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(54) **HEAT PIPE**

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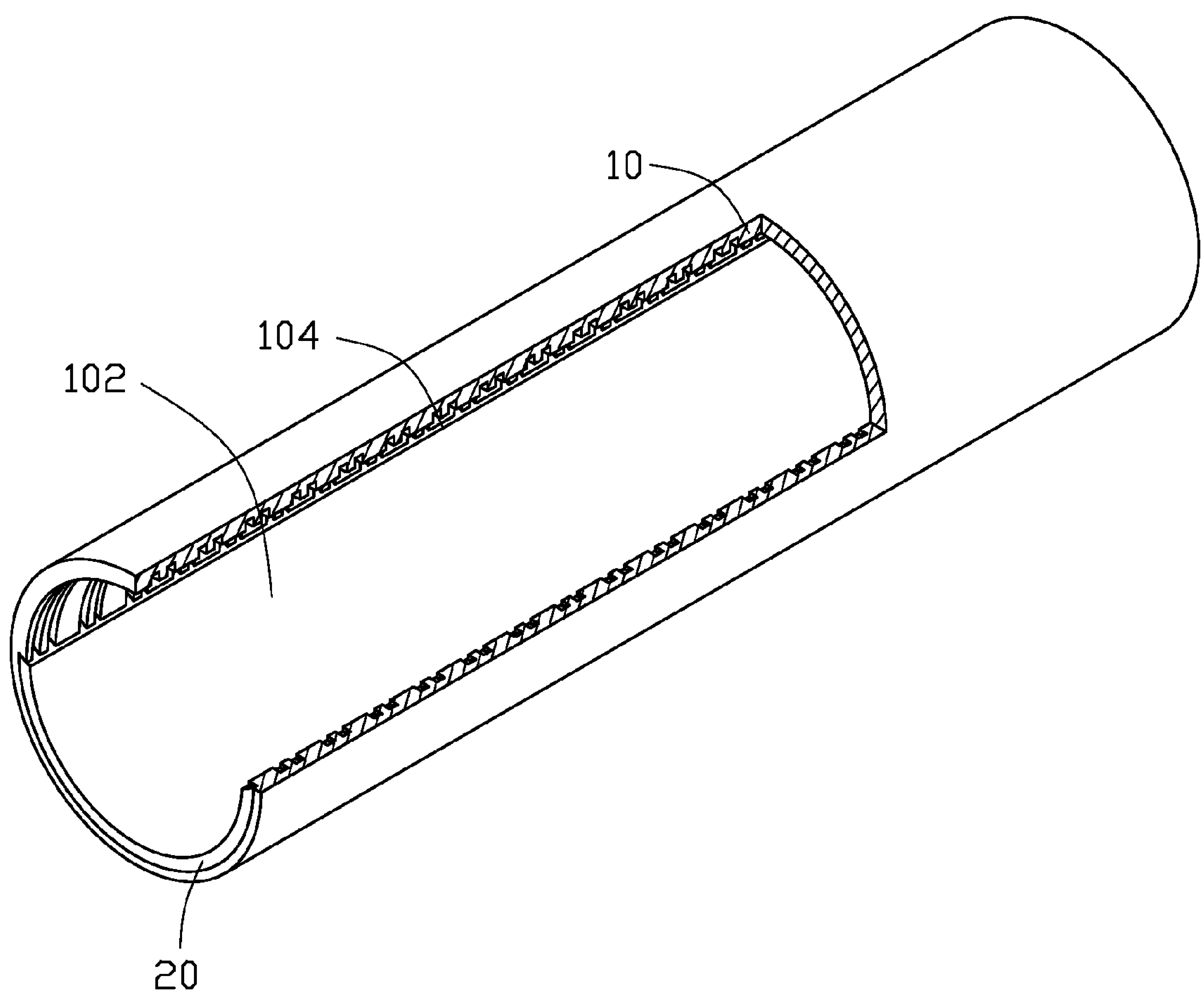
(57) **ABSTRACT**

A heat pipe includes a hollow metal casing and a wick structure arranged at an inner surface of the hollow metal casing. A part of the inner surface of the hollow metal casing is covered with the wick structure and other parts of the inner surface are uncovered with the wick structure.



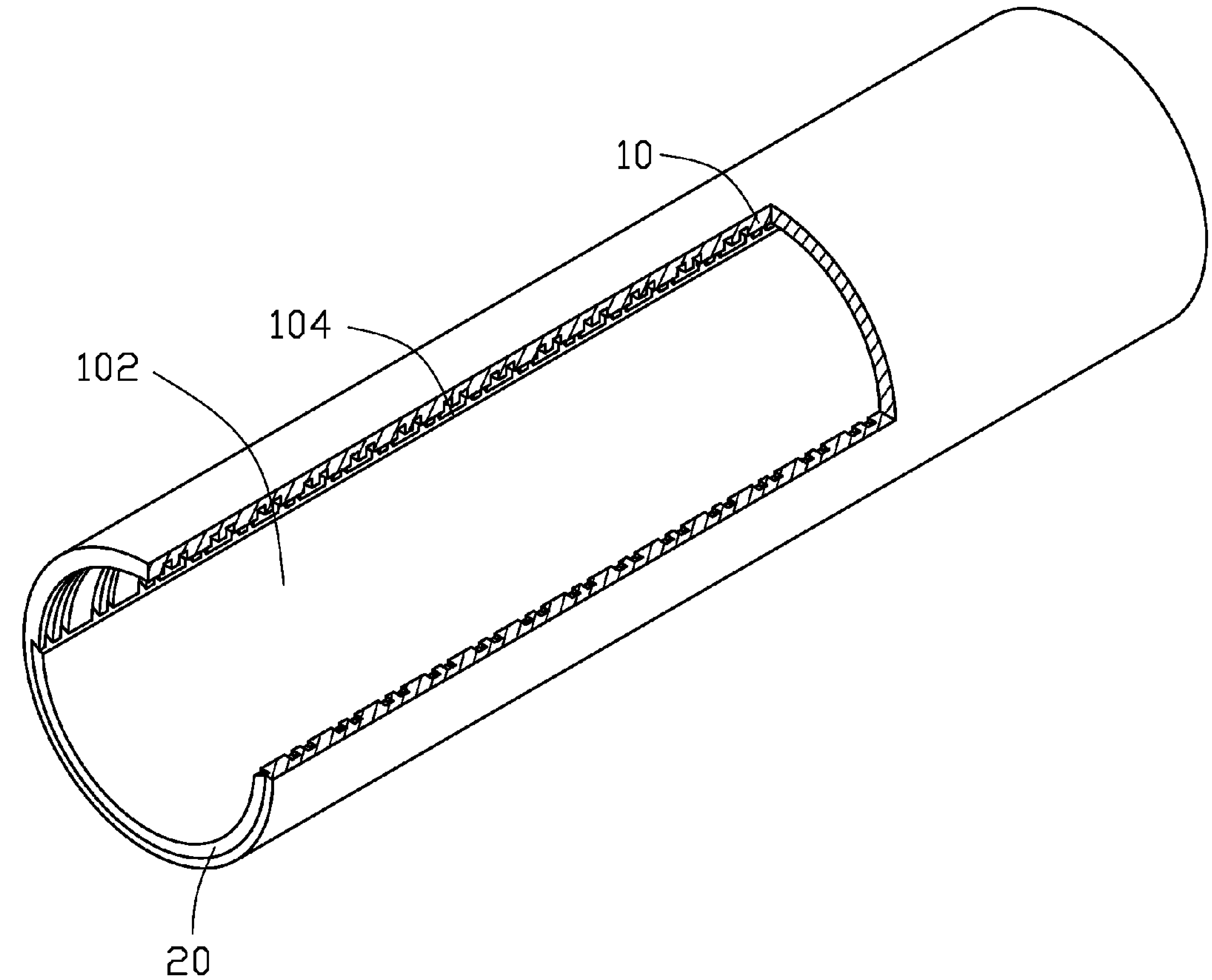


FIG. 1

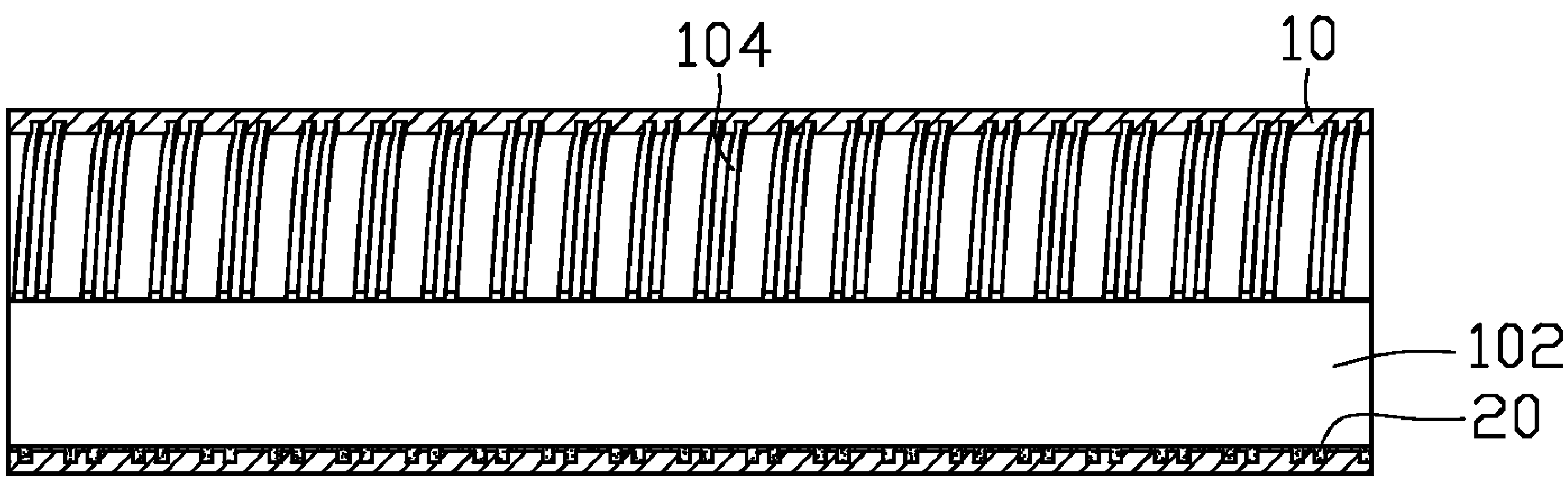


FIG. 2

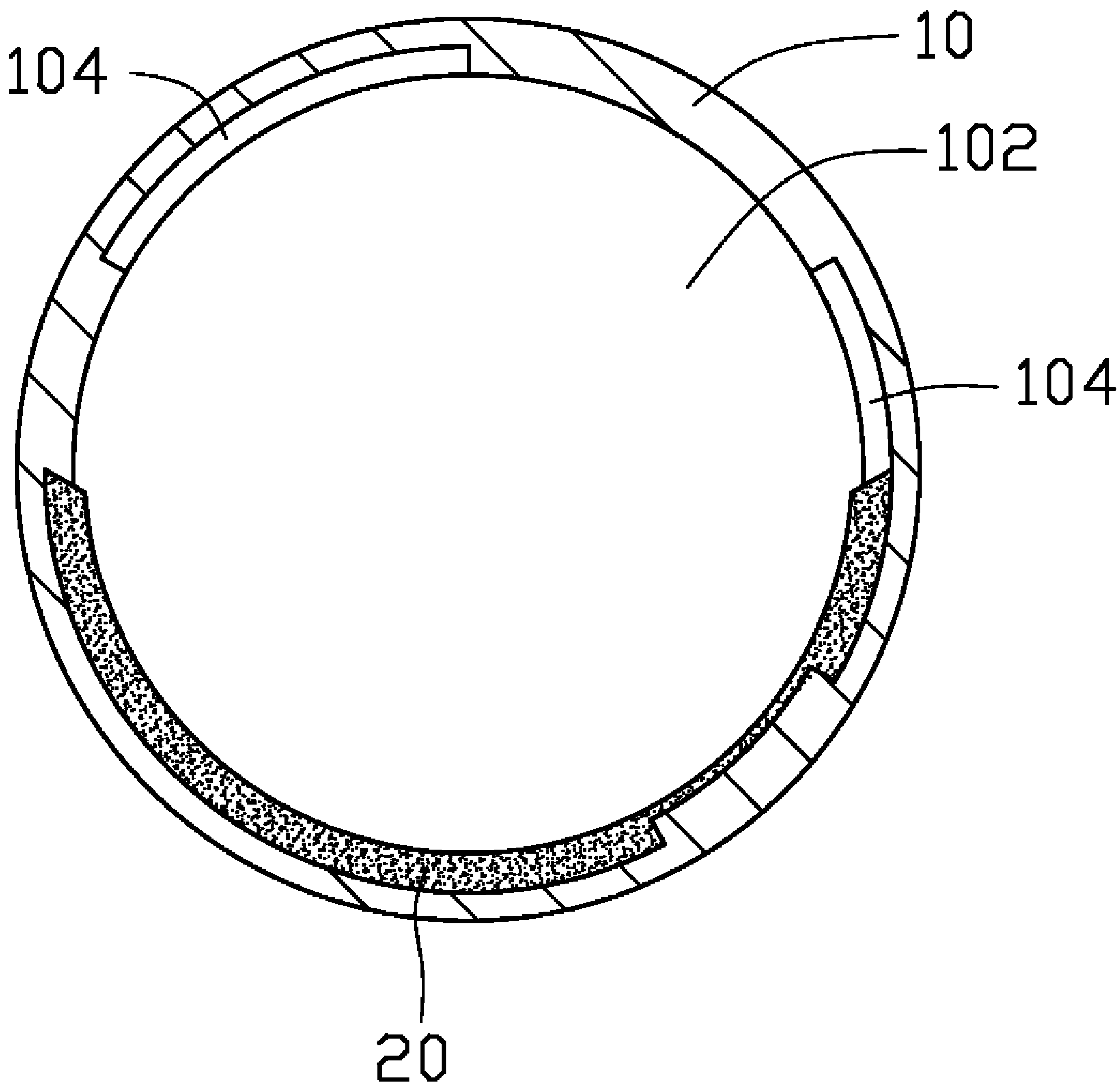


FIG. 3

HEAT PIPE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to an apparatus for transfer or dissipation heat from heat-generating components, and more particularly to a heat pipe having a unique wick structure.

[0003] 2. Description of Related Art

[0004] It is well known that a heat pipe is generally a vacuum-sealed pipe. A porous wick structure is provided on an inner face of the pipe, and the pipe is filled with at least a phase changeable working media employed to carry heat. Generally, according to positions from which heat is input or output, the heat pipe has two sections, an evaporating section and a condensing section.

[0005] In use, the heat pipe transfers heat from one place to another place mainly by virtue of phase change of the working media taking place therein. Generally, the working media is liquid such as alcohol, water and the like. When the working media in the evaporating section of the heat pipe is heated up, it evaporates, and a pressure difference is thus produced between the evaporating section and the condensing section in the heat pipe. As a result vapor with high enthalpy flows to the condensing section and condenses there. Then the condensed liquid reflows to the evaporating section along the wick structure. This evaporating/condensing cycle continues in the heat pipe; consequently, heat can be continuously transferred from the evaporating section to the condensing section. Due to the continual phase change of the working media, the evaporating section is kept at or near the same temperature as the condensing section of the heat pipe.

[0006] However, in the conventional heat pipe, the wick structure of the condensing section is the same as that of the evaporating section, which reduces the speed of the condensed liquid in returning back to the evaporating section and therefore limits the heat transfer performance of the heat pipe. As a result, the heat pipe often suffers from drying-out at the evaporating section as the condensed liquid cannot be timely sent back to the evaporating section of the heat pipe.

[0007] What is needed, therefore, is a heat pipe having a unique wick structure which can overcome the above-mentioned disadvantages.

SUMMARY OF THE INVENTION

[0008] A heat pipe is disclosed. The heat pipe includes a hollow metal casing and a wick structure layer arranged at an inner surface of the hollow metal casing. The wick structure layer is arranged on only part of the inner surface of the hollow metal casing and not arranged on other parts of the inner surface of the hollow metal casing.

[0009] Other advantages and novel features will become more apparent from the following detailed description of preferred embodiments when taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Many aspects of the present embodiments can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present embodiments. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0011] FIG. **1** is an isometric view of a heat pipe in accordance with a preferred embodiment of the present invention, wherein a casing of the heat pipe has a part being removed to clearly show an inner structure of the heat pipe.

[0012] FIG. **2** is a longitudinally cross-sectional view of the heat pipe of FIG. **1**.

[0013] FIG. **3** is a transversely cross-sectional view of the heat pipe of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

[0014] FIG. **1** illustrates a heat pipe in accordance with a preferred embodiment of the present invention. The heat pipe of the present embodiment is a straight cylindrical pipe, and only a part of the heat pipe is shown in FIG. **1**. The heat pipe includes a cylindrical sealed hollow metal casing **10** having an inner surface and a wick structure layer **20** arranged at the inner surface of the casing **10**. The wick structure layer **20** is saturated with a working fluid (not shown), which acts as a heat carrier for carry thermal energy from one end of the heat pipe toward the other end of the heat pipe when undergoing a phase transition from liquid state to vaporous state.

[0015] The casing **10** is typically made of highly thermally conductive materials such as copper or copper alloys. A sealed vacuum **102** is defined in the casing **10** along a lengthwise direction of the heat pipe. The vacuum **102** also functions as a vapor channel when the working fluid translates to vaporous state.

[0016] Please also referring to FIG. **2** and FIG. **3**, a plurality of spiral micro-channels **104** is defined in the inner surface of the casing **10**. The micro-channels **104** extend through the whole inner surface of the casing **10** from one end of the heat pipe to the other end of the heat pipe.

[0017] The wick structure layer **20** is only arranged at a part of the inner surface of the casing **10**. In this embodiment, the wick structure layer **20** is arranged at half of the inner surface of the casing **10** along a circumferential direction. Specifically, the wick structure layer **20** covers on a lower half circle inner surface of the casing **10**, yet an upper half circle inner surface of the casing **10** is not covered by the wick structure layer **20**. The wick structure layer **20** extends through the whole inner surface of the casing **10** along an axial direction. Understandably, the percentage of the wick structure layer **20** covers on the inner surface of the casing **10** along the circumferential direction can be different in different embodiments. The wick structure layer **20** of this embodiment is a sintered copper powder layer, and is sintered by inserting copper powders into the casing **10** after defining the micro-channels **104** in the inner surface of the casing **10**. Of course, the wick structure layer **20** can be other types in other embodiments, such as a plurality of metal slices stacked together with many pores defined therein. A maximum thickness of the wick structure layer **20**, i.e., the thickness of the wick structure layer **20** at the micro-channel **104** is larger than a depth of the micro-channel **104**. In other words, the wick structure layer **20** overflows on the micro-channel **104**. Therefore, a continuity of the wick structure layer **20** along the axial direction can be maintained and a working performance of the heat pipe can be enhanced.

[0018] In order to illuminate a working theory of the heat pipe more conveniently, a left end of the heat pipe in FIG. **2** is defined as an evaporating portion and a right end of the heat pipe in FIG. **2** is defined as a condensing portion. When the evaporating portion of the heat pipe contacts a heat generating element and heats up, heat is absorbed by the working fluid in the casing **10**. The working fluid translates from liquid state to vaporous state and a lot of vapors with high enthalpy flows in the vacuum **102** along the axial direction to the condensing portion and condenses there. Then the condensed liquid reflows to the evaporating portion along the wick structure layer **20** and the micro-channels **104**. This evaporating/condensing cycle continues in the heat pipe and heat can be continuously transferred from the evaporating portion to the condensing portion.

[0019] When the heat pipe is in use, a part of the heat pipe is near the heat generating element, and another part of the heat pipe is far away from the heat generating element. Please referring to FIG. **3** again, a lower portion of the casing **10**, i.e., the lower half circle inner surface is near the heat generating element. When the lower portion of the heat pipe contacts the heat generating element and heats up, heat is absorbed by the working fluid in the lower half circle inner surface of the casing **10**. The working fluid translates from liquid state to vaporous state and a lot of vapors with high enthalpy flows in the vacuum **102** along a radial direction to the upper half circle inner surface of the casing **10** and condenses there. Then the condensed liquid reflows to the lower half circle inner surface of the casing **10** along the micro-channels **104**. That is to say, another evaporating portion is defined at the lower half circle inner surface of the casing **10**, and another condensing portion is defined at the upper half circle inner surface of the casing **10**. A dual evaporating/condensing cycle is defined in the heat pipe. Thus, heat transferring speed can be much higher and the working performance of the heat pipe can be enhanced.

[0020] More importantly, due to the upper half circle inner surface of the casing **10** uncovered with the wick structure layer **20**, when exchanging the heat with the upper half circle inner surface of the casing **10**, the vapors have not to pass through the wick structure layer **20**. Thus, a heat exchanging resistance is reduced between the vapors and the inner surface of the casing **10**. Furthermore, the condensed liquid at the upper half circle inner surface of the casing **10** can reflow to the lower half circle inner surface of the casing **10** more quickly without the resistance of the wick structure layer **20**. Therefore, a drying-out phenomenon at the lower half circle inner surface of the casing **10** can be avoided and the heat transferring performance of the heat pipe can be enhanced.

[0021] The heat pipe of the present embodiment is a straight cylindrical pipe. Understandably, the heat pipe can be other configurations such as, not limited, U-shaped or S-shaped, and a part of the heat pipe or the whole heat pipe can be flattened.

[0022] It is believed that the present embodiments and their advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the examples hereinbefore described merely being preferred or exemplary embodiments of the invention.

What is claimed is:

1. A heat pipe comprising:

a hollow metal casing; and

a wick structure layer arranged at an inner surface of the hollow metal casing, wherein a part of the inner surface of the hollow metal casing is covered with the wick structure, and other parts of the inner surface of the hollow metal casing uncovered with the wick structure.

2. The heat pipe as claimed in claim **1**, wherein the hollow metal casing is a cylindrical pipe, and the wick structure is arranged on part of the inner surface of the hollow metal casing along a circumferential direction.

3. The heat pipe as claimed in claim **2**, wherein the wick structure is arranged on half of the inner surface of the hollow metal casing along a circumferential direction.

4. The heat pipe as claimed in claim **2**, wherein the wick structure is continuously arranged on the inner surface of the hollow metal casing along an axial direction.

5. The heat pipe as claimed in claim **1**, wherein the wick structure is a sintered copper powder layer.

6. The heat pipe as claimed in claim **1**, wherein a plurality of spiral micro-channels is defined in the inner surface of the hollow metal casing.

7. The heat pipe as claimed in claim **6**, wherein the wick structure covers on the micro-channels and a maximum thickness of the wick structure is larger than a depth of the micro-channels.

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