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(54) **METHOD FOR ASSEMBLING AND BRAZING CPU HEAT SINK MODULES**

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(57) **ABSTRACT**

A method of brazing components of a heat sink module is described. The method may include the steps of assembling the components to be brazed, and placing a copper-silver alloy filler at junctions between the components. The assembled components may be pre-heated in an air-tight environment to burn up most of the oxygen present, and then heated to the melting point of the copper-silver alloy filler in an air-tight environment having an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components, making the filler melt and evenly spread over the gaps at the junctions of the components. The assembled components may then be cooled to solidify the liquid filler at the junctions, to form a finished product. Also, an assembly line system for brazing the components of a heat sink module is described.

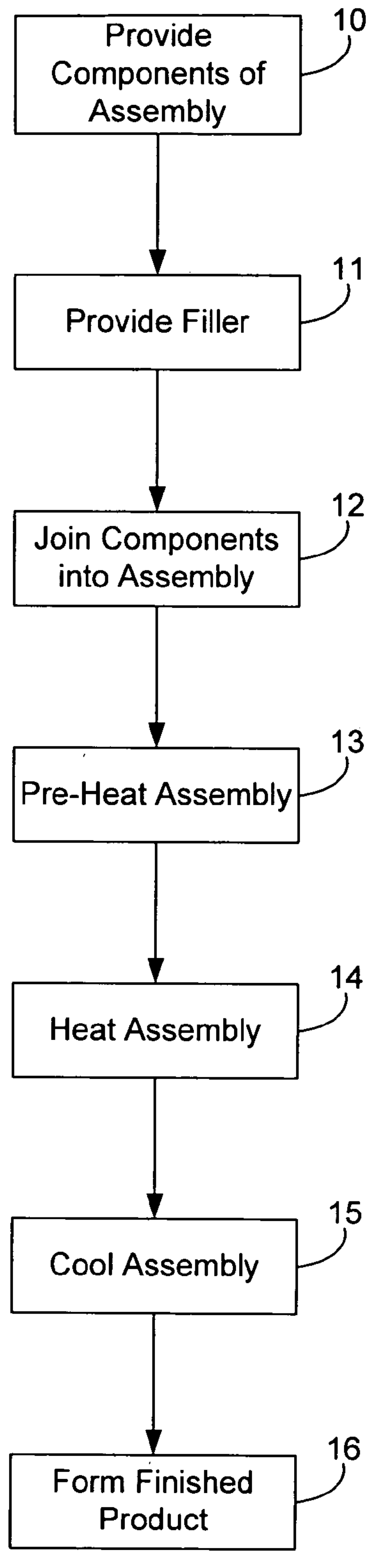
Provide Components of Assembly
10
Provide Filler
11
Join Components into Assembly
12
Pre-Heat Assembly
13
Heat Assembly
14
Cool Assembly
15
Form Finished Product
16

FIG. 1

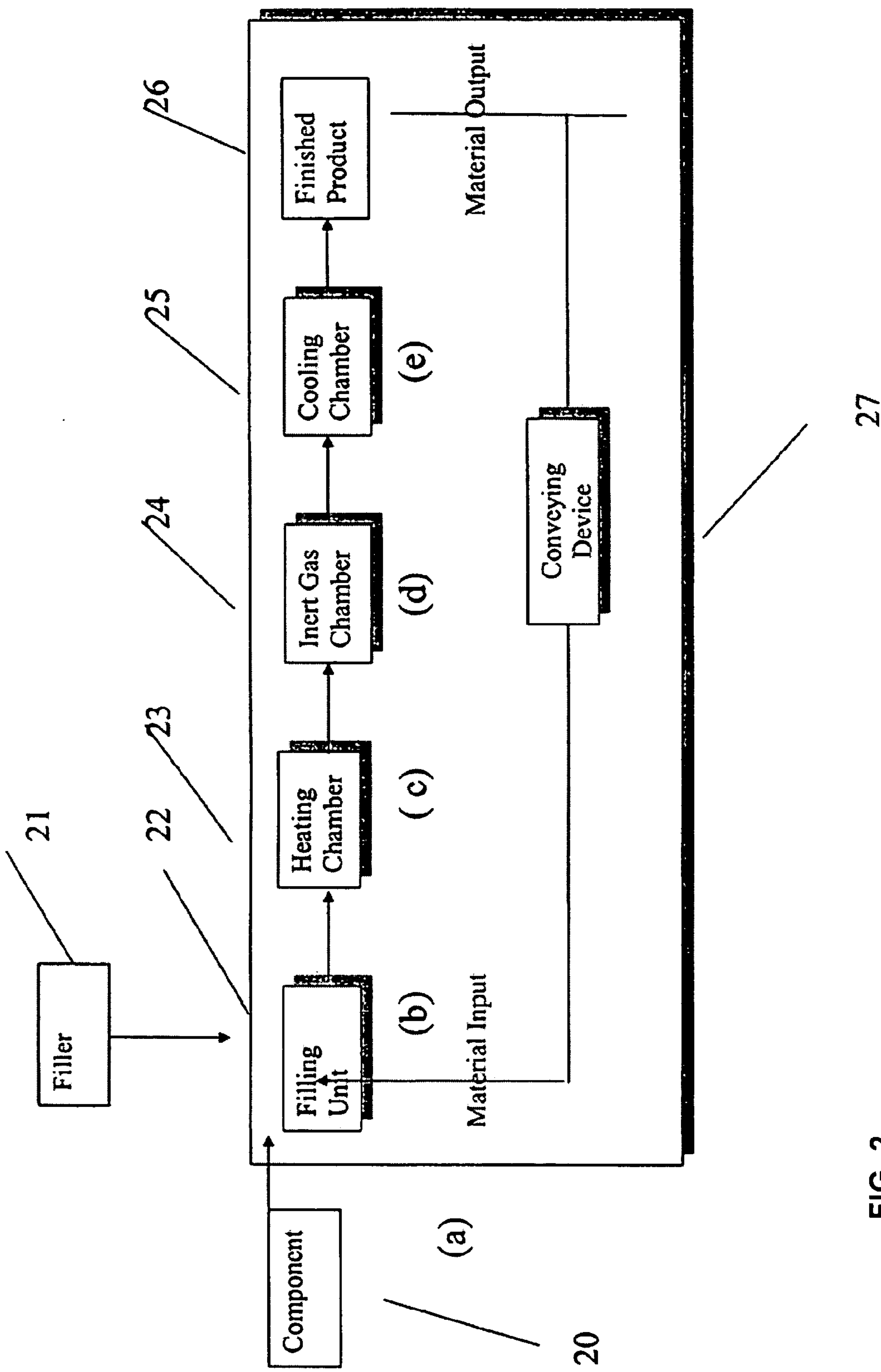
Component
Filler
Filling Unit
Heating Chamber
Inert Gas Chamber
Cooling Chamber
Finished Product
Conveying Device
Material Input
Material Output
(a)
(b)
(c)
(d)
(e)
20
21
22
23
24
25
26
27

FIG. 2

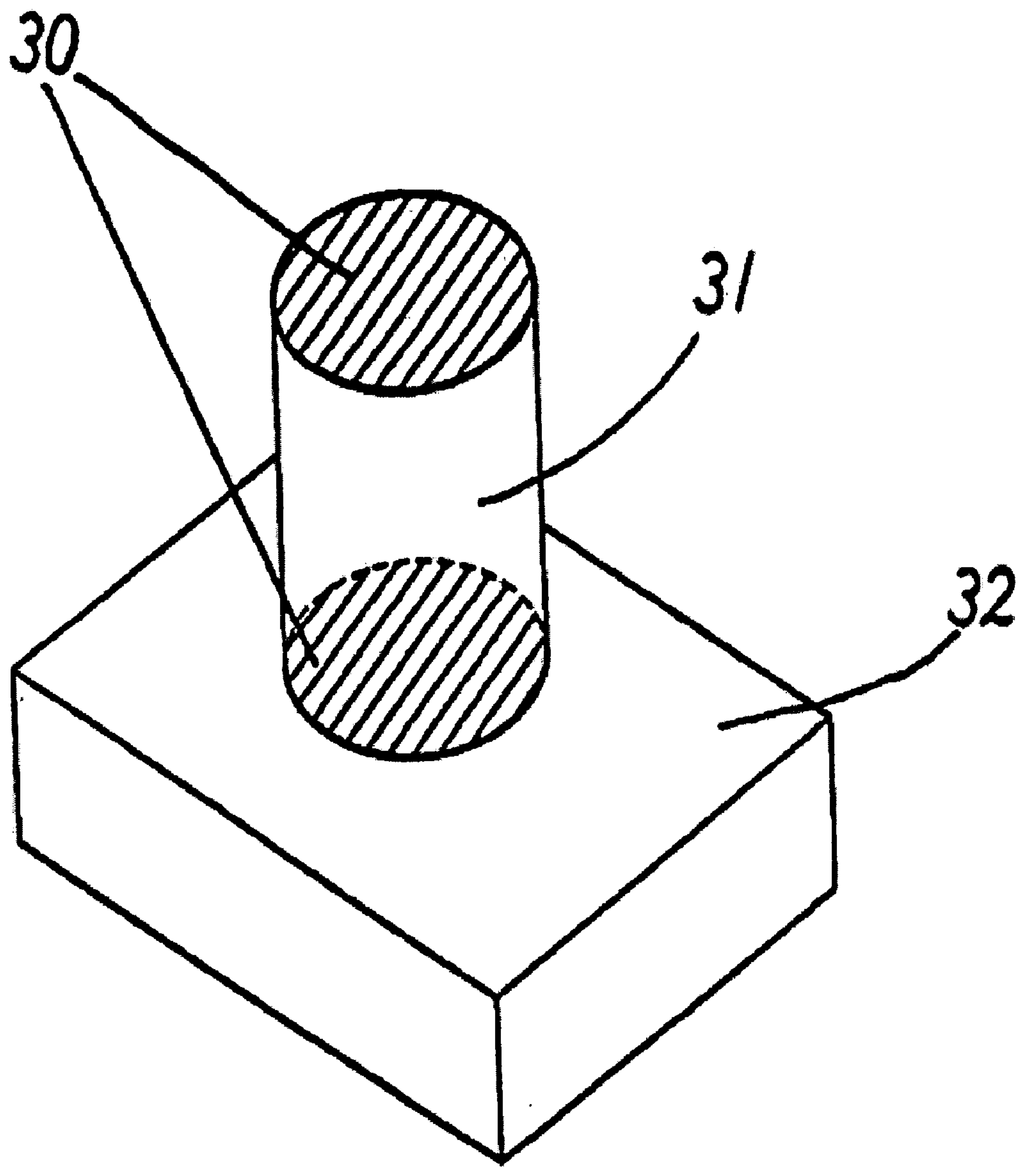

FIG. 3

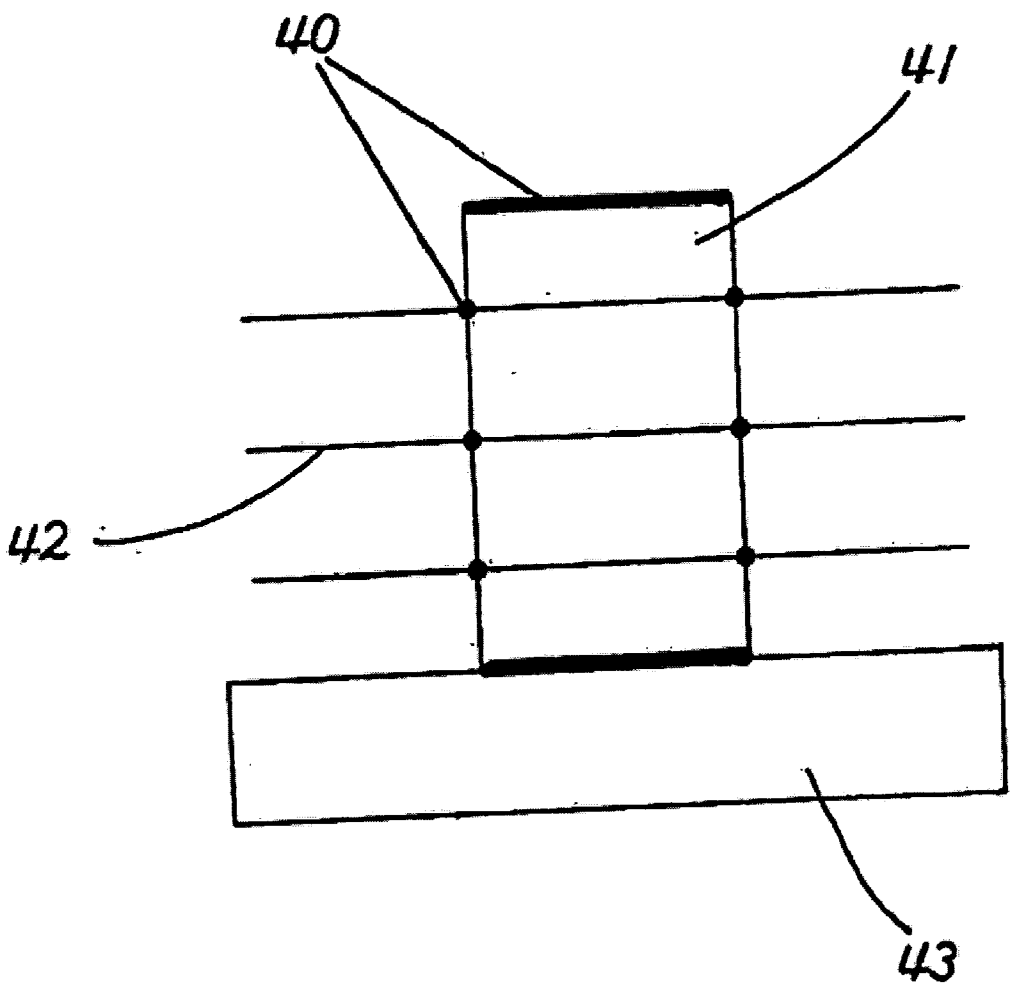

FIG. 4

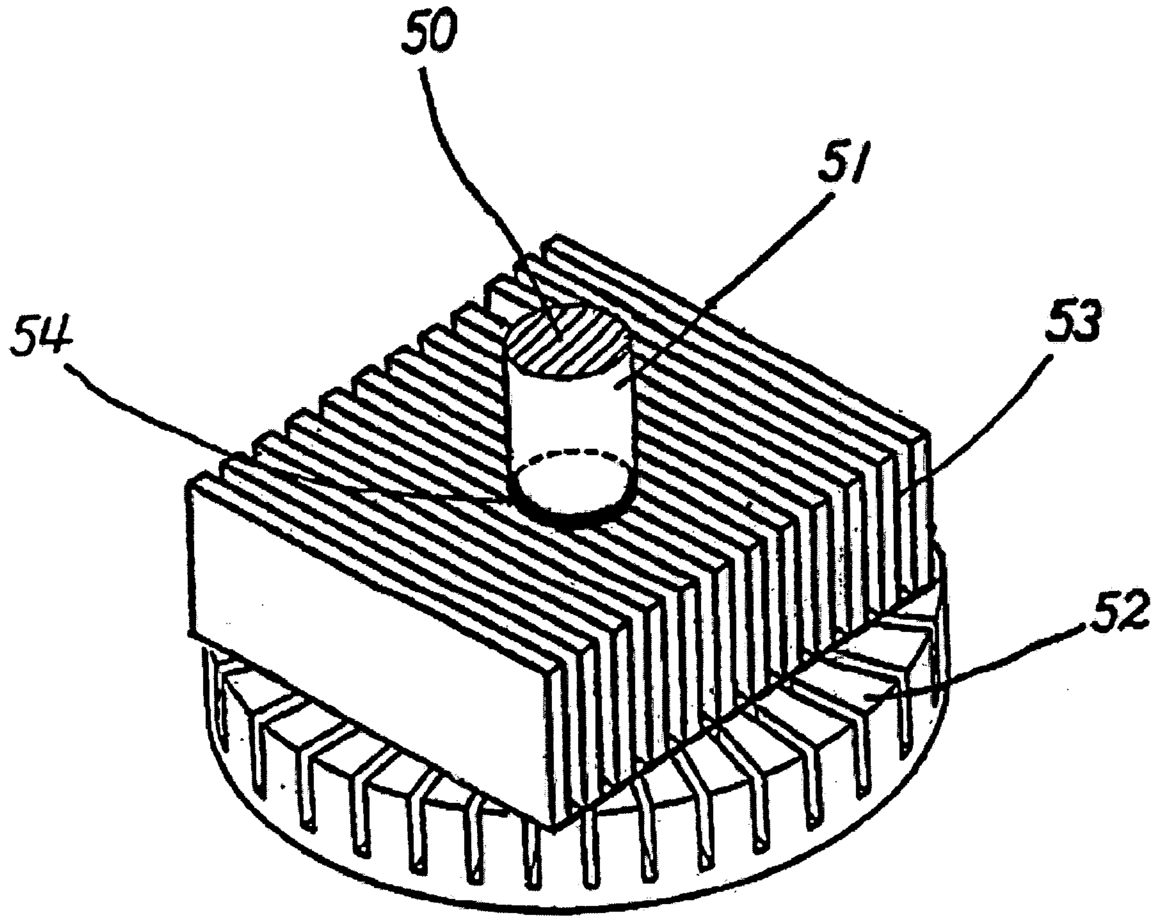

FIG. 5

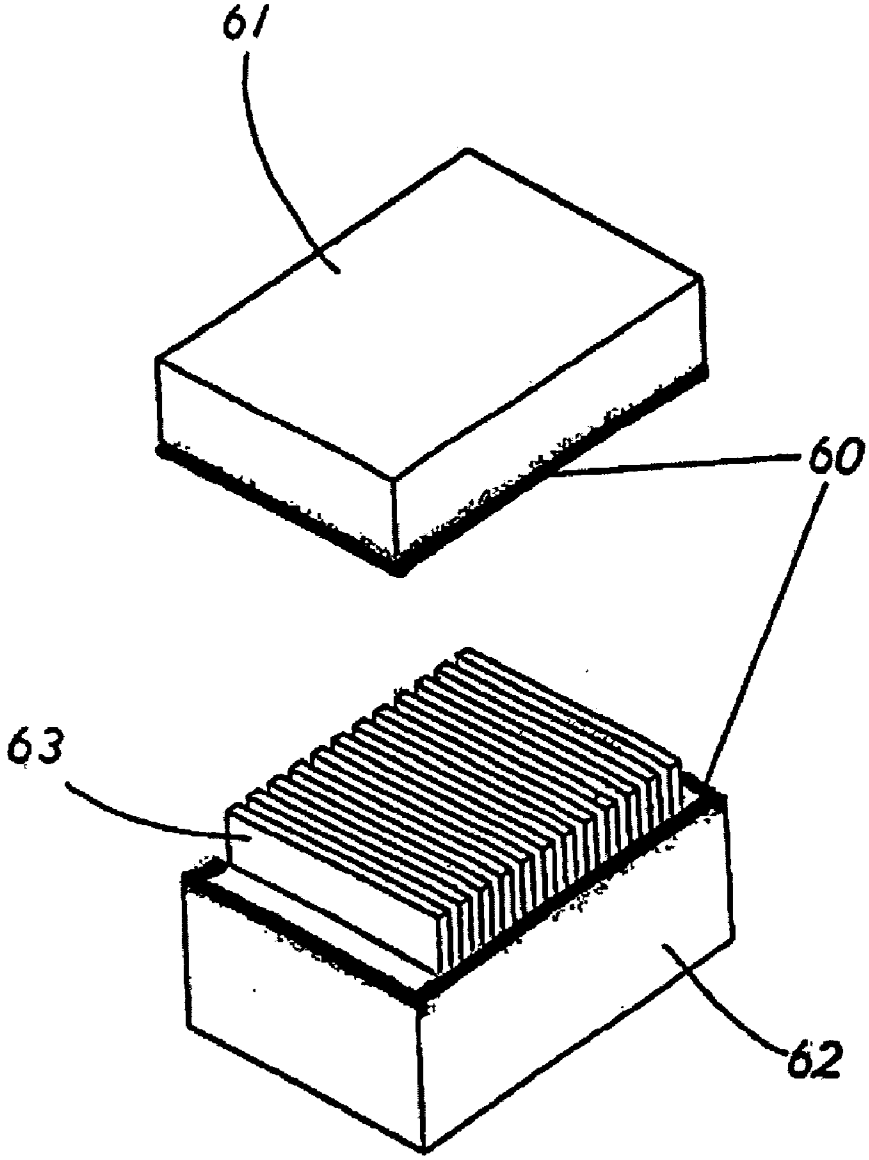

FIG. 6

METHOD FOR ASSEMBLING AND BRAZING CPU HEAT SINK MODULES

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims priority to Taiwanese Patent Bureau Application No. 093110301, filed Apr. 13, 2004, the entire contents of which are hereby incorporated by reference for all purposes.

FIELD OF THE INVENTION

[0002] The present invention relates to methods of assembling heat sinks and attaching them to semiconductor devices. Specifically, the invention relates to methods of brazing (e.g., copper welding) heat sink modules and attaching them to a computer CPU (Central Processing Unit).

BACKGROUND OF THE INVENTION

[0003] Welding is a common process that saves labor, time and materials and is widely used in industrial production processes. Whether used with or without a filler, welding heats and/or pressurizes the molecules in a metal and makes use of cohesion to bond two metals as one.

[0004] Welding techniques include fusion welding and pressure welding. Fusion welding is a type of welding process where the parts to be joined are heated without pressurization until melted to form a welded joint. Examples of fusion welding include hand arc welding and argon arc welding. When pressurization is used during welding to form a welded joint, the welding process is called pressure welding, and examples include contact resistance spot welding and friction welding.

[0005] Sometimes during a production process it is necessary to weld two different metals together, for example, welding aluminum and copper together. Because the difference in the metallic properties can be quite large, normal hand arc welding or argon arc welding cannot be used. It is even more difficult to weld components of different materials because of their own unique structures.

[0006] Tin, having a relatively low melting point, is often used as a filler to weld the heat pipes, fins and base at a low melting point to form a heat sink. When the heat sink is combined with fans, it becomes a heat sink module. In the past, when CPUs operated at lower powers, the heat sink module was able to dissipate the heat generated by the CPU at a satisfactory rate. However, the electronic industry has rapidly made improvements and developed many precision electronic components. These components operate at a higher speeds and powers, generating more heat. For example, when the CPU is operating at a full load, the surface temperature of the chip can reach 100° C. or more. CPU heat sink modules made with traditional soldered heat pipes, fins, and base cannot conduct the heat away from the CPU at a satisfactory rate.

[0007] The electronic industry has tried to make more efficient CPU heat sink modules by introducing new materials and fin shapes. A good heat-dissipating material has been used and multiple fins have been designed to expand the area of the CPU in which heat can be dissipated. An effort to effectively lower the surface temperature of the CPU and to change the air flow of the heat-dissipating fans has been made by way of turning fan blades, causing the cold air of the air current to absorb the heat generated by the CPU to lower the temperature. Despite improvements, the increased efficiencies of heat-dissipating fans and heat sinks have still not kept pace with the increasing rates heat is being generated by faster, more powerful CPUs.

[0008] One reason for the shortcoming may be due to the heat sink's structure: Conventional heat sink modules use tin as the filler to solder the heat pipes, fins and base together. In the rapidly improving electronic industry, tin's low melting point and heat-transfer coefficient is poorly suited for high-heat generating electronic parts. Some manufacturers have responded by substituting pure tin filler with alloys of tin and lead. Tin containing lead has a low melting point, good thermal conductivity and is easy to process, making it a good substitute for pure tin in CPU heat sink applications. However, lead is a very toxic metal, and many government regulatory bodies have restricted (or outright banned) the use of lead in electronic devices.

[0009] In response, electronics manufacturers have experimented with soldering instead of welding the heat sink modules together. Finished products made with soldering at around 180° C., however, are prone to cracking, and even breaking apart. Manufacturers have also experimented with shaping the components of the heat sink module into interlocking pieces that may be joined together without filler or solder. Unfortunately, the heat conductivity of these units is reduced when the pieces loosen after a few heating and cooling cycles, which can create poorly conducting air gaps between the interlocked pieces. This there remains a need for new methods of making heat sink modules, and attaching them to heat generating electronic components such as CPUs.

BRIEF SUMMARY OF THE INVENTION

[0010] Embodiments of the invention include methods of brazing components of heat sink modules. The methods may include the steps of assembling the components to be brazed, and placing a copper-silver alloy filler at junctions between the components. The assembled components may be preheated in an air-tight environment to burn up most of the oxygen present, and then heated to the melting point of the copper-silver alloy filler in an air-tight environment having an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components, making the filler melt and evenly spread over the gaps at the junctions of the components. The assembled components may then be cooled to solidify the liquid filler at the junctions, to form a finished product.

[0011] Embodiments of the invention also include assembly line systems for brazing the components of heat sink modules. The systems may include material input means for introducing assembled components to be brazed, and means for placing copper-silver alloy filler at the junctions of the components to join them and to seal them. The systems may also include a heating unit having an air-tight internal heating chamber for pre-heating the assembled components to burn up most of the oxygen present, and a brazing unit having an air-tight inert gas chamber containing an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components. The system may further include a means for heating the assembled components to a melting point of the filler so as to make the filler melt and evenly spread over the gaps at the junctions of the components, and a cooling unit having a cooling chamber for rapidly chilling the assembled components to solidify the liquid filler at the junctions, thereby forming a finished product. The system may also include a material output means for removing finished products, and a continuous annular conveying device encompassing and connecting the above units to form a automatic and sequential structure.

[0012] Embodiments of the invention also include methods of brazing components of a heat sink module, where the methods may include the steps of providing components of the heat sink module to be brazed, and placing a copper filler on joints of the components and assembling the components. The methods may also include pre-heating the assembled components in an air-tight heating unit to burn up most of the oxygen and pollutants on surfaces of the components, and then heating the assembled components to the melting point of the copper filler in an air-tight brazing unit that has an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components, thereby making the filler melt and evenly spread over the gaps at the junctions of the components. The components may then be cooled to solidify the liquid copper filler at the joints and form the heat sink module.

[0013] Additional embodiments and features are set forth in part in the description that follows, and in part will become apparent to those skilled in the art upon examination of the specification or may be learned by the practice of the invention. The features and advantages of the invention may be realized and attained by means of the instrumentalities, combinations, and methods described in the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a flowchart of the steps of the invention.

[0015] **FIG. 2** is a schematic diagram of the assembly line of the invention.

[0016] **FIG. 3** is perspective view of one embodiment of the invention wherein the components of a heat pipe are assembled and sealed.

[0017] **FIG. 4** is a side view of one embodiment of the invention wherein a heat pipe and flat heat sink are brazed together.

[0018] **FIG. 5** is a perspective view of an interlocked heat sink module wherein no welding is used to form the module.

[0019] **FIG. 6** is a perspective view of one embodiment of the invention illustrating the assembly of a heat sink plate (vapor chamber) used in notebook computers.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present invention relates to methods of assembling and brazing (herein sometimes referred to as "copper welding") the components of heat sink modules for integrated circuit chips, such as computer CPUs (Central Processing Units). The methods employ a filler (e.g., copper, copper-silver alloy, etc.) that is used to braze the components of heat sink modules together securely and durably. The filler is generally easier to melt and harder than the materials from which the components are made. The components of the heat sink modules may be made from a single material, or a plurality of different materials. These materials may include metals and alloys, such as copper, aluminum, and/or combinations of metals.

[0021] The method of the invention may include assembling the components to be brazed, and placing filler at the junctions of these components to join them and to seal them (this may be done at a filling unit). The assembled components may be pre-heated to burn up most of the oxygen present (this may be done at a heating unit), and then heated to the melting point of the filler in the presence of an amount of inert gas sufficient to isolate any remaining oxygen so as to avoid oxidation of the components, thereby making the filler melt and evenly spread over the gaps at the junctions of the components (this may be done at a brazing unit). The fused components may then be rapidly chilled to solidify the liquid filler at the junctions, thereby forming a finished product (this may be done at a cooling unit). The heat sink modules produced are highly durable, airtight and corrosion-resistant. Cold welding and oxidation will not happen and the speed of heat conductivity and efficiency of the heat sink module will be enhanced.

[0022] The present invention also relates to assembly line systems used to braze the components of heat sink modules into finished products. These systems may include a heating unit, a brazing unit, and a cooling unit. The units may be joined by a continuous annular conveying device, and a material input and material output, to form an automatic and sequential structure. The heating unit may be an airtight heating chamber that provides pre-heating of the assembled components to burn up most of the oxygen present in the heating chamber. The brazing unit (also referred to as the welding unit) may be an airtight, inert-gas chamber that provides a sufficient amount of inert gas to displace most of the residual oxygen to avoid oxidizing the components, as they are heated at high temperature to melt the filler material and spread it evenly over the gaps to be brazed. The cooling unit may be an airtight cooling chamber that chills the filler rapidly at the welded joint and solidifies it, thereby joining the components together to form a finished product. As mentioned, all three units may be connected by an annular conveying device.

[0023] The assembly line systems may be automated for mass production of the heat sink modules in a neutral environment, that gives the modules the characteristic of non-attenuation. The methods and systems can produce light mass finished products, avoid heavy metal pollution and reduce other pollution during the production process. Because the electronic industry is rapidly upgrading and developing components which are more precise, efficient and have more thermal energy, large amounts of heat sink modules are needed more than ever in combination with components of high thermal energy. Hence, it is anticipated that the methods and systems described here will be widely applied.

[0024] The methods and assembly line systems of the present invention produce heat sink modules having increased speed and efficiency for conducting heat away from the integrated circuit. The methods and systems avoid cold welding in air, which reduces oxidation of the welded components of the modules. The modules produced are highly durable, airtight, and corrosion-resistant. The methods and systems permit components to be made from materials with high heat-transfer coefficients, and also allow welding together components made from different materials, such as metals having different physical properties and special structure requirements. The present invention further provides production processes that produce heat sink modules having all the parts tightly joined, and are tightly sealed, corrosion-resistant and durable.

[0025] The heat sink modules produced by the methods and assembly line systems of the invention may include heat pipes, fins and a base. Modules with multiple fins having non-conventional shapes may be produced to expand the surface area of heat dissipation from the integrated circuit chip. The fins may be made of copper alloy and copper-silver alloy, which have higher and better heat-transfer coefficient than more conventional materials like aluminum. The methods and systems of the invention allow two different metals to be welded together, like aluminum and copper, without using hand arc welding or argon arc welding, which are difficult to use due to differences in metallic properties. The methods and systems also permit the components to be joined without having to rely on conventional soldering to join different metallic materials together.

[0026] The following description, with reference to the drawings, will help to explain the application and the principles of the invention for better understanding.

[0027] **FIG. 1** is a flowchart showing the steps comprising the process of the invention (the unit of the assembly line used to perform the step is in parentheses). The steps of the process may include providing the components of the assembly **10** to be brazed; providing a filler **11** (e.g., copper-silver alloy filler) at the junctions of the components; and joining and/or sealing the components into the assembly **12**. This may be done at the filler unit. The steps of the process may further include preheating the assembled components **13** to burn up most of the oxygen present (this may be done at the heating unit); and heating the assembled components **14** to the melting point of the copper-silver alloy filler in the presence of an amount of inert gas sufficient to isolate any remaining oxygen so as to avoid oxidation of the components, thereby making filler melt and evenly spread over the gaps at the junctions of the components. The heating step may be performed at the brazing (copper welding) unit. The process may still further include the steps of rapidly chilling the assembly **15** at a cooling unit to solidify the liquid filler at the junctions, thereby forming a finished product **16**.

[0028] **FIG. 2** is a schematic diagram of the assembly line of the present invention. Heating chamber **23** is an airtight chamber which can burn up most of the oxygen with preheating. Inert gas chamber **24** is an airtight chamber that contains an amount of inert gas sufficient to isolate any remaining oxygen to avoid oxidation and that uses high temperature heating to reach the melting point of the copper-silver alloy filler so as to melt it and spread it over the gaps of the welded joints. Cooling unit **25** is also an airtight chamber that is used to rapidly chill and solidify the liquid filler at the welded joints of the assembled components **20**, thereby turning the assembled components **20** into a finished product **26**. An annular conveying device **27** is used to join the aforementioned units into a continuous assembly line that has a material input for introducing components **20** and a material output for exiting finished products **26**, thereby making it an automatic and sequential structure. A filling unit **22** can be installed at the material input of the annular conveying device **27** to simplify the above-described step (b), and annular conveying device **27** may convey assembled components **20** to the heating chamber **23** for the above-described step (c), wherein the assembled components **20** are preheated to burn up most of the oxygen. The annular conveying device **27** may then convey assembled components **20** to the inert gas chamber **24**, wherein an appropriate amount of inert gas is present to isolate the remaining oxygen to avoid oxidation of the components and high temperature heating is used to reach the melting point of copper-silver alloy filler **21** so as to melt the filler **21** and spread it over the gaps of the welded joints of the assembled unit **20**. Finally the assembled components. **20** is then conveyed to cooling chamber **25** from the inert gas chamber **24** to rapidly chill and solidify the filler **21** at the welded joints of the assembled unit **20** thereby forming a finished product **26**. The finished product **26** is then sent to the material output by the annular conveying device **27**. The whole procedure is automatic and sequential.

[0029] The aforementioned automatic production process of the present invention is an easy and convenient procedure. It breaks the bottlenecks of the traditional soldering technology and makes airtight, durable, corrosion-resistant finished products which will greatly improve the speed and efficiency of heat conductivity. The products of the process are not subject to cold welding and oxidation. Ever-improving, highly efficient electronic components will no longer have problems with heat dissipation when the process of the invention is used, possess high economic benefits and can be used in a wider scope of applications.

[0030] **FIG. 3** illustrates the above-described steps (a) assembling the components to be brazed, and (b) placing copper-silver alloy **30** at the junctions of these components to join, seal and assemble them. **FIG. 3** mainly shows the sealing and assembling of a heat pipe **31**. The structural design and shape of heat pipe **31** will change according to different applications, but basically filler **30** is used to seal and assemble the components into an airtight heat pipe **31**. The internal structure design of the heat pipe **31** is used to increase its heat conductivity and heat dissipation. Filler is then used to weld heat pipe **31** to the base **32**. Known technology mainly uses tin filler to seal and assemble heat pipe **31**, but when soldering is heated to around 180° C., it is easy for the welded components of different metals (heat pipe **31** and base **32**) to come apart, to crack or to leak air. These are commonly known as shortcomings of cold welding; hence, up to now the joining of heat pipe **31** and base **32** has been a problem for manufacturers. In accordance with the present invention, copper-silver alloy filler may be placed at the welded joints of the heat pipe **31** and base **32** to seal and assemble them (the above-described step (b) of this invention). The process of this invention is then used to braze the heat sink module, and after brazing (copper welding), both the seal at the heat pipe **31** opening and the seal at the bottom of heat pipe **31** and base **32** are durable, airtight and corrosion-resistant. Cold welding and oxidation will not occur, and the speed and efficiency of heat conductivity of the heat sink module can be highly improved.

[0031] As previously mentioned, to keep up with the ever-improving components with high efficiency and high thermal energy, the heat pipes, fins and base of the heat sink module have gradually moved away from the traditional aluminum raw material and changed to other materials of higher heat-transfer coefficient than aluminum, hoping to increase the heat dissipating efficiency and speed of the heat sink modules. However, traditional soldering technology and fillers have exhibited the various aforementioned bottlenecks and problems. Even though some manufacturers have used vacuum furnaces to apply the brazing (copper welding) process, the machines are not easy to operate, are complicated and costly. There are still problems to overcome; hence, some manufacturers discard the welding method and use the interlocking method to interlock heat pipes, fins and base to form as a unit. But the heat conductivity is not ideal because of not being tightly joined and because of gaps between the components.

[0032] **FIG. 4** illustrates brazing between the heat pipe **41** and the flat heat sink **42**. Likewise, copper-silver alloy filler **40** is placed at the welded joints of the components (heat pipe **41** and flat heat sink **42**) to proceed with the sealing and assembling of the unit (step (b) of the present invention). To make clear the locations of the filler **40**, bold lines and dots are used in the figure.

[0033] **FIG. 5** illustrates an interlocked heat sink module wherein no welding is used to form the unit. A hole **54** having the same diameter as heat pipe **51** is made in the middle of aluminum extrusion heat sink **53**. The aluminum extrusion heat sink **53** interlocks with the heat pipe **51** and then sets on base **52**. In another method, the diameter of hole **54** of the aluminum extrusion heat sink **53** is made slightly smaller than the heat pipe **51**. When heated, the aluminum extrusion heat sink **53** and the heat pipe **51** will expand, interlock with each other and avoid coming apart. The above-mentioned methods will lose not only the heat dissipating efficiency of the heat sink module but also its beneficial results. In contrast, with the procedure of the present invention, copper-silver alloy filler **50** is used to weld and seal the opening of the heat pipe **51**, and the heat pipe is then welded onto the base **52**. After that the heat pipe **51** is inserted into the hole **54** of the aluminum extrusion heat sink **53**, an appropriate amount of filler **50** is placed around the hole **54** of the aluminum extrusion heat sink **53**. (Depending on the material of the heat sink, either tin filler or copper-silver filler is used). The sealing and assembling process are performed next in accordance with step (b) of the present invention. Proceeding with the process of this invention, brazing (copper welding) is the next step. The assembled heat sink module after brazing (copper welding) is durable, airtight and corrosion-resistant, whether it involves the sealing of the opening of the heat pipe **41** (**FIG. 4**), the brazing (copper welding) at the welded joints of the heat pipe **41** and the flat heat sink **42**, the brazing (copper welding) of heat pipe **51** and the base **52** (of different materials) or the brazing (copper welding) of the heat pipe **51** and the aluminum extrusion heat sink **53**. Cold welding and oxidation will not happen to the module. In addition, the speed and efficiency of the heat conductivity of the heat sink module will improve enormously.

[0034] **FIG. 6** illustrates the butt-welding and assembling of a heat sink plate (vapor chamber) used in notebook computers. Skived fins **63** on the bottom cover **62** of the heat sink plate expand and accelerate the speed of heat conductivity of the bottom cover **62**. Known technology uses pure tin (unleaded tin) as filler and flux to butt-weld during the sealing and assembling process of the top cover **61** and the bottom cover **62**. The assembled unit becomes an airtight heat sink plate (vapor chamber), but filler of pure tin (unleaded tin) and flux oxidizes easily and leaks air. Furthermore, the usage of pure tin (unleaded tin) as filler will cause the heat sink plate (vapor chamber) to be incapable of further processing, and the excess pressure resistance of the soldered heat sink plate (vapor chamber) is only 5 kilograms per square centimeter (5 kg/cm^2). The flaws of air leak and weak pressure resistance weaken the heat dissipation effect of notebooks. Using the process of the present invention to seal and assemble the heat sink module, filler **60** made of copper and silver alloy is placed at the corners of the top cover **61** and the bottom cover **62** to butt-weld (the above-described step (b) of this invention). Bold lines are used to mark clearly the locations of the filler. Following the steps of this invention for brazing (copper welding), the heat sink plate (vapor chamber) after brazing (copper welding) is more durable, airtight and corrosion-resistant, and cold welding and oxidation will not happen. The excess pressure resistance will be upgraded to be more than 5 kilograms (5 kg/cm^2), greatly improving the speed and efficiency of the heat conductivity of the heat sink plate (vapor chamber).

[0035] Summarizing the aforementioned, this invention provides an assembly line and brazing (copper welding) process to be applied to the manufacture of heat sink modules. The design is simple and the structure is innovative and unique, offering practical and improved effectiveness. Because the electronic industry is upgrading rapidly, many components of higher precision and efficacy have been developed, and heat sink modules are widely used with the industry's high thermal energy components.

[0036] Having described several embodiments, it will be recognized by those of skill in the art that various modifications, alternative constructions, and equivalents may be used without departing from the spirit of the invention. Additionally, a number of well known processes and elements have not been described in order to avoid unnecessarily obscuring the present invention. Accordingly, the above description should not be taken as limiting the scope of the invention.

[0037] Where a range of values is provided, it is understood that each intervening value, to the tenth of the unit of the lower limit unless the context clearly dictates otherwise, between the upper and lower limits of that range is also specifically disclosed. Each smaller range between any stated value or intervening value in a stated range and any other stated or intervening value in that stated range is encompassed. The upper and lower limits of these smaller ranges may independently be included or excluded in the range, and each range where either, neither or both limits are included in the smaller ranges is also encompassed within the invention, subject to any specifically excluded limit in the stated range. Where the stated range includes one or both of the limits, ranges excluding either or both of those included limits are also included.

[0038] As used herein and in the appended claims, the singular forms "a", "an", and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a process" includes a plurality of such processes and reference to "the electrode" includes reference to one or more electrodes and equivalents thereof known to those skilled in the art, and so forth.

[0039] Also, the words "comprise,""comprising,""include,""including," and "includes" when used in this specification and in the following claims are intended to specify the presence of stated features, integers, components, or steps, but they do not preclude the presence or addition of one or more other features, integers, components, steps, acts, or groups.

What is claimed is:

1. A method of brazing components of a heat sink module comprising the steps of:

(a) assembling the components to be brazed;

(b) placing a copper-silver alloy filler at junctions between the components;

(c) pre-heating the assembled components in an air-tight environment to burn up most of the oxygen present;

(d) heating the assembled components to the melting point of the copper-silver alloy filler in an air-tight environment having an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components, thereby making the filler melt and evenly spread over the gaps at the junctions of the components; and

(e) cooling the assembled components to solidify the liquid filler at the junctions, thereby forming a finished product.

2. The method of claim 1, wherein the components of the heat sink module comprise a heat pipe, fins and base.

3. The method of claim 1, wherein the components are components of a heat sink plate for a central processing unit of a computer.

4. The method of claim 3, wherein the computer is a notebook computer.

5. The method of claim 1, wherein the components of the heat sink module are made of copper.

6. The method of claim 1, wherein the placing of the filler at the junctions the junctions of the components is done by an automatic filling unit.

7. The method of claim 1, wherein the assembled components are pre-heated at about 200° C.

8. The method of claim 1, wherein the assembled components are heated up to about 800° C. to melt the filler.

9. The method of claim 1, wherein the inert gas comprises N_2.

10. An assembly line system for brazing the components of a heat sink module comprising:

material input means for introducing assembled components to be brazed;

means for placing copper-silver alloy filler at the junctions of the components to join them and to seal them;

a heating unit having an air-tight internal heating chamber for pre-heating the assembled components to burn up most of the oxygen present;

a brazing unit having an air-tight inert gas chamber containing an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components, and means for heating the assembled components to a melting point of the filler so as to make the filler melt and evenly spread over the gaps at the junctions of the components;

a cooling unit having a cooling chamber for rapidly chilling the assembled components to solidify the liquid filler at the junctions, thereby forming a finished product;

material output means for removing finished products; and

a continuous annular conveying device encompassing and connecting the above units to form a automatic and sequential structure.

11. The assembly line system of claim 11, wherein the means for placing copper-silver alloy filler is a filling device installed at the material input means.

12. The assembly line system of claim 12, wherein the filling device is an automatic filling unit.

13. The assembly line system of claim 11, wherein the heating unit comprises a heating chamber in which the assembled components are pre-heated to about 200° C.

14. The assembly line system of claim 11, wherein the brazing unit comprises a passivation chamber in which the assembled components are heated up to about 800° C.

15. The assembly line system of claim 11, wherein the inert gas to displace oxygen comprises N_2.

16. The assembly line system of claim 11, wherein the assembled components are components of a heat sink plate for a central processing unit of a computer.

17. The assembly line system of claim 11, wherein the computer is a notebook computer.

18. The assembly line system of claim 11, wherein the assembled components comprise at least one heat pipe, at least one heating fin, and a base.

19. The assembly line system of claim 11, wherein the components of the heat sink module are made of copper.

20. A method of brazing components of a heat sink module comprising the steps of:

providing components of the heat sink module to be brazed;

placing a copper filler on joints of the components and assembling the components;

pre-heating the assembled components in an air-tight heating unit to burn up most of the oxygen and pollutants on surfaces of the components;

heating the assembled components to the melting point of the copper filler in an air-tight brazing unit that has an amount of inert gas sufficient to displace oxygen so as to avoid oxidation of the components, thereby making the filler melt and evenly spread over the gaps at the junctions of the components; and

cooling the assembled components to solidify the liquid copper filler at the joints and form the heat sink module.

* * * * *