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(54) **COMPRESSED MESH WICK, METHOD FOR
MANUFACTURING SAME, AND PLATE
TYPE HEAT PIPE INCLUDING
COMPRESSED MESH WICK**

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(76) Inventors: **Masaaki Yamamoto**, Tokyo (JP);
Tatsuhiko Ueki, Tokyo (JP); **Masami
Ikeda**, Tokyo (JP)

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(57) **ABSTRACT**

A compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing the bent layered mesh body.

Correspondence Address:

**KNOBBE MARTENS OLSON & BEAR LLP
620 NEWPORT CENTER DRIVE
SIXTEENTH FLOOR
NEWPORT BEACH, CA 92660 (US)**

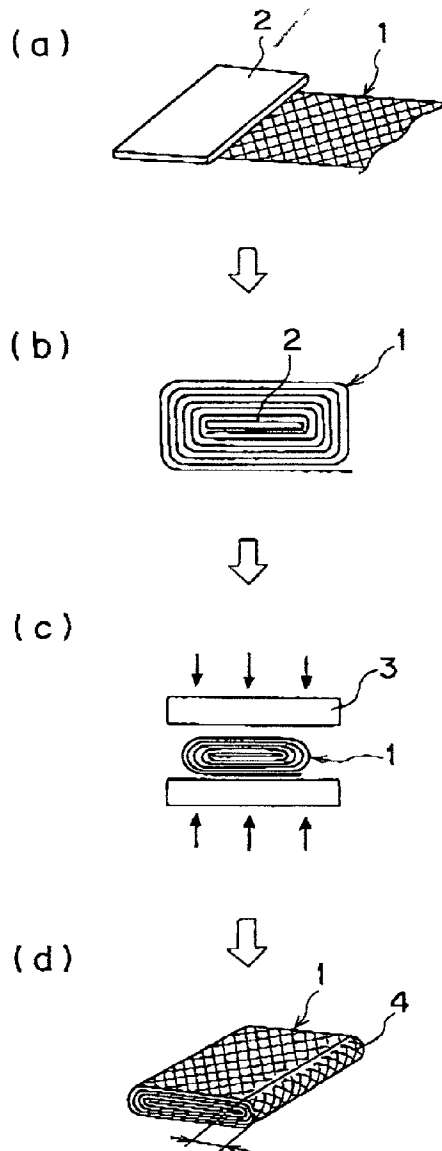


FIG. 1

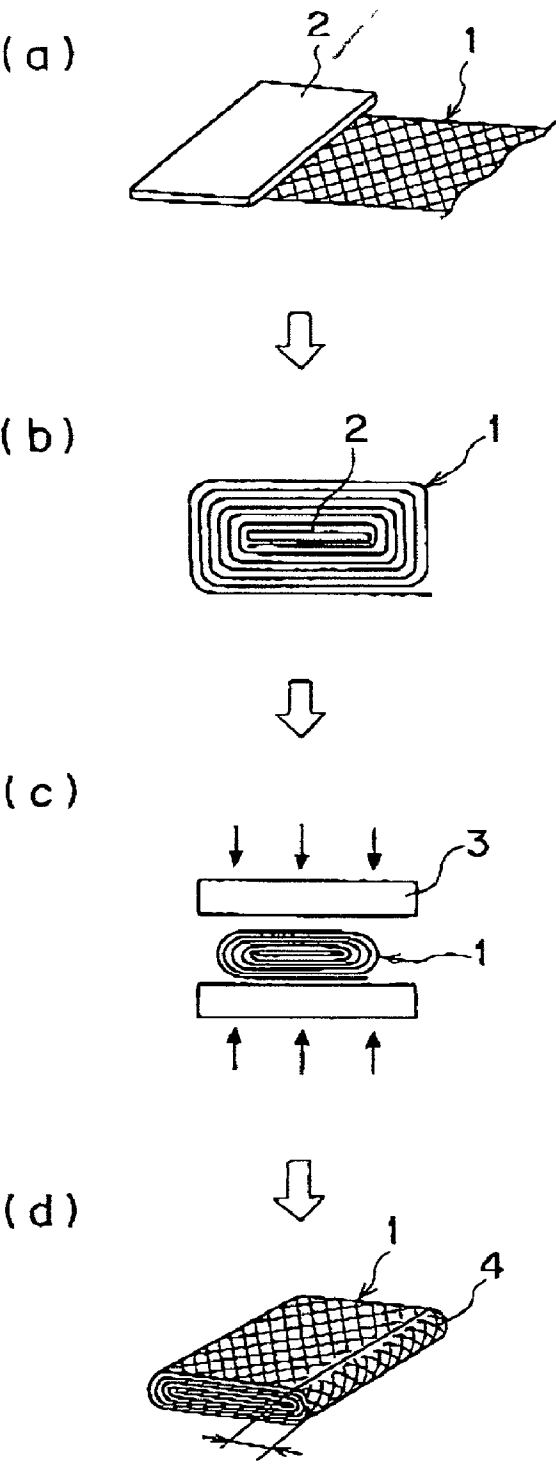


FIG. 2(A)

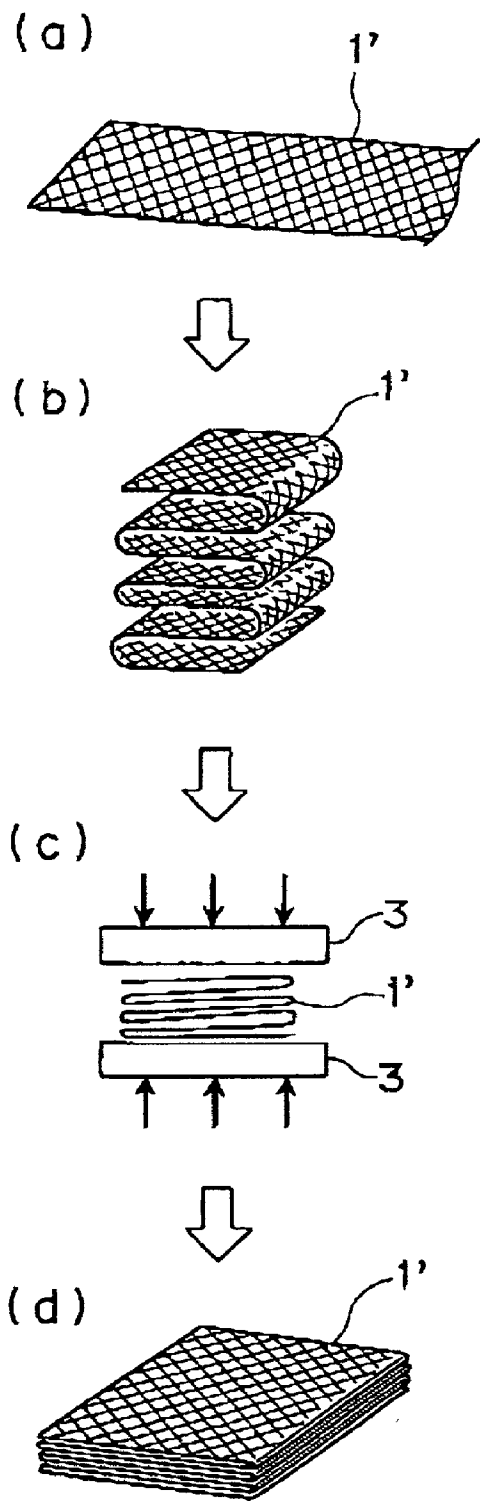


FIG. 2(B)

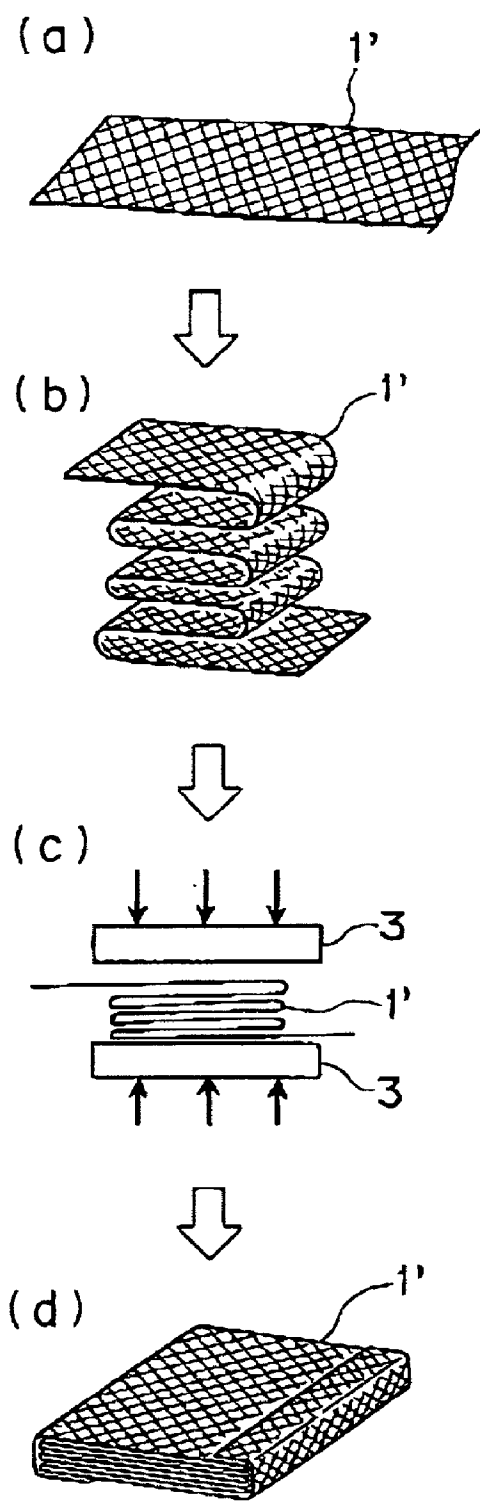


FIG. 3

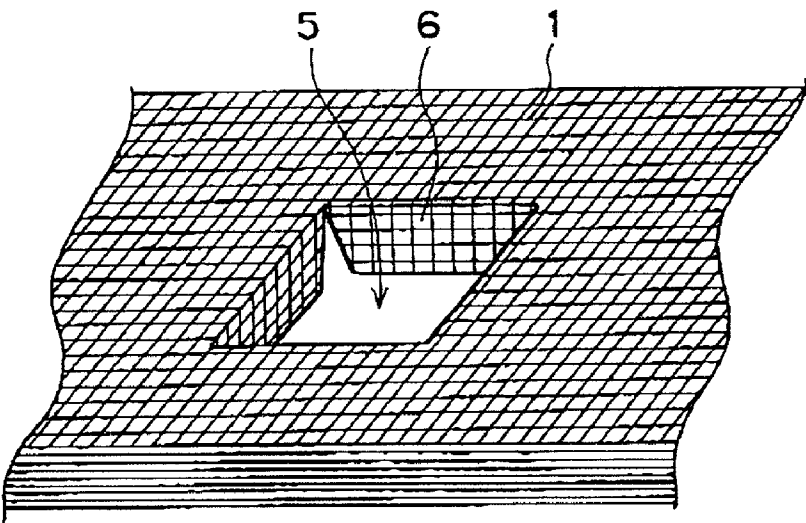


FIG. 4

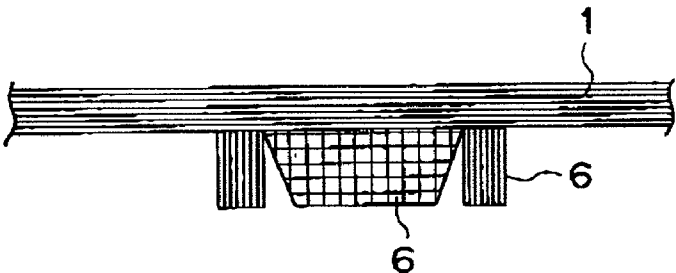


FIG. 5

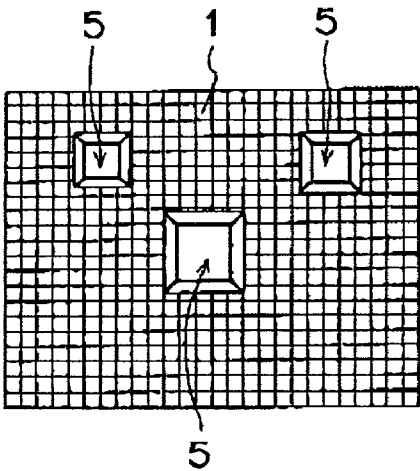


FIG. 6

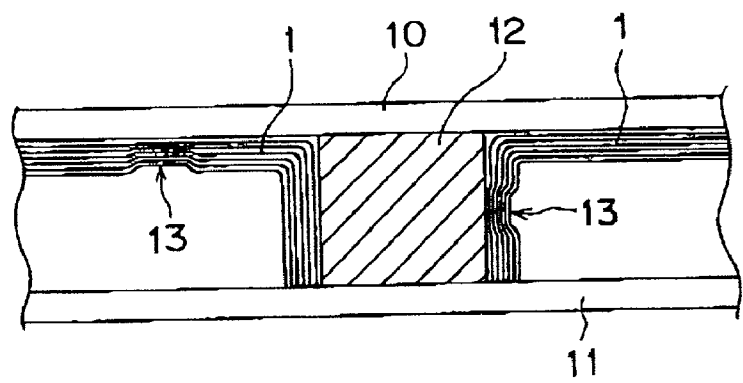


FIG. 7

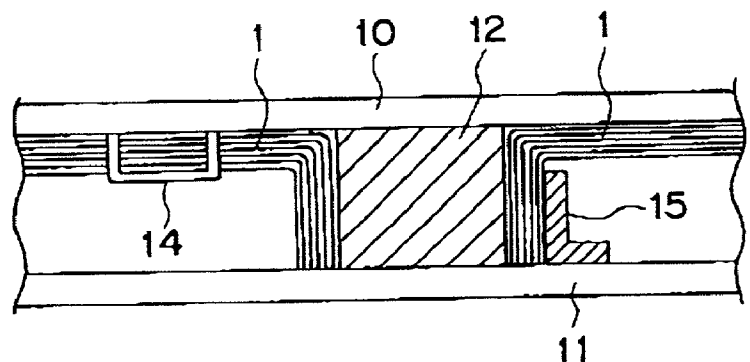
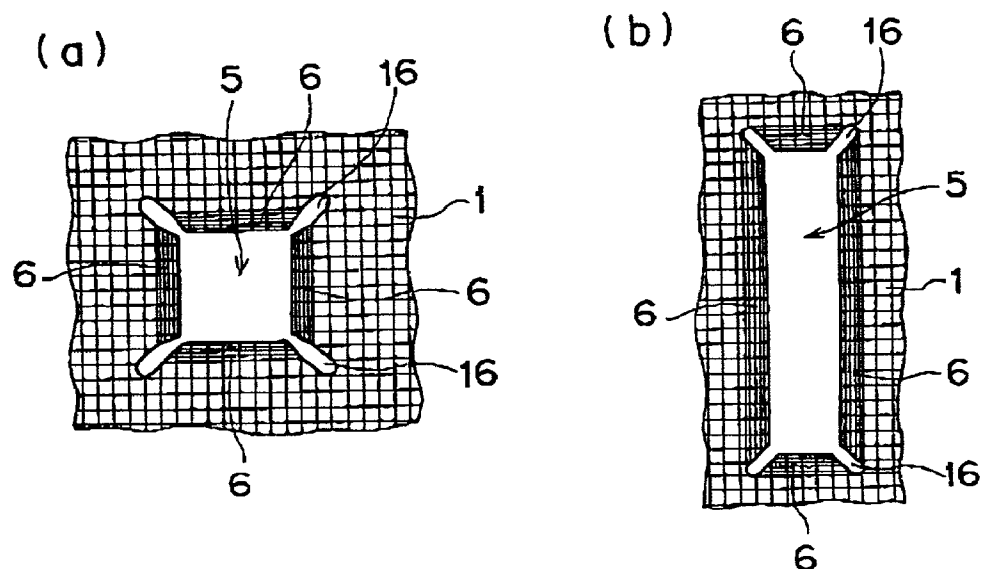


FIG. 8



**COMPRESSED MESH WICK, METHOD FOR
MANUFACTURING SAME, AND PLATE TYPE
HEAT PIPE INCLUDING COMPRESSED MESH
WICK**

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a plate type heat pipe for cooling various electronic components such as semiconductor chips or the like, a mesh wick used for a plate type heat pipe, and in particular, relates to a mesh wick comprising multiple mesh wire sheets, a method for manufacturing same, and a plate type heat pipe using same in which the container is light weighted, is not deformed by a vapor pressure of a working fluid, and has a low heat transfer resistance.

[0003] 2. Description of the Related Art

[0004] Electric or electronic parts such as semiconductor chips or the like generate heat to some extent, when used, which are mounted on various devices such as personal computers and electric or electronic devices such as power equipment. The function of the electric or electronic parts deteriorates and the life time thereof is shortened, when the electric or electronic parts are excessively heated. Lately, the electronic devices represented by the personal computer or the like are remarkably downsized, and the development of the method for cooling the electric or electronic parts mounted in the electric devices becomes an important technical issue.

[0005] There is provided an air cooling type cooling method as one of the method of cooling electric or electronic elements which is to be cooled (hereinafter referred to as the "part to be cooled"). More specifically, in the air cooling type cooling method, a fan or the like is installed in the box accommodating the electric devices on which the parts to be cooled are mounted, and the inside of the box is cooled by the fan or the like so as to prevent the temperature of the parts to be cooled from being excessively risen. The above-mentioned cooling method is particularly effective to cool the relatively large-sized electric devices.

[0006] In addition to the above-mentioned air cooling type cooling method, there is another widely used cooling method in which a heat sink or fin or the like is connected to the parts to be cooled. In the cooling method, the heat of the parts to be cooled is dissipated through the heat sink. In addition, there is a cooling system in which a heat pipe is installed between the parts to be cooled and the heat sink or fin to improve effectiveness of the heat dissipation. Furthermore, there is developed a technique to attain further improved cooling efficiency in which air is blown to the heat sink, fin or the like by an electrically driven fan.

[0007] Then, a heat pipe is explained hereunder. Heat pipe includes a container having a hermetically sealed hollow portion, i.e., cavity therein. Heat is transferred by means of phase transition and movement of a working fluid received within the hollow portion. Although a part of the heat is transferred through the material per se forming the container by means of heat conduction, the heat transfer by means of the heat conduction is relatively small in comparison with the heat transfer by means of phase transition and movement of the working fluid.

[0008] Then, the operation of the heat pipe is briefly described. A round bar type heat pipe is explained as an example. A heat generating component (i. e., part to be cooled) is connected to the vicinity of one end portion of the heat pipe, and a fin is attached to the vicinity of the other end portion of the heat pipe. In the portion of the heat pipe to which the heat generating component is connected (hereinafter referred to as a "heat absorbing side or heat absorbing portion"), a working fluid is vaporized by the heat transferred through the material of the container from the heat generating component, and the vaporized working fluid moves toward the portion to which the fin is attached (hereinafter referred to as a "heat dissipating side or heat dissipating portion"). The vaporized working fluid is condensed and returns to the liquid phase in the heat dissipating side. Then the heat accompanied with the condensation is dissipated from the hollow portion toward outside by means of the fin. Thus, the heat is transferred from the heat absorbing side to the heat dissipating side.

[0009] In order to cause the above-mentioned heat transfer to be continuously effected, the working fluid returned to the liquid phase in the heat dissipating side is required to be circulated back to the heat absorbing side. In case of the heat pipe using gravity to circulate the working fluid, the heat absorbing side is positioned to be lower than the heat dissipating side, thus the heat pipe effectively functions (this type is called as a "bottom heat mode"). In this case, the working fluid returned to the liquid phase in the heat dissipating side by phase transition is circulated back to the heat absorbing side by the function of gravity. However, when the heat absorbing side is positioned above the heat dissipating side (this type is called as a "top heat mode"), the working fluid is not effectively circulated back to the heat absorbing side, thus the so-called dry out phenomenon often occurs.

[0010] There is a round pipe type heat pipe which is widely used. Recently, a plate type heat pipe comes to attract attention. The plate type heat pipe may be called as a flat type heat pipe, a flat plate type heat pipe or the like. The plate type heat pipe has such a superior feature that the parts to be cooled can be effectively cooled, since the parts to be cooled can be contacted with the container in wide area depending on the shape of the container.

[0011] As described above, the plate type heat pipe has the superior feature in which the parts to be cooled is contacted in wide area with the heat absorbing surface of the container. In order to secure the flows of the working fluid from the heat dissipating portion to the heat absorbing portion, i.e., flowing back of the working fluid in the plate type heat pipe having the above-mentioned feature, it is preferable to use the heat pipe in so-called bottom heat mode (namely, the mode in which the heat pipe is used with the heat absorbing portion positioned below the heat dissipating portion).

[0012] Accordingly, the heat pipe is preferably installed in such manner that the plate type heat pipe is placed with the heat absorbing surface faced downward, and then, the parts to be cooled is contacted with the heat absorbing surface of thus placed heat pipe, and then, the heat sink is provided on the heat dissipating surface which is positioned upper side of the heat pipe. The above-mentioned installation of the heat pipe in relation to the parts to be cooled is the most ideal installation. According to the above installation, the lower

side of the plate type heat pipe becomes the heat absorbing surface, and the upper side of the plate type heat pipe on which the heat sink is provided becomes the heat dissipating surface, thus the plate type heat pipe of the so-called bottom heat mode is obtained.

[0013] However, the size of the computer or the like becomes remarkably smaller. Together with the downsizing of the computer or the like, the electric or electronic devices mounting the parts to be cooled is installed not only in a fixed manner (for example, is placed on the desk), but also in a mobile manner (for example, is carried by human being). More specifically, the portable type of electric or electronic apparatus is widely used. In particular, it is considered that the small sized computer is to be used under the condition in which the heat pipe is kept inclined. In view of the above situation, it is expected to be provided the plate type heat pipe excellent in cooling efficiency even in case that the heat absorbing surface is positioned above the heat dissipating surface, i.e., the relative vertical position of the heat absorbing surface to the heat dissipating surface is reversed (which is called as the so-called "top heat mode").

[0014] Furthermore, as described above, a wick is installed within the container in order to circulate the working fluid which returns to a liquid phase in the heat dissipating side back to the heat absorbing side. The working fluid is swiftly circulated back to the heat absorbing side by the capillary action of the wick.

[0015] A mesh type wick is used in the plate type heat pipe because of the relative shape of the mesh wick and the heat pipe. In order to improve the capillary action of the wick, a wick formed by placing plurality of mesh type wicks in layers is used. However, the above-mentioned wick has the following problem. More specifically, since the mesh per se has no rigid body, it is difficult to fix the mesh wick placed in layers in both lengthwise and widthwise directions. As a result, it is difficult to have the mesh wick contacted with the specific inner wall of the container, thus the mesh wick contacts with the various inner walls so as to deteriorate the function of the heat pipe.

[0016] Furthermore, the mesh wick placed in layers has gaps (i.e., space) between mesh wick layers in the width direction. When the gaps exist in the width direction of the mesh wick placed in layers, the capillary power is lowered so as to cause the heat resistance to rise, thus deteriorating the function of the heat pipe.

[0017] In addition, in general, mesh wick is formed by fine wire having a diameter within a range of 30 to 150 micron meter. Accordingly, when the mesh wick is formed to be a prescribed shape, the end portion thereof is not sharply cut, thus the remaining fine wires at the end portion contact with various inner walls of the container, thus deteriorating the function of the heat pipe.

[0018] An object of the present invention is therefore to provide a plate type heat pipe which is light-weight, and has a small heat transfer resistance, when used for cooling various electronic parts such as semiconductors having high heat generating density, a compressed mesh wick having excellent capillary action, and a method for manufacturing same.

SUMMARY OF THE INVENTION

[0019] To solve the above-mentioned problems in the conventional art, the present inventors have been studying

hard. As a result, it has been found that when a compressed mesh wick is manufactured by winding a sheet of band type mesh wire around a metal plate, bar type body or cylindrical body as a core member to prepare a wound mesh body, then, removing the core member from thus prepared wound mesh body, and pressing the wound mesh body, it is possible to provide a compressed mesh wick comprising a pressed number of mesh wires placed in layers with little gap therebetween in the width direction, thus having excellent capillary action.

[0020] Furthermore, it has been found that when a compressed mesh wick is manufactured by bending a sheet of band type mesh wire in a corrugated form in place of winding the mesh wire to prepare a bent layered mesh body, and pressing the bent layered mesh body, it is possible to provide a compressed mesh wick comprising a pressed number of mesh wires placed in layers with little gap therebetween in the width direction, thus having excellent capillary action.

[0021] Furthermore, it has been found that when an opening portion is formed in the compressed mesh wick, then, the peripheral portions of the opening portion are bent (for example, squarely bent) to form a bent opened portion, then furthermore, a heat transfer block is placed in the bent opened portion, and the peripheral portions of the compressed mesh wick are press-attached to the side walls of the heat transfer block, it is possible to improve a capillary action of the compressed mesh wick, and to provide a plate type heat pipe light-weight and having a small heat transfer resistance.

[0022] The present invention is made based on the above-mentioned findings. The first embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises steps of:

[0023] (a) bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body; and

[0024] (b) pressing said bent layered mesh body to prepare a compressed mesh wick.

[0025] The second embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises the method, wherein said bent layered mesh body comprises a bent layered mesh in spiral form.

[0026] The third embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises the method, wherein said bent layered mesh body comprises a corrugated bent layered mesh.

[0027] The fourth embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises steps of:

[0028] (a) winding at least one sheet of band type mesh wire around a core member to prepare a wound mesh body;

[0029] (b) removing said core member from said wound mesh body; and

[0030] (c) pressing said wound mesh body with said core member removed to prepare a compressed mesh wick.

[0031] The fifth embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises steps of:

[0032] (a) winding at least one sheet of band type mesh wire and at least one sheet of thin metal foil around a core member to prepare a wound complex mesh body comprising mesh wire and metal foil;

[0033] (b) removing said core member from said wound complex mesh body; and

[0034] (c) pressing said wound complex mesh body with said core member removed to prepare a compressed mesh wick.

[0035] The sixth embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises the method, wherein the method further comprises steps of:

[0036] punching said compressed mesh wick at a prescribed position thereof to form at least one prescribed opening portions; and

[0037] bending peripheral portions of said opening portions to form at least one bent opened portions.

[0038] The seventh embodiment of a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe comprises the method, wherein the method further comprises a step of:

[0039] forming cut-in portions between adjacent peripheral portions forming said bent opened portion.

[0040] The first embodiment of a plate type heat pipe of the invention comprises:

[0041] (a) a container having a hermetically sealed hollow portion formed by at least two plate member, including a heat absorbing surface and a heat dissipating surface;

[0042] (b) a compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing said bent layered mesh body, which is installed within said container such that said compressed mesh wick is press-attached to at least one surface of said heat absorbing surface and said heat dissipating surface;

[0043] (c) working fluid received within said container.

[0044] The second embodiment of a plate type heat pipe of the invention comprises:

[0045] (a) a container having a hermetically sealed hollow portion formed by at least two plate member, including a heat absorbing surface and a heat dissipating surface;

[0046] (b) at least one heat transfer block for transferring heat, which is installed within said container such that an inner wall of said heat absorbing surface is thermally connected to an inner wall of said heat dissipating surface by said heat transfer block;

[0047] (c) a compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing said bent layered mesh body, which is installed within said container such that said

compressed mesh wick is press-attached to at least one surface of said heat absorbing surface and said heat dissipating surface, as well as a side surface of said heat transfer block; and

[0048] (d) working fluid received within said container.

[0049] The third embodiment of a plate type heat pipe of the invention comprises the plate type heat pipe, wherein said bent layered mesh body comprises a bent layered mesh in spiral form.

[0050] The fourth embodiment of a plate type heat pipe of the invention comprises the plate type heat pipe, wherein said bent layered mesh body comprises a corrugated bent layered mesh.

[0051] The fifth embodiment of a plate type heat pipe of the invention comprises the plate type heat pipe, wherein said compressed mesh wick is punched at a prescribed position thereof to form at least one prescribed opening portion, and peripheral portions of said opening portion are about squarely bent to form at least one bent opened portion.

[0052] The sixth embodiment of a plate type heat pipe of the invention comprises the plate type heat pipe, wherein said compressed mesh wick is punched at a prescribed position thereof to form at least one prescribed opening portion, and peripheral portions of said opening portion are about squarely bent to form at least one bent opened portion, and in addition, said heat transfer block is arranged in at least one said bent opened portion.

[0053] The first embodiment of a compressed mesh wick of the present invention comprises a compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing said bent layered mesh body.

[0054] The second embodiment of a compressed mesh wick of the present invention comprises a compressed mesh wick, wherein said bent layered mesh body comprises a bent layered mesh in spiral form.

[0055] The third embodiment of a compressed mesh wick of the present invention comprises a compressed mesh wick, wherein said bent layered mesh body comprises a corrugated bent layered mesh.

[0056] The fourth embodiment of a compressed mesh wick of the present invention comprises a compressed mesh wick, wherein said bent layered mesh body is a complex mesh body comprising at least one sheet of band type mesh wire and at least one sheet of thin metal foil.

[0057] The fifth embodiment of a compressed mesh wick of the present invention comprises a compressed mesh wick, wherein at least one bent opened portion is provided at a prescribed position of said compressed mesh wick, which is formed by being punched to form a prescribed opening portion and bending peripheral portions of said opening portion.

[0058] The sixth embodiment of a compressed mesh wick of the present invention comprises a compressed mesh wick, wherein cut-in portions are formed between adjacent peripheral portions forming said bent opened portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059] FIG. 1 is a schematic descriptive view showing a method for manufacturing a compressed mesh wick of the present invention;

[0060] FIG. 2 is a schematic descriptive view showing other method for manufacturing a compressed mesh wick of the present invention;

[0061] FIG. 3 is a partially enlarged perspective view of a compressed mesh wick including a bent opened portion of the present invention;

[0062] FIG. 4 is a schematic partial side view of a compressed mesh wick including a bent opened portion of the present invention;

[0063] FIG. 5 is a schematic partial plan view of a compressed mesh wick including a plurality of bent opened portions of the present invention;

[0064] FIG. 6 is a partially enlarged view of a plate type heat pipe of the present invention;

[0065] FIG. 7 is a partially enlarged view of a plate type heat pipe of the present invention; and

[0066] FIG. 8 is a partially enlarged view of a compressed mesh wick of the invention to show bent opened portions with cut-in portions formed.

DETAILED DESCRIPTION OF THE PREFERABLE EMBODIMENTS

[0067] With reference to drawings, a compressed mesh wick, a method for manufacturing same, and a plate type heat pipe including a compressed mesh wick of the present invention are described in detail.

[0068] A method for manufacturing a compressed mesh wick used for a plate type heat pipe comprising steps of: bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing the bent layered mesh body to prepare a compressed mesh wick. The above-mentioned bent layered mesh body may comprise a bent layered mesh in spiral form (refer to FIG. 1). The bent layered mesh body may comprise a corrugated bent layered mesh, alternatively (refer to FIGS. 2(A), 2(B)).

[0069] Firstly, there is described a method for manufacturing a compressed mesh wick used for a plate type heat pipe in which at least one sheet of band type mesh wire is wound around a core member to prepare a wound mesh body, then, the core member is removed from the wound mesh body, and the wound mesh body with the core member removed is pressed to prepare a compressed mesh wick.

[0070] FIG. 1 is a schematic descriptive view showing one embodiment of the method for manufacturing a compressed mesh wick of the present invention. As shown in FIG. 1(a), a square metal plate 2 as a core member for winding and a sheet of band type mesh wire having a prescribed width and length are prepared. First of all, one end of the band type mesh wire 1 is aligned with the side end of the metal plate 2. Then, as shown in FIG. 1(b), the band type mesh wire 1 is wound about ten times around the metal plate as the core member to prepare a wound mesh body. Then, the metal plate is removed from the wound mesh

body, and then, as shown in FIG. 1(c), the wound mesh body 1 with the metal plate removed is pressed from both sides by a prescribed machinery 3 to manufacture a compressed mesh wick of the present invention.

[0071] Thus manufactured compressed mesh wick is compressed and has an end portion having a width of up to about 5 mm in the side thereof as shown in FIG. (d). Due to the end portion thus processed, it is possible to prevent the end portion of the wound mesh wire from being disjointed. A cylindrical body may be used as the core member in place of the metal plate. The size of the cylindrical body may be appropriately selected in accordance with the width of the mesh to be manufactured. A compressed mesh wick comprising a prescribed layers of mesh wire may be manufactured by using one sheet of band type mesh wire. In addition, a compressed mesh wick comprising a prescribed layers of mesh wire may be manufactured by using a plurality of sheets of band type mesh wire.

[0072] Furthermore, a method of the present invention for manufacturing a compressed mesh wick used for a plate type heat pipe may comprise steps of: winding at least one sheet of band type mesh wire and at least one sheet of thin metal foil around a metal plate or a cylindrical body as a core member to prepare a wound complex mesh body comprising mesh wire and metal foil, removing the core member from the wound complex mesh body, and pressing the wound complex mesh body with the core member removed to prepare a compressed mesh wick.

[0073] As described above, for example, a complex mesh body may be prepared by winding one sheet of band type mesh wire and one sheet of thin metal foil around the metal plate as the core member. Due to the use of the metal foil, a rigid body can be provided with the mesh wick, thus improving the press efficiency to reduce the gap between layers of the mesh wire in the width direction.

[0074] Furthermore, a method of the present invention for manufacturing a compressed mesh wick may further comprise the steps of: punching the compressed mesh wick at a prescribed position thereof to form at least one prescribed opening portions, and bending peripheral portions of the opening portions to form at least one bent opened portions (refer to FIG. 3).

[0075] In addition, a method of the present invention for manufacturing a compressed mesh wick may comprise steps of: bending and winding for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent and wound layered mesh body, and pressing the bent and wound layered mesh body to prepare a compressed mesh wick. Since the thus prepared compressed mesh wick is a band type wick bent and wound, it is easy to maintain the plate type body, and in addition easy to fix the wick to the inner wall of the container.

[0076] FIG. 2 is a schematic descriptive view showing other method for manufacturing a compressed mesh wick of the present invention. As shown in FIG. 2 (A)(a), one sheet of band type mesh wire 1' having prescribed width and length is prepared. Then, as shown in FIG. 2(A) (b), the band type mesh wire 1' is bent in a corrugated form to prepare the mesh which is placed in layers. Then, thus prepared mesh which is placed in layers is pressed from both surfaces by a prescribed machinery, as shown in FIG. (A)(c)

to manufacture a compressed mesh wick. Thus manufactured compressed mesh wick has a feature that the compressed mesh wick maintains a stable and firm shape as is compressed (in other words, the shape of the wick which is placed in layers and pressed is not collapsed), as shown in FIG. 2(A)(d).

[0077] Furthermore, as other embodiment, as shown in FIG. 2(B)(a), one sheet of band type mesh wire 1' having prescribed width and length is prepared. Then, as shown in FIG. 2(B) (b), the band type mesh wire 1' is bent in a corrugated form to prepare the mesh which is placed in layers. On this case, both ends of the band type mesh wire 1' are prepared so as to have extra portion having prescribed length, respectively. Then, thus prepared mesh which is placed in layers is pressed from both surfaces by a prescribed machinery, as shown in FIG. (B)(c), and then both ends of the meshed wick are covered by the extra portions, to manufacture a compressed mesh wick. Thus manufactured compressed mesh wick has a feature that the compressed mesh wick maintains a stable and firm shape because of the treatment of the end portions, as shown in FIG. 2(B)(d). Incidentally, the treatment of the end portions of the compressed mesh wick shown in FIGS. 1 and 2 may be as is pressed, or may be joined. Even the treatment as is pressed can maintain the stable and firm shape of the compressed mesh wick, as described above.

[0078] FIG. 3 is a partially enlarged perspective view of a compressed mesh wick including a bent opened portion of the present invention. FIG. 4 is a schematic partial side view of a compressed mesh wick including a bent opened portion of the present invention. FIG. 5 is a schematic partial plan view of a compressed mesh wick including a plurality of bent opened portions of the present invention.

[0079] As shown in FIG. 3, a square bent opened portion 5, for example, is formed in the compressed mesh wick 1 manufactured by the steps depicted in FIG. 1 or FIG. 2. More specifically, the compressed mesh wick 1 is punched to form an opening portion, and four peripheral portions 6 of the opening portion are squarely bent downwardly, thus forming the bent opened portion 5. Thus formed four peripheral portions 6 may have a size, for example, corresponding to the height of the hollow portion of the container. As a result, when the main body of the compressed mesh wick is attached to one of the main inner surface of the container, the end portion of the peripheral portion 6 contacts with the other main inner surface of the container.

[0080] As shown in FIG. 4, the peripheral portions 6 are squarely bent downward from the main body of the compressed mesh wick 1 and are positioned vertically.

[0081] As shown in FIG. 5, a plurality of bent opened portions 5 may be formed in the compressed mesh wick 1 in the present invention. The size of the bent opened portion is determined considering the size of the heat transfer block arranged therein.

[0082] FIG. 8 is a partially enlarged view of a compressed mesh wick of the invention to show bent opened portions with cut-in portions formed. As shown in FIG. 8(a), four peripheral portions 6 are prepared in the square bent opened portion 5 formed in the compressed mesh wick 1. Cut-in portions 16 are further formed between adjacent peripheral portions 6. When the cut-in portions are formed, as

described above, end portions of the mesh wires are trimmed in order, thus preventing the function of the mesh from being lowered. FIG. 8(b) shows another embodiment of the bent opened portion with cut-in portions prepared. As shown in FIG. 8(b), four peripheral portions 6 are prepared in the elongated square bent opened portion 5 formed in the compressed mesh wick 1. Cut-in portions 16 are further formed between adjacent peripheral portions 6.

[0083] Then, the plate type heat pipe of the invention is described.

[0084] A plate type heat pipe of the present invention comprises: (a) a container having a hermetically sealed hollow portion formed by at least two plate member, including a heat absorbing surface and a heat dissipating surface, (b) a compressed mesh wick prepared by winding or bending in a corrugated form at least one sheet of band type mesh wire and pressing, which is installed within the container such that the compressed mesh wick is press-attached to at least one surface of the heat absorbing surface and the heat dissipating surface, and (c) working fluid received within the container.

[0085] Furthermore, a plate type heat pipe of the present invention may comprise: (a) a container having a hermetically sealed hollow portion formed by at least two plate member, including a heat absorbing surface and a heat dissipating surface, (b) at least one heat transfer block for transferring heat, which is installed within the container such that an inner wall of the heat absorbing surface is thermally connected to an inner wall of the heat dissipating surface by the heat transfer block, (c) a compressed mesh wick prepared by winding or bending in a corrugated form at least one sheet of band type mesh wire and pressing, which is installed within the container such that the compressed mesh wick is press-attached to at least one surface of the heat absorbing surface and the heat dissipating surface, and (d) working fluid received within the container.

[0086] FIG. 6 and FIG. 7 are a partially enlarged view of a plate type heat pipe of the present invention. As shown in FIG. 6, a heat transfer block 12 is arranged between the heat absorbing side 11 and the heat dissipating side 10 so as to connect the respective inner walls. In addition, the compressed mesh wick is arranged from the inner wall of the heat dissipating side 10 through the side wall of the heat transfer block 12 so as to be closely attached thereto. The compressed mesh wick comprises the mesh wick formed by winding at least one sheet of band type mesh wire and pressed. The compressed mesh wick may comprise the mesh wick formed by bending in a corrugated form at least one sheet of band type mesh wire and pressed. The compressed mesh wick is press-attached to the side wall, and/or the inner wall of the heat dissipating side by, for example, a spot welding, as indicated in the drawing by the reference numeral 13. FIG. 7 shows another embodiment. As shown in FIG. 7, the compressed mesh wick 1 may be press-attached to the side wall, and/or the inner wall of the heat dissipating side by, in place of the spot welding, being pinched by the member 14 or another member 15.

[0087] The above-mentioned compressed mesh wick used for the plate type heat pipe is described in more detail. A compressed mesh wick of the present invention, as shown in FIG. 1, comprises a compressed mesh wick prepared by winding at least one sheet of band type mesh wire around a

metal plate or a cylindrical body as a core member to prepare a wound mesh body, removing the core member from the wound mesh body, and pressing the wound mesh body with the metal plate or the cylindrical body as the core member removed to prepare a compressed mesh wick. Both ends of the compressed mesh wick of the present invention are not cut off, but prepared by winding or bending.

[0088] Furthermore, a compressed mesh wick of the present invention may comprises a compressed mesh wick prepared by winding at least one sheet of band type mesh wire and at least one sheet of thin metal foil around a metal plate or a cylindrical body as a core member (for example, placing the sheet of band type mesh wire and the thin metal foil in a sandwiched manner and winding same) to prepare a wound complex mesh body, removing the metal plate or the cylindrical body as the core member from the wound complex mesh body, and pressing the wound complex mesh body with the core member removed. Furthermore, the compressed mesh wick of the invention may be manufactured by winding or bending a band type mesh wire and metal foil without using the core member such as the metal plate or the cylindrical body to prepare the wound mesh body or the wound complex mesh body, and pressing same.

[0089] Furthermore, the compressed mesh wick may be a corrugated bent layered mesh wick, as shown in FIG. 2, in place of the wound mesh wick.

[0090] In addition, as described above, the compressed mesh wick may include at least one bent opened portion which is provided at a prescribed position, and formed by being punched to form a prescribed opening portion and bending peripheral portions of the opening portion.

[0091] In addition, the compressed mesh wick may include at least one bent opened portion which is provided at a prescribed position, and formed by being punched to form a prescribed opening portion and bending peripheral portions of the opening portion, and the heat transfer block may be arranged in at least one bent opened portion.

[0092] The material of the container constituting the plate type heat pipe is not specifically limited. However, when such materials excellent in heat conductivity as a copper material or an aluminum material is used, the plate type heat pipe having an excellent heat performance can be obtained, thus favorable. There are listed as the copper material, JIS (Japanese Industrial Standard) C1020 type, C1100 type or the like, and as the aluminum material, JIS A1100 type, A3000 type, A5000 type, A6000 type or the like.

[0093] Within the hollow portion of the plate type heat pipe of the invention, (not shown) an appropriate amount of working fluid is contained. There are water, substituted Freon, ammonium, alcohol, acetone or the like as the working fluid.

[0094] A heat dissipating fin may be arranged on the heat dissipating side of the container, although not shown. When the heat dissipating fin is integrally formed as one unit with the container as the part of the container, the heat transfer efficiency is further improved, and the manufacturing cost of the heat sink is lowered, thus favorable.

[0095] The heat transfer block 12 may be metal bonded to the respective inner walls by soldering or the like. When the

heat transfer block 11 is joined to the inner walls by metal bonding, the heat resistance becomes small, thus favorable.

[0096] One or plurality of protruding portions may be arranged in the plate member forming a heat absorbing side of the container. In this case, the heat transfer block may be arranged in at least one protruding portions.

[0097] The container may be manufactured by press-forming at least one plate member, then drawing the portion of the plate member corresponding to the location to which a heat generating component is attached, and combining the two plate members, thus the container contacts with the heat generating component by the flat surface thereof. As the method of joining two plate members, there are soldering, laser welding or the like. As the soldering, in order to obtain a reliability of the heat pipe, Cu/Ag JIS BAG-8 is preferable. Furthermore, as the soldering, there are a vacuum soldering, atmosphere soldering or the like.

[0098] The plate type heat pipe of the present invention is further described by the example.

EXAMPLE

Example 1

[0099] As shown in FIG. 1(a), ten sheets of band type mesh wire, each of which sheet has a thickness of 110 micron meter, a width of 100 mm, a length of 663 mm and 100 meshes were layered. Then, the end of thus layered sheets were aligned with a metal plate having a width of about 48 mm. Then, as shown in FIG. 1(b), the layered sheets of the band type mesh wire were wound around the metal plate. Then, the metal plate was removed from the wound mesh body, and as shown in FIG. 1(c), the force of 150 to 200 kgf/cm² was applied so as to press the wound mesh body. Thus, the compressed mesh wick of about 51 mm×100 mm was prepared. The thickness of the compressed mesh wick was up to about 1.5 mm. The end portion of the wound mesh wick was prepared in such manner that the length of the end portion was about 5 mm from the tip of the side portion of the compressed mesh wick, as shown in FIG. 1(d). As a result, it was possible to remarkably reduce the gap between the layers of the mesh wire. In addition, fine wires were not protrude outward and scattered.

[0100] Thus prepared compressed mesh wick was press-attached to the inner wall of the heat dissipating side and the side wall of the heat transfer block by the spot welding, as shown in FIG. 6. As a result, the heat pipe having excellent capillary action was obtained.

Example 2

[0101] As shown in FIG. 2A(a), ten sheets of band type mesh wire, each of which sheet has a thickness of 110 micron meter, a width of 100 mm, a length of 663 mm and 100 meshes were layered. Then, as shown in FIG. 2A(b), a corrugated bent layered mesh body was prepared by bending the band type mesh wire in a corrugated form. Then, as shown in FIG. 2A(c), the force of 150 to 200 kgf/cm² was applied to the corrugated bent layered mesh body so as to press same. Thus, the compressed mesh wick of about 51 mm×100 mm was prepared. The thickness of the compressed mesh wick was up to about 1.5 mm. As a result, it was possible to remarkably reduce the gap between the

layers of the mesh wire. In addition, fine wires were not protrude outward and scattered.

[0102] Thus prepared compressed mesh wick was press-attached to the inner wall of the heat dissipating side and the side wall of the heat transfer block by the spot welding, as shown in FIG. 6. As a result, the heat pipe having excellent capillary action was obtained.

[0103] According to the present invention, as described above, since a compressed mesh wick is prepared by winding a plurality of band type mesh wire and pressing same, it is possible to provide a compressed mesh wire having an excellent capillary action. In addition, when the compressed mesh wick of the invention is applied to the plate type heat pipe in which the compressed mesh wick is press-attached to the inner wall of the container and the side wall of the heat transfer block, it is possible to provide a plate type heat pipe which is light-weight and has a lower heat transfer resistance, so as to cool various electronic components such as high density of semiconductor chips or the like, thus industriously advantageous.

What is claimed is:

1. A method for manufacturing a compressed mesh wick used for a plate type heat pipe comprising steps of:

- (a) bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body; and
- (b) pressing said bent layered mesh body to prepare a compressed mesh wick.

2. The method as claimed in claim 1, wherein said bent layered mesh body comprises a bent layered mesh in spiral form.

3. The method as claimed in claim 1, wherein said bent layered mesh body comprises a corrugated bent layered mesh.

4. A method for manufacturing a compressed mesh wick used for a plate type heat pipe comprising steps of:

- (a) winding at least one sheet of band type mesh wire around a core member to prepare a wound mesh body;
- (b) removing said core member from said wound mesh body; and
- (c) pressing said wound mesh body with said core member removed to prepare a compressed mesh wick.

5. A method for manufacturing a compressed mesh wick used for a plate type heat pipe comprising steps of:

- (a) winding at least one sheet of band type mesh wire and at least one sheet of thin metal foil around a core member to prepare a wound complex mesh body comprising mesh wire and metal foil;
- (b) removing said core member from said wound complex mesh body; and
- (c) pressing said wound complex mesh body with said core member removed to prepare a compressed mesh wick.

6. The method as claimed in any one of claims 1 to 5, wherein the method further comprises steps of:

- punching said compressed mesh wick at a prescribed position thereof to form at least one prescribed opening portions; and

bending peripheral portions of said opening portions to form at least one bent opened portions.

7. The method as claimed in claim 6, wherein the method further comprises a step of:

forming cut-in portions between adjacent peripheral portions forming said bent opened portion.

8. A plate type heat pipe comprises:

- (a) a container having a hermetically sealed hollow portion formed by at least two plate member, including a heat absorbing surface and a heat dissipating surface;
- (b) a compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing said bent layered mesh body, which is installed within said container such that said compressed mesh wick is press-attached to at least one surface of said heat absorbing surface and said heat dissipating surface;

(c) working fluid received within said container.

9. A plate type heat pipe comprises:

- (a) a container having a hermetically sealed hollow portion formed by at least two plate member, including a heat absorbing surface and a heat dissipating surface;
- (b) at least one heat transfer block for transferring heat, which is installed within said container such that an inner wall of said heat absorbing surface is thermally connected to an inner wall of said heat dissipating surface by said heat transfer block;

(c) a compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing said bent layered mesh body, which is installed within said container such that said compressed mesh wick is press-attached to at least one surface of said heat absorbing surface and said heat dissipating surface, as well as a side surface of said heat transfer block; and

(d) working fluid received within said container.

10. The plate type heat pipe as claimed in claim 8 or 9, wherein said bent layered mesh body comprises a bent layered mesh in spiral form.

11. The plate type heat pipe as claimed in claim 8 or 9, wherein said bent layered mesh body comprises a corrugated bent layered mesh.

12. The plate type heat pipe as claimed in claim 8, wherein said compressed mesh wick is punched at a prescribed position thereof to form at least one prescribed opening portion, and peripheral portions of said opening portion are about squarely bent to form at least one bent opened portion.

13. The plate type heat pipe as claimed in claim 9, wherein said compressed mesh wick is punched at a prescribed position thereof to form at least one prescribed opening portion, and peripheral portions of said opening portion are about squarely bent to form at least one bent opened portion, and in addition, said heat transfer block is arranged in at least one said bent opened portion.

14. A compressed mesh wick prepared by bending for plurality of times at least one sheet of band type mesh wire to form a prescribed shape, thus preparing a bent layered mesh body, and pressing said bent layered mesh body.

15. The compressed mesh wick as claimed in claim 14, wherein said bent layered mesh body comprises a bent layered mesh in spiral form.

16. The compressed mesh wick as claimed in claim 14, wherein said bent layered mesh body comprises a corrugated bent layered mesh.

17. The compressed mesh wick as claimed in claim 15 or 16, wherein said bent layered mesh body is a complex mesh body comprising at least one sheet of band type mesh wire and at least one sheet of thin metal foil.

18. The compressed mesh wick as claimed in any one of claims 14 to 16, wherein at least one bent opened portion is provided at a prescribed position of said compressed mesh wick, which is formed by being punched to form a prescribed opening portion and bending peripheral portions of said opening portion.

19. The compressed mesh wick as claimed in claim 18, wherein cut-in portions are formed between adjacent peripheral portions forming said bent opened portion.

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