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(54) **LIQUID-GAS CIRCULATION HEAT-DISSIPATING UNIT**

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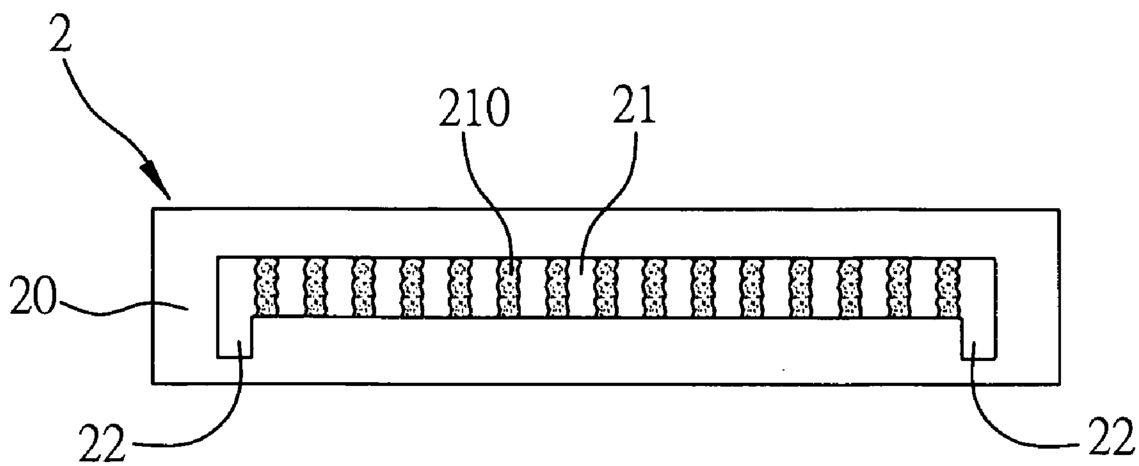
(57) **ABSTRACT**

A liquid-gas circulation heat-dissipating unit includes a body having a hollow portion, a capillary structure evenly coated on an inner wall of the hollow portion and configured to soak up working fluid, and a regulating portion disposed in the body and communicating with the hollow portion. The hollow portion is filled with the working fluid of an amount more than a greatest possible amount adsorbed on the capillary structure. The regulating portion is stored with an excess of the working fluid. As a result, quantity tolerance between the working fluid of the greatest possible amount adsorbed on the capillary structure and the actually introduced working fluid increases. Accordingly, the capillary structure is adsorbed with the greatest possible amount of the working fluid and thus achieves optimal efficiency of heat dissipation.



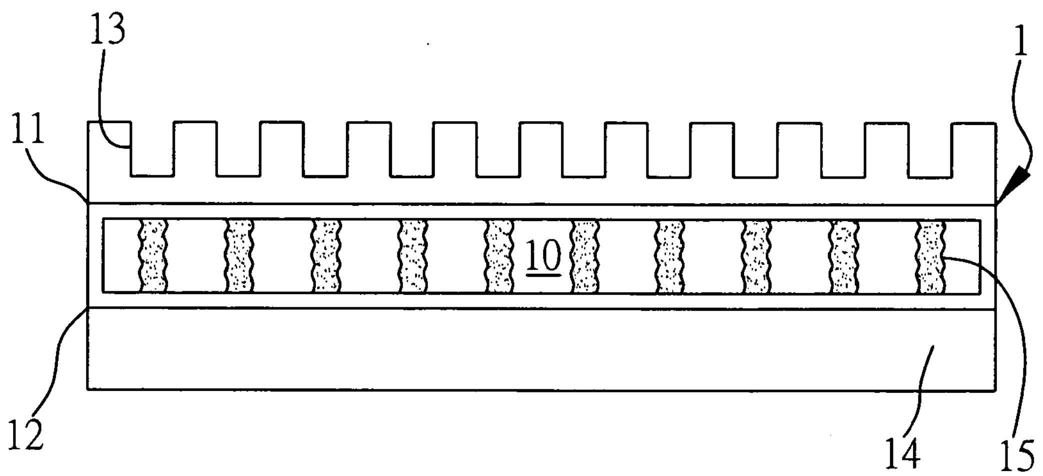


FIG. 1 (PRIOR ART)

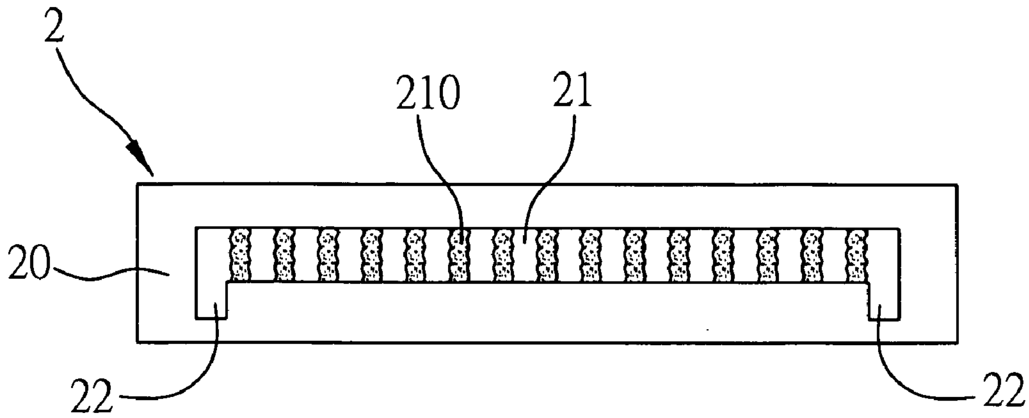


FIG. 2

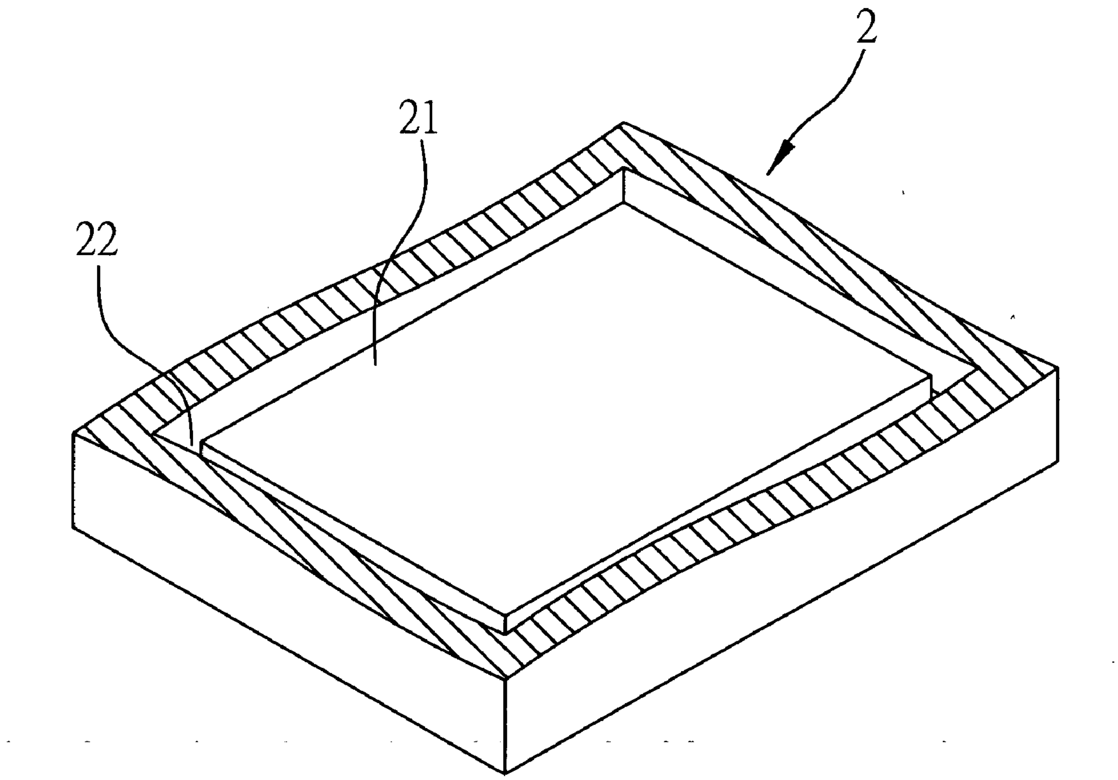


FIG. 3

LIQUID-GAS CIRCULATION HEAT-DISSIPATING UNIT

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a heat-dissipating unit and, more particularly, to a liquid-gas circulation heat-dissipating unit.

[0003] 2. Description of the Prior Art

[0004] Computer functionalities are ever increasing with the processing speed of the semiconductor devices related to computer's computation speed. However, the faster a high-speed semiconductor device performs computation, the higher the operating voltage will be, and the more will be the heat generated. The latest heat dissipation technology involves providing a cooler with a chamber disposed therein, disposing a capillary structure in the chamber, and filling the chamber with working fluid, such that heat generated by a heat-generating device is dissipated by evaporation and condensation of the working fluid inside the chamber.

[0005] Referring to FIG. **1**, a panel-shaped cooler **1** comprises a chamber **10**, a condensation side **11**, and an evaporation side **12**. The condensation side **11** is equipped with a cooling fin **13**. The evaporation side **12** is mounted with a heat-generating component **14** like a CPU. The chamber **10** is filled with working fluid of a high coefficient of thermal expansion. A capillary structure **15** is disposed between two opposing inner sides of the chamber **10**. The capillary structure **15** is adsorbed with the working fluid and configured for capillarity.

[0006] Once the heat-generating component **14** operates and generates heat, the working fluid is heated up and thereby evaporated into gas by the evaporation side **12**. As a result, the working fluid close to the condensation side **11** is adsorbed on the capillary structure **15** and thereby moved toward the evaporation side **12**. The gaseous working fluid flows in the opposite direction, reaches the condensation side **11**, and is condensed into liquid before being adsorbed on the capillary structure **15** and moved toward the evaporation side **12** again. Heat dissipation is achieved by repeating the aforesaid steps.

[0007] An existing method for filling a chamber with working fluid involves disposing in the cooler **1** a small hole communicating with the chamber, introducing an appropriate amount of working fluid into the chamber via the small hole, and sealing the small hole.

[0008] In order to facilitate liquid-gas circulation based on phase transition, initially the capillary structure **15** has to be adsorbed with the greatest possible amount of working fluid (in liquid state). However, excessive adsorption of the working fluid tends to slow down evaporation of the working fluid (in liquid state). Conversely, inadequate adsorption of the working fluid results in the dry heating of the capillary structure **15**. Hence, the heat dissipation function of the cooler **1** is compromised by both excessive and inadequate adsorption of working fluid on the capillary structure **15**.

[0009] However, it is rather difficult to allow the capillary structure **15** to be adsorbed with the right amount of working fluid, because of a small quantity tolerance between the greatest possible amount of working fluid that can be adsorbed on the capillary structure **15** and the amount of working fluid actually introduced. The heat dissipation function of the cooler **1** will be greatly compromised, if the capillary structure **15** is adsorbed with working fluid that is slightly too much or slight too little. Density of the capillary structure **15** in the cooler **1** varies from cooler to cooler, but mass production of the cooler **1** entails introducing a fixed average amount of working fluid into the cooler **1**, and thus at the end of the fabrication process the working fluid contained in the cooler **1** is always either too much or too little.

[0010] In order to allow the capillary structure **15** to be adsorbed with the greatest possible amount of working fluid, the process of introducing the working fluid into a chamber should be monitored and controlled, such that the existing working fluid is deliberately supplemented with additional working fluid in response to foreseeable inadequate adsorption of working fluid on the capillary structure **15**, and introduction of the working fluid into the chamber is deliberately slowed down in response to foreseeable excessive adsorption of working fluid on the capillary structure **15**; however, in so doing, the fabrication process of the cooler **1** becomes complex and slow.

[0011] Accordingly, an issue calling for urgent solution involves solving the aforesaid problems.

SUMMARY OF THE INVENTION

[0012] In light of the aforesaid drawbacks of the prior art, it is a primary objective of the present invention to provide a liquid-gas circulation heat-dissipating unit characterized by an optimal liquid-gas circulation based on phase transition.

[0013] Another objective of the present invention is to provide a liquid-gas circulation heat-dissipating unit so as to increase the quantity tolerance between the required amount of working fluid and the amount of the working fluid actually introduced.

[0014] Yet another objective of the present invention is to provide a liquid-gas circulation heat-dissipating unit so as to simplify a fabrication process.

[0015] In order to achieve the above and other objectives, the present invention provides a liquid-gas circulation heat-dissipating unit. The liquid-gas circulation heat-dissipating unit comprises a body, a capillary structure, and a regulating portion. The body comprises a hollow portion. The capillary structure is evenly coated on an inner wall of the hollow portion and adsorbed with working fluid. The regulating portion is disposed in the body and communicating with the hollow portion. The hollow portion is filled with the working fluid of an amount more than the greatest possible amount adsorbed on the capillary structure. The regulating portion is stored with an excess of the working fluid.

[0016] Unlike the prior art whereby a cooler may be inefficient because the cooler is equipped with a capillary structure that fails to be adsorbed with the greatest possible amount of working fluid, the present invention discloses a liquid-gas circulation heat-dissipating unit with optimal efficiency of heat dissipation, because the liquid-gas circulation heat-dissipating unit not only has a regulating portion that stores a small amount of working fluid but also has a capillary structure that is adsorbed with the greatest possible amount of working fluid.

[0017] As regards the present invention, during a fabrication process whereby the hollow portion is filled with working fluid, the working fluid is introduced into the hollow portion through a small hole as what is typically done according to the prior art. The amount of the working fluid introduced can be more than an average possible amount of the working fluid adsorbed on the capillary structure but less than the sum of the average possible amount of the working fluid adsorbed and the capacity of the regulating portion. Hence, it is feasible to allow the capillary structure to be adsorbed with the greatest possible amount of the working fluid by keeping the introduced working fluid within the aforesaid range. Unlike the prior art whereby the quantity tolerance between the amount of the working fluid actually introduced and the greatest possible amount of the working fluid adsorbed on the capillary structure is so small that the working fluid introduced tends to be either too little or too much. The liquid-gas circulation heat-dissipating unit of the present invention is equipped with the regulating portion configured for storage of the working fluid and thus is allowed to have a quantity tolerance greater than that of the prior art, and, more importantly, any errors less than the quantity tolerance can never compromise the heat dissipation efficiency of the liquid-gas circulation heat-dissipating unit of the present invention.

[0018] A process based on the prior art is typically complex and slow because, in the process, a capillary structure of a cooler can be adsorbed with the greatest possible amount of working fluid only if introduction of the working fluid into the cooler is strictly monitored and controlled. By contrast, the present invention discloses a liquid-gas circulation heat-dissipating unit equipped with a regulating portion that spares a working fluid introduction process strict monitoring and strict control as long as the amount of the working fluid introduced into a hollow portion is kept within a range, thus streamlining and speeding up the process.

[0019] The regulating portion is a groove peripherally disposed in the bottom of the hollow portion, such that redundant working fluid flows into the groove and thereby forms a ring-shaped liquid zone for additional heat dissipation.

[0020] In short, designed to solve the problems facing the prior art and thereby attain higher heat dissipation efficiency, the present invention has high industrial applicability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. **1** (PRIOR ART) is a cross-sectional view showing a conventional cooler capable of dissipating heat of a heat-generating device by liquid-gas phase transition and circulation;

[0022] FIG. **2** is a cross-sectional view showing a liquid-gas circulation heat-dissipating unit of the present invention; and

[0023] FIG. **3** is a schematic view showing a regulating portion of a liquid-gas circulation heat-dissipating unit of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0024] The present invention is herein illustrated with a specific embodiment so that one ordinarily skilled in the pertinent art can easily understand other advantages and effects of the present invention from the disclosure of the invention.

[0025] Referring to FIG. **2**, a liquid-gas circulation heat-dissipating unit **2** of the present invention comprises a body **20**, a capillary structure **210**, and a regulating portion **22**. The body **20** comprises a hollow portion **21**. The capillary structure **210** is evenly coated on an inner wall of the hollow portion **21** and adsorbed with working fluid. The regulating portion **22** is disposed in the body **20** and communicating with the hollow portion **21**. The hollow portion **21** is filled with the working fluid of an amount more than the greatest possible amount adsorbed on the capillary structure **210**. The regulating portion **22** is stored with an excess of the working fluid. The working fluid is a fluid with a low boiling point. The capillary structure **210** is a metal powder sintered structure.

[0026] The body **20** is in contact with a heat-generating device (not shown) on one side. The heat-generating device in operation generates heat and evaporates the working fluid adsorbed on the capillary structure **210** and close to the heat-generating device, and thus the capillary structure **210** fully adsorbed with the working fluid previously becomes partly adsorbed with the working fluid, moving the working fluid toward the heat-generating device via the capillary structure **210**. Afterward, the working fluid in gas state rises and reaches the other side of the hollow portion **21**, that is, the side opposite the heat-generating device, to be cooled down and condensed to liquid. The working fluid, now condensed and liquid, is adsorbed on the capillary structure **210**. Heat generated by the heat-generating device is dissipated by repeating the aforesaid steps of liquid-gas circulation based on phase transition.

[0027] Unlike the prior art whereby a cooler may be inefficient because the cooler is equipped with a capillary structure that fails to be adsorbed with the greatest possible amount of working fluid, the present invention discloses a liquid-gas circulation heat-dissipating unit with optimal efficiency of heat dissipation, because the liquid-gas circulation heat-dissipating unit **2** not only has a regulating portion **22** that stores a small amount of working fluid but also has a capillary structure **210** that is adsorbed with the greatest possible amount of working fluid.

[0028] As regards the present invention, during a fabrication process whereby the hollow portion **21** is filled with working fluid, a required amount of the working fluid is introduced into the hollow portion **21** through a small hole (not shown), and then the small hole is sealed. The amount of the working fluid introduced can be more than an average possible amount of the working fluid adsorbed on the capillary structure **210** but less than the sum of the average possible amount of the working fluid adsorbed and a capacity of the regulating portion **22**. Hence, it is feasible to allow the capillary structure **210** to be adsorbed with the greatest possible amount of the working fluid by keeping the introduced working fluid within the aforesaid range. The working fluid introduced into the hollow portion **21** is mostly adsorbed on the capillary structure **210**. A small amount of the working fluid introduced into the hollow portion **21** after full adsorption of the working fluid on the capillary structure **210** is eventually stored in the regulating portion **22**. The volume of the working fluid not adsorbed on the capillary structure **210** is slightly less than the capacity of the regulating portion **22** so as to prevent accumulation of the working fluid in the bottom of the hollow portion **21** which may otherwise affects the phase transition and circulation of the working fluid. Unlike the prior art whereby the quantity tolerance between the amount of the working fluid actually introduced and the greatest possible amount of the working fluid adsorbed on the capillary structure is so small that the working fluid introduced tends to be either too little or too much. The liquid-gas circulation heat-dissipating unit **2** of the present invention is equipped with the regulating portion **22** configured for storage of the working fluid and thus is allowed to have a quantity tolerance greater than that of the prior art, and, more importantly, any errors less than the quantity tolerance can never compromise the heat dissipation efficiency of the liquid-gas circulation heat-dissipating unit **2** of the present invention.

[0029] A process based on the prior art is typically complex and slow because, in the process, a capillary structure of a cooler can be adsorbed with the greatest possible amount of working fluid only if introduction of the working fluid into the cooler is strictly monitored and controlled. By contrast, the present invention discloses a liquid-gas circulation heat-dissipating unit equipped with a regulating portion that spares a working fluid introduction process strict monitoring and strict control as long as the amount of the working fluid introduced into a hollow portion is kept within a range, thus streamlining and speeding up the process.

[0030] Referring to FIG. **3**, the body **20** is panel-shaped and made of metal, and the regulating portion **22** is a groove peripherally disposed in the bottom of the hollow portion **21**, such that redundant working fluid flows into the groove and thereby forms a ring-shaped liquid zone for additional heat dissipation.

[0031] The regulating portion **22** is not to be limited by this embodiment; instead, the regulating portion **22** may appear in various forms, for example, cruciform, and round. No such variations, however, can affect the primary purpose of the present invention.

[0032] In short, a liquid-gas circulation heat-dissipating unit of the present invention solves the problems facing the prior art and thus dissipates heat more efficiently. Hence, the present invention has high industrial applicability.

[0033] The foregoing embodiment is only illustrative of the features and functions of the present invention but is not intended to restrict the scope of the present invention. It is apparent to those skilled in the art that all equivalent modifications and variations made in the foregoing embodiments according to the spirit and principle in the disclosure of the present invention should fall within the scope of the appended claims.

What is claimed is:

1. A liquid-gas circulation heat-dissipating unit, comprising:

a body comprising a hollow portion;

a capillary structure evenly coated on an inner wall of the hollow portion and adsorbed with working fluid; and

a regulating portion disposed in the body and communicating with the hollow portion, wherein the hollow portion is filled with the working fluid of an amount more than a greatest possible amount adsorbed on the capillary structure, and the regulating portion is stored with an excess of the working fluid.

2. The liquid-gas circulation heat-dissipating unit of claim **1**, wherein the body is panel-shaped.

3. The liquid-gas circulation heat-dissipating unit of claim **1**, wherein the body is made of metal.

4. The liquid-gas circulation heat-dissipating unit of claim **1**, wherein the regulating portion is a groove disposed in the bottom of the hollow portion.

5. The liquid-gas circulation heat-dissipating unit of claim **4**, wherein the groove is peripherally disposed in the bottom of the hollow portion and thereby is ring-shaped.

6. The liquid-gas circulation heat-dissipating unit of claim **4**, wherein the groove is cruciform.

7. The liquid-gas circulation heat-dissipating unit of claim **4**, wherein the groove is round.

8. The liquid-gas circulation heat-dissipating unit of claim **1**, wherein the capillary structure is a metal powder sintered structure.

9. The liquid-gas circulation heat-dissipating unit of claim **1**, wherein the excess of the working fluid has volume less than a capacity of the regulating portion.

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