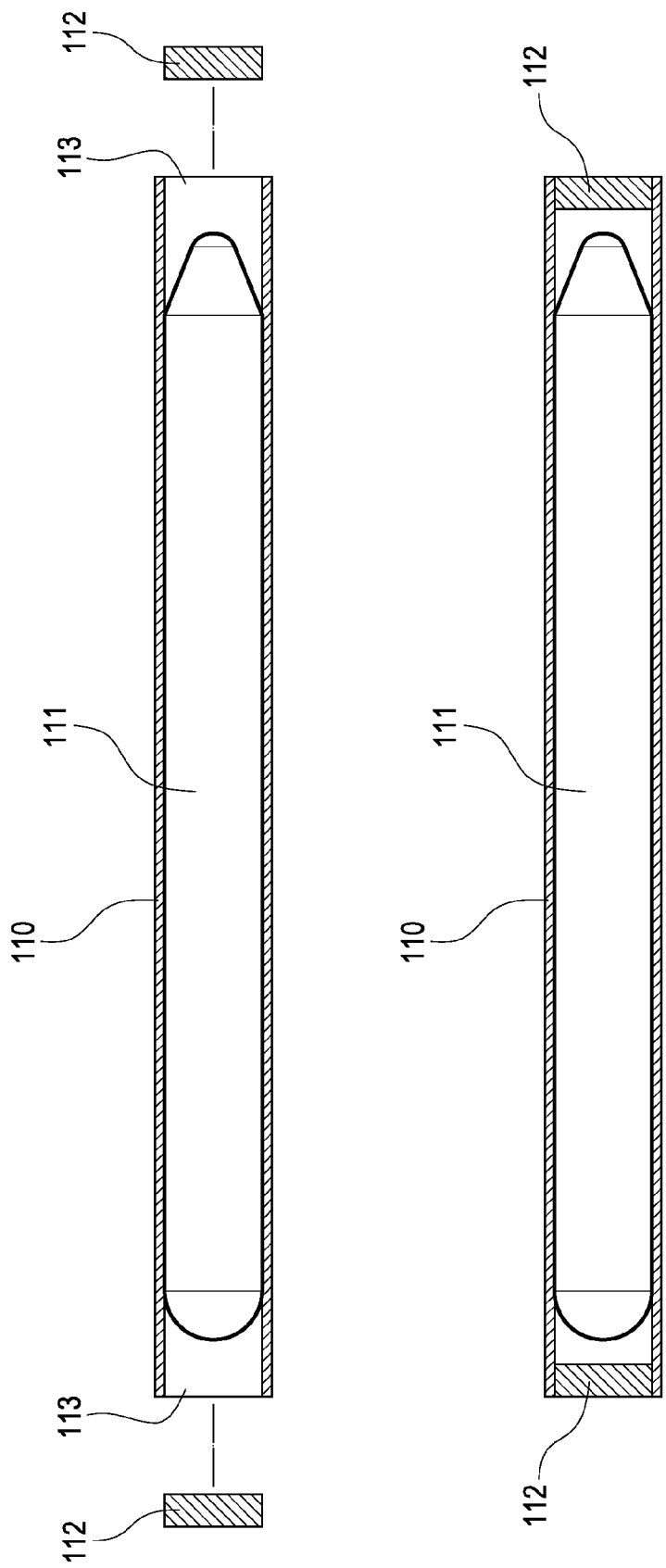


FIG.6

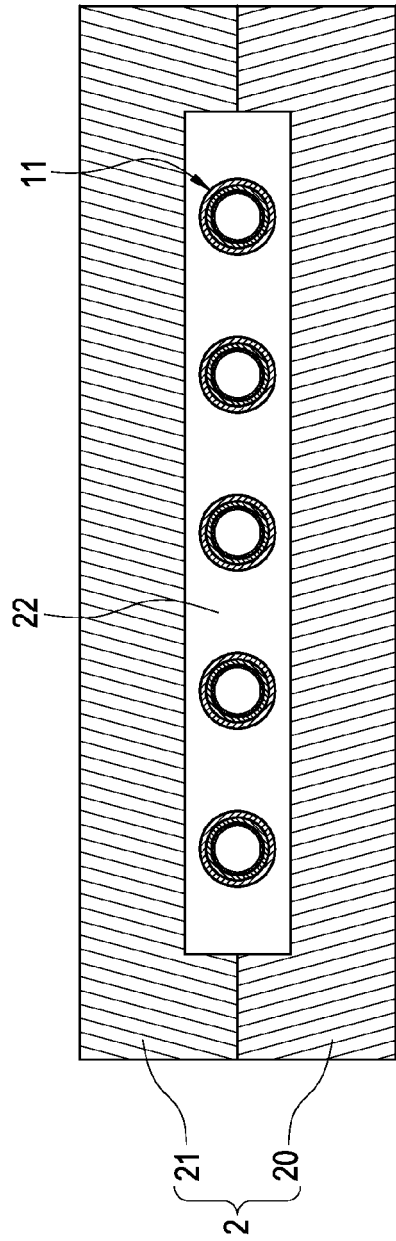


FIG. 7

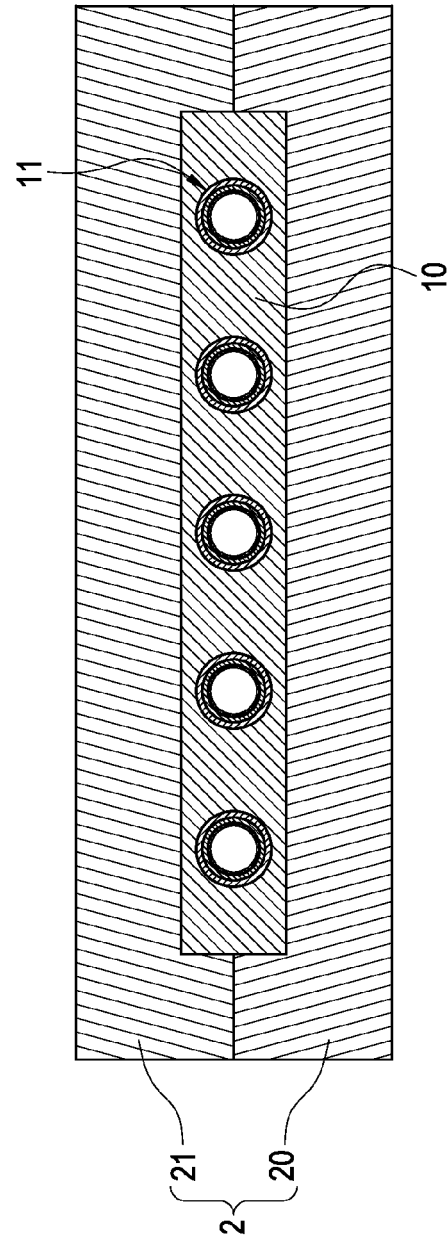


FIG. 8

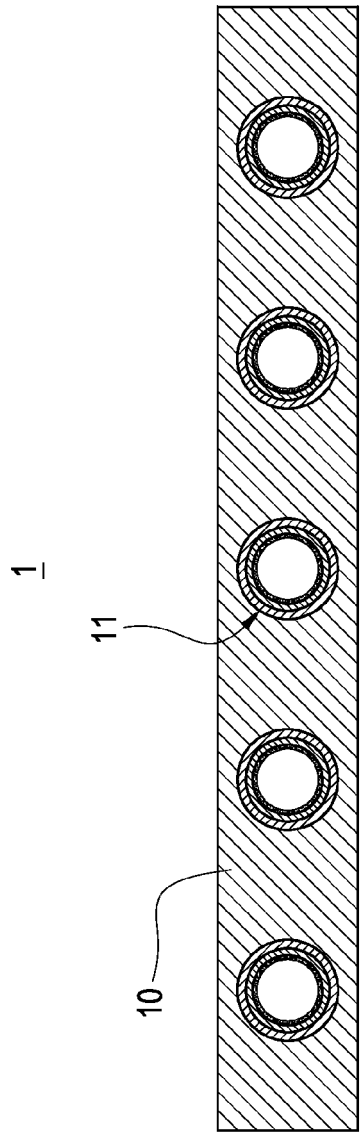


FIG.9



EUROPEAN SEARCH REPORT

Application Number
EP 12 15 1028

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2011/005727 A1 (YU YE-FEI [CN] ET AL) 13 January 2011 (2011-01-13) * abstract; claims *	1-11	INV. F28D15/02
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F28D
Place of search		Date of completion of the search	Examiner
The Hague		28 June 2012	Oliveira, Casimiro
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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28-06-2012

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