A support structure of a heat-pipe multi-layer wick structure, having a hollow heat-pipe tube and multiple separate layers of weaving mesh wick structure overlaying on an interior surface of the heat-pipe tube. The wick structure has a curly circular shape. The outermost layer of the wick structure has finer mesh compared to the inner layers of thereof. Thereby, the capillary force of the heat pipe is enhanced, while the coarse mesh at the inner layers provide better support to the outer layers of the wick structure.
SUPPORT STRUCTURE OF HEAT-PIPE MULTI-LAYER WICK STRUCTURE

BACKGROUND OF THE INVENTION

[0001] The present invention relates in general to a support structure of a heat-pipe multi-layer wick structure, and more particularly, to a support structure allowing the multi-layer wick structure to be set on an interior surface of the heat pipe.

[0002] The heat pipe has been applied in various types of electronic products for delivering large amount of heat without consuming significant power because of the characteristics of high thermal transmission capacity, high thermal transmission speed, high thermal conduction efficiency, lightweight, small mobile element, simple structure and versatile applications. The conventional heat pipe includes a wick structure attached to an interior surface of a heat-pipe body. The wick structure includes weaving mesh that has capillary effect, such that a working fluid filled in the heat-pipe body can be used to deliver heat. To improve the capillary force and the amount of heat to be transferred by the wick structure, multi-layer structure has been adopted in the heat pipe.

[0003] FIG. 1 shows a conventional weaving mesh of a wick structure 1a which is curved into a multi-layer structure. When the curved wick structure 1a is inserted into the heat pipe body 2a, a sintering process is required to attach the curved wick structure 1a to the internal surface of the heat pipe body 2a. However, as the weaving mesh of the wick structure 1a is typically too soft to support itself. The multi-layer portion A formed by curling process makes the attachment worse. As there provides no additional support structure, the wick structure 1a is easily softened and collapsed due to the heat generated in the high-temperature sintering process.

BRIEF SUMMARY OF THE INVENTION

[0004] To resolve the above drawbacks, a support structure of a multi-layer wick structure of a heat pipe is provided. By shrinking the tubular member of the heat pipe, the weaving meshes of each layer of the wick structure can be attached to an interior surface of the tubular member. Further, the finer portion of the wick structure is arranged as the outermost layer to provide enhanced capillary force of the working fluid, while the coarser portion of the wick structure is arranged in the inner layers to provide better attaching effect to the interior surface of the tubular member.

[0005] Accordingly, the support structure of the multi-layer wick structure of a heat pipe includes a hollow heat-pipe tube and multiple separate layers of weaving mesh wick structure overlaying on an interior surface of the heat-pipe tube. The wick structure has a curly circular shape. The outermost layer of the wick structure has finer mesh compared to the inner layers of thereof. Thereby, the capillary force of the heat pipe is enhanced, while the coarse mesh at the inner layers provide better support of the outer layers of the wick structure.

[0006] The objectives of the present invention will become obvious to those of ordinary skill in the art after reading the following detailed description of preferred embodiments.

[0007] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The above objects and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0009] FIG. 1 shows an a cross sectional view of a conventional heat pipe;

[0010] FIG. 2 shows the process of winding a multi-layer wick structure;

[0011] FIG. 3 shows the open circular profile of the winded multi-layer wick structure;

[0012] FIG. 4 shows the process for inserting the wick structure into a tubular member of a heat pipe;

[0013] FIG. 5 shows the cross sectional view of the heat pipe before the tubular member is shrunk; and

[0014] FIG. 6 shows the cross sectional view of the end-product of the heat pipe.

DETAILED DESCRIPTION OF THE INVENTION

[0015] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

[0016] Referring to FIGS. 2-6, a support structure of a multi-layer wick structure of a heat pipe is provided. The wick structure is attached to the interior surface of a tubular member by a shrinking process performed to the tubular member.

[0017] As shown in FIGS. 2 and 3, the wick structure has an outer layer and an inner layer of weaving meshes 1 and 1' overlying each other. As shown in FIGS. 2 and 3, the wick structure is wound into an open circle with the layer of weaving mesh 1 encircling the layer of weaving mesh 1'. Therefore, the outer layer 1 is preferably longer than the inner layer 1'.

[0018] As shown in FIG. 4, a tubular member 2 is provided. Preferably, the tubular member 2 has an internal diameter no less than the external diameter of the open circle formed of the layers of weaving meshes 1 and 1', such that the layers of weaving meshes 1 and 1' can be easily inserted into the tubular member 2. A cross sectional view of the tubular member 2 and the wick structure formed of the wound layers of weaving meshes 1 and 1' is shown in FIG. 5.

[0019] In FIG. 6, a shrinking process is performed to the tubular member 2. As shown, an external force is applied to press the tubular member 2 inwardly. Thereby, the diameter of the tubular member 2 is reduced, and the open circle made by the layers of weaving meshes 1 and 1' is closed and firmly attached to the interior surface of the tubular member as
shown. Thereby, a sintering process is not required for attaching the wick structure to the tubular member 2, such that the wick structure will not be peeled from the tubular member in the subsequent annealing process.

[0020] Preferably, the outer layer 1 of the wick structure has a weaving mesh finer than that of the inner layer 1'. The finer weaving mesh provides better capillary force to the working fluid filled in the tubular member 2, while the coarser weaving mesh provides better support effect of the wick structure. Therefore, during the high-temperature annealing process, the coarser weaving mesh of the inner layer 1' can provide sufficient support to the finer weaving mesh of the outer layer 1 so that the finer weaving mesh of the outer layer 1 is not easily softened and peeled from the interior surface of the tubular member 2.

[0021] Both the layers 1 and 1' are made of weaving meshes each having longitudinal wires extending along an axis of the tubular member 2 and transverse wires extending about the axis. In one embodiment, the longitudinal and transverse wires can be made of materials having different melting points. For example, the longitudinal wires can be made of bronze, while the transverse wires can be made of oxygen-free copper and vice versa. Moreover, the higher-melting-point longitudinal/transverse wires can have the melting point higher than the temperature of the annealing process, and the lower-melting-point transverse/longitudinal wires can have the melting point lower than the temperature of the annealing process. Thereby, when the wires having lower melting point are melted to attach on the interior surface of the tubular member in the annealing process, the wires having the higher melting point will not be melted and can provide support of the others.

[0022] By the above process, the wick structure does not need to be curled into a close circle before being inserted into the tubular member 2. The insertion is thus easier. By the shrinking process of the tubular member 2, the wick structure can be easily attached to the interior surface thereof. Further, as the outer layer 1 has a finer mesh compared to that of the inner layer 1', the capillary force of the heat pipe is enhanced, while the coarse mesh at the inner layers 1' provides better support to the outer layers of the wick structure.

[0023] While the present invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those of ordinary skill in the art that the various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the appended claims.

1-4. (canceled)

5. A heat pipe, comprising:

a tubular member;

a wick structure, comprising multiple layers of weaving meshes, wherein an outermost weaving mesh of the wick structure is directly attached to an interior surface of the tubular member, and the outermost weaving mesh is finer than the other weaving mesh here the outermost weaving mesh and the other weaving meshes each has a plurality of longitudinal extending along an axis of the tubular member and a plurality of transverse wires extending about the axis and the longitudinal wires and the transverse wires are fabricated from materials having different melting points; and

wherein before an external force is applied, the inserted first weaving mesh and the second weaving mesh would form two open circles and after the external force is applied, the diameter of the tubular member will be reduced to a predetermined size where both open-circles become enclosed.

6. The heat pipe of claim 5, further comprising a working fluid filled in the tubular member.

7. (canceled)

8. (canceled)

9. The heat pipe of claim 5, wherein one of the melting points is lower than an operation temperature of an annealing process, and the other of the melting points is higher than the operation temperature.

10. A support structure of a multi-layer wick structure attached to a tubular member fabricated by the steps of:

overlying a first weaving mesh and a second weaving mesh, wherein the first weaving mesh is finer than the second weaving mesh;

winding the first and the second weaving meshes into an open circular wick structure with the first weaving mesh encircling the second weaving mesh;

inserting the open circular wick structure into the tubular member;

shrinking the diameter of the tubular member to press the open circular wick structure into a close circular wick structure; and

melting the first weaving mesh to firmly attach on an interior surface of the tubular member by an annealing process.

11. A support structure of a multi-layer wick structure attached to a tubular member of a heat pipe, comprising:

a first weaving mesh which is sandwiched between a second weaving mesh and an interior surface of the tubular member, wherein the wires of the first weaving mesh is finer than the wires of the second weaving mesh, and the first and the second weaving meshes comprise a plurality of longitudinal wires extending along an axis of the tubular member and a plurality of transverse wires extending about the axis and the longitudinal wires and the transverse wires are fabricated from materials having different melting points; and

wherein before an external force is applied, the inserted first weaving mesh and the second weaving mesh would form two open circles and after the external force is applied, the diameter of the tubular member will be reduced to a predetermined size where both open-circles become enclosed.

12. The structure of claim 11, wherein one of the melting points is lower than an operation temperature of an annealing process, and the other of the melting points is higher than the operation temperature.

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