TEMPERATURE MANAGING FOR ELECTRONIC COMPONENTS

Inventor: Torbjörn Nilsson, Valda (SE)

Correspondence Address:
ERICSSON INC.
6300 LEGACY DRIVE, M/S EVR 1-C-11
PLANO, TX 75024 (US)

Appl. No.: 12/302,618
PCT Filed: Jun. 2, 2006
PCT No.: PCT/SE2006/000657
§ 371 (c)(1), (2), (4) Date: Nov. 26, 2008

Publication Classification

Int. Cl. (51)
P28D 15/00 (2006.01)

U.S. Cl. .......................................................... 165/104.33 (52)

ABSTRACT

A method and arrangement for managing the temperature of an electronic component. A reservoir holds a tempering liquid. A pressurizing device pressurizes the liquid, and provides the liquid to a spraying device, which sprays the liquid onto the electronic component. A heat remover cools the liquid when thermal energy is to be removed from the component, and a heating device heats the liquid when thermal energy is to be provided to the component when powering up the component in low temperatures.
TEMPERATURE MANAGING FOR ELECTRONIC COMPONENTS

TECHNICAL FIELD

[0001] The present invention relates in general to a spray tempering arrangement capable of both cooling and heating electronic components.

BACKGROUND OF THE INVENTION

[0002] Today liquid cooling is well known in the art of cooling electronics. As air cooling systems continue to be pushed to new performance levels, so has their cost, complexity, and weight. Liquid cooling is replacing air cooling and enables the performance of electronics to grow exponentially.

[0003] A preferred method of liquid cooling is the so-called two-phase cooling. A two-phase cooling occurs when the coolant changes from one phase to another, e.g. from liquid to vapor. Due to the increased energy required for a phase change, two-phase cooling systems often offers the ability to provide more compact and higher performance cooling systems than single-phase systems. As a contrast, a single-phase cooling occurs when the coolant remains in the same phase during the whole cooling process, e.g. remains liquidified or vaporized during the whole cooling process.

[0004] An exemplary two-phase cooling method is spray cooling. Common spray cooling system uses at least one pump for supplying fluid to at least one nozzle that transforms the fluid into droplets. These droplets impinge on the surface of the component to be cooled so as to typically create a thin liquid film. Energy is transferred from the surface of the component to the thin liquid film as the liquid evaporates. Since the fluid may be dispersed at or near its saturation point, the absorbed heat causes the thin film to turn to vapor. This vapor is then condensed, often by means of a heat exchanger, or condenser, and returned to a reservoir and/or the pump.

[0005] However, even if the cooling ability of a spray cooling system may be satisfactory the opposite problem is not approached. Today there is a problem to get electronics to start, or start properly, in low temperatures. This may e.g. be the case during power up in winter conditions or on high altitudes. In addition, an operative electronic component may also be exposed to environment temperatures and/or operative conditions that lower the working temperature of the operative component to an unsatisfactory level.

[0006] However, some alternatives exist to deal with low temperature in electronic components:

[0007] Foil or resistors or other type of electrical heaters can be arranged close to the electronic components. However this requires a certain amount of volume, extra cabling and it has to be designed into the system from the start. In addition, the trend is dense packaging of the electronic components, not to insert a number of extra components.

[0008] Heated air can be arranged to flow around the electronics. However, this requires extra volume for air channels, fan and heater. It will also add extra weight to the system.

[0009] Heated liquid can be arranged to flow in radiators or convectors near the electronics. However, this requires extra volume for piping, radiators/convectors and pump. It will also add extra weight to the system.

[0010] The electronic components can be selected from components that are specified for particularly low temperatures. However, this is only possible to a certain degree, e.g. depending on the limited availability of such components with the required functions. The components are also costly and rarer than normal components.

[0011] Hence there is a need for an improved temperature managing arrangement which utilizes the advantages of a two-phase cooling method or at least a single-phase cooling method for cooling electronic components, which arrangement avoids at least one of the disadvantages associated with starting and/or operating electronic components in low temperatures as mentioned above.

SUMMARY OF THE INVENTION

[0012] The present invention represents an improvement compared to prior art by providing a spray tempering arrangement capable of both heating and cooling electronic components.

[0013] This is achieved by a temperature managing arrangement comprising a reservoir arranged to operatively accumulate a tempering liquid, a pressurizing device arranged to operatively pressurise the tempering liquid and at least one spray module arranged to operatively receive the pressurized liquid and which comprises at least one spraying device, e.g. a nozzle, arranged to operatively spray the liquid on at least one electronic component so as to create a thermal coupling between the sprayed liquid and the component. In addition, the temperature managing arrangement comprises a heat remover arranged to operatively cool the tempering liquid after spraying when thermal energy is to be removed from said component (224). Here, the tempering liquid becomes at least one of a liquid, a vapor or a mist after spraying, e.g. due to sprinkling in the spraying device or heating by the electric component. Further, the tempering managing arrangement comprises a heating device arranged to operatively heat the tempering liquid before spraying when thermal energy is to be provided to said component. Here, the tempering liquid is in liquid form before spraying.

[0014] Regarding a removal of thermal energy it is preferred that the thermal energy is removed from said component according to a two-phase cooling.

[0015] The tempering liquid is preferably an electrically insulating fluid.

[0016] The heating device is preferably arranged to operatively heat the tempering liquid to a temperature near or above the middle of the temperature range specified by the manufacturer for the electronic component to be provided with thermal energy.

[0017] Said at least one spraying device can be arranged to operatively spray the tempering liquid on a first electronic component in the form of a cooling flange or a cooling surface thermally coupled to a second electronic component to be heated or cooled by the liquid.

[0018] Said at least one spraying device can be arranged to operatively spray the tempering liquid on an electronic component in the form of a circuit board, or a rack provided with a plurality of circuit boards.

[0019] Said at least one spraying device can be arranged to operatively spray the tempering liquid on a first electronic component in the form of a cooling flange or a cooling surface thermally coupled to a second electronic to be heated or cooled by the liquid.
Said spray module can comprise at least two types of spraying devices, wherein a first spraying device type is arranged to be operatively used when the temperature managing arrangement operates as a cooling arrangement and a second spraying device type is arranged to be operatively used when the temperature managing arrangement operates as a heating system.

In addition, the present invention represents an improvement compared to prior art by providing a method for temperature managing using said temperature managing arrangement, which method comprises the steps of accumulating a tempering liquid (242) in a reservoir (140, 240); pressurizing the tempering liquid (242) by means of a pressurizing device (110, 210); providing the pressurized liquid (242) to at least one spray module (120, 220) comprising at least one spraying device (222) arranged to spray the liquid (242) onto at least one electronic component (224) so as to create a thermal coupling between the sprayed liquid (242) and the component (224); cooling the tempering liquid (242), being in at least one of a liquid, a vapor or a mist form after spraying, by means of a heat remover (130, 230) when thermal energy is to be removed from said component (224); and heating the tempering liquid (242) by means of a heating device (145, 245) before spraying, when thermal energy is to be provided to said component (224).

The steps must not necessarily be performed in the above order.

According to the method, the tempering liquid is preferably heated to a temperature near or above the middle of the temperature range specified by the manufacturer for the electronic component to be provided with thermal energy.

According to the method, at least one spraying device is spraying the tempering liquid on a first electronic component in the form of a cooling flange or a cooling surface thermally coupled to a second electronic component to be heated or cooled by the liquid.

According to the method, said at least one spraying device can spray the tempering liquid on an electronic component in the form of a circuit board, or a rack provided with a plurality of circuit boards.

According to the method, said at least one spraying device can spray the tempering liquid on a first electronic component in the form of a cooling flange or a cooling surface thermally coupled to a second electronic to be heated or cooled by the liquid.

Further advantages of the present invention and embodiments thereof will appear from the following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of a temperature managing arrangement in the form of an exemplifying spray tempering system 100 according to a first embodiment of the present invention.

FIG. 2 is a schematic illustration of a temperature managing arrangement in the form of an exemplifying spray tempering system 200 according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A First Embodiment

Structural Elements

FIG. 1 is a schematic illustration of a closed loop two-phase spray tempering system 100 according to a first exemplifying embodiment of the present invention. The exemplifying spray tempering system 100 comprises a pump 110, a spray module 120, a heat remover 130 and a reservoir 140 provided with a heating device 145. The tempering system 100 also comprises a tube system 150 for connecting said components in a suitable manner, i.e. said reservoir 140 to said pressurizing device 110 and further to said spray module 120 and to said heat remover 130 and back again to said pressurizing device 110.

The pump 110 is adapted to pressurize a suitable tempering liquid (not shown in FIG. 1). Preferably the pump 110 is powered by means of a direct-current motor for creating accurate and precise pressures and flow rates. However, the pump 110 can be powered by other means, e.g. an alternating current motor, a hydraulic motor or any other suitable powering means. The pump 110 operates according to any suitable method for pressurizing the tempering liquid, e.g. according to a reciprocating method or a rotary method in connection with displacement pumping or dynamic pumping.

The spray module 120 is provided with at least one nozzle. Several spray modules 120 may be used within the spray tempering system 100 and each spray module may comprise a plurality of nozzles.

The heat remover 130 may be a heat exchanger or some other suitable condensing means adapted to operatively condense the mixture of liquid, mist (i.e. small droplets of the liquid floating through air or some other gas) and vapor (i.e. the gas state of the liquid) that is created within or in the vicinity of the spray module 120 during cooling.

The reservoir 140 is adapted to accumulate the tempering liquid of the tempering system 100. The reservoir is illustrated as a separate unit in FIG. 1, being connected to the spray tempering system by the tube system 150. This indicates that the reservoir 140 is formed as a separate chamber of suitable size. However, in some embodiments a reservoir may be formed entirely by the tube system 150, i.e. the tubes alone may provide enough volume to form a suitable reservoir.

The heating device 145 is preferably arranged in the liquid-filled part of the tempering system 100. As indicated in FIG. 1 it is particularly preferred that the heating device 145 is arranged in the reservoir 140 to operatively heat the tempering liquid therein. The heating device 145 is preferably an immersion heater or similar arranged within the tempering liquid. However, other heat sources are clearly conceivable, e.g. a heat exchanger or even a microwave emitter.

Function of and Co-Operation Between the Structural Elements

In operation the tempering liquid is pressurized by the pump 110 and subsequently moved to a series of system components via the tube system 150. The tube system 150 is made of a material that is compatible with the tempering liquid. The material can be rigid or semi-rigid, or even flexible to allow for variable three dimensional configurations.

The spray module 120 in the spray tempering system 100 is arranged to operatively receive pressurized tempering liquid from the pump 110. The nozzle or nozzles of the spray module 120 is/are arranged to operatively spray the received tempering liquid onto at least one electronic component (not shown in FIG. 1).

When the electronic components are cooled by the spray module 120, a mixture of liquid, mist and vapor is created within or in the vicinity of the spray module 120. The liquid and the mist are essentially created by the spraying
activity of the spray module 120, whereas the vapor is essentially created from the liquid being gasified by absorbing energy from the hot components within or in the vicinity of the spray module 120.

[0039] The resulting mixture of liquid, mist and vapor is received by the heat remover 130 via the tube system 150 of the spray tempering system 100. It is preferred that the heat remover 130 is arranged in the mixture filled and not the liquid filled part of the spray tempering system 100. The heat remover 130 in FIG. 1 is illustrated as a separate unit connected to the spray tempering system 100 by the tube system 150. However, the heat remover 130 may alternatively be arranged in the spray module 120 or in the reservoir 140 or in any other suitable position in the mixture filled parts of the spray tempering system 100.

[0040] The condensed liquid is collected in the reservoir 140 from which the liquid is subsequently retrieved to be pressurized again by the pump 110.

[0041] The spray-cooling function of the exemplifying spray tempering system 100 in FIG. 1 has been discussed above in some detail. The description will now proceed with a discussion of the spray-heating capability of the spray tempering system 100 in FIG. 1.

[0042] The heating capability of the spray tempering system 100 requires a heating device. Hence, an exemplifying heating device 145 arranged in the reservoir 140 is schematically illustrated in FIG. 1. It is particularly preferred that the heater 145 is arranged in the reservoir 140 for operatively heating the tempering liquid therein to a temperature within the temperature interval specified by the manufacturer of the electronic component (e.g. specified by the manufacturer of an integrated circuit). For components with a specified temperature range of 0-70°C, the tempering liquid could e.g. be heated to a temperature within the interval of 10-65°C or within the interval of 20-55°C, or more preferably to a temperature near the middle of the temperature range specified by the manufacturer. For components with a specified temperature range of e.g. 0-70°C, this implies that the tempering liquid may be heated to a temperature near 35°C. However, due to losses in the tube system 250 and in other components of the spray tempering system 100 it may be necessary to heat the tempering liquid even further, e.g. heated an additional 5-20°C.

[0043] The heated tempering liquid in the reservoir 140 is moved by the pump 110 to the spray module 120. The spray module 120 is arranged to operatively spray the received heated tempering liquid onto at least one electronic component (not shown in FIG. 1). The spraying is preferably accomplished by utilizing the same spraying means (e.g. the same nozzle) that is used for spray-cooling the electronic component as previously described.

[0044] When the electronic components are spray-heated by the spray module 120, a heated mixture of liquid and mist (i.e. small droplets floating through air or similar gas) is created by the spraying activity within the spray module 120. However, since the temperature of the electronic components are assumed to be below the temperature of the sprayed mixture there will be no energy transported from the components to the heated mixture when the spray-heating capability of the system 100 is utilized. Consequently, there is no creation of vapor. Instead the heated mixture will be cooled by the electronic components in the spray module 120, at the same time as the mixture will assume a liquid state as it hits the components and objects in the spray module 120.

[0045] The liquefied mixture is received by the heat remover 130 and is then collected in the reservoir 140, wherein the liquid is heated and subsequently retrieved to be pressurized again by the pump 110. It should be added that the heat remover 130 may be idle or even turned off when the heating capability of the spray tempering system 100 is used, since there is substantially no mist or vapor to condensate when the spray-heating capability is utilized. In other words, the liquefied mixture (i.e. the tempering liquid) is simply moved through the heat remover 130, or is alternatively bypassing the heat remover 130 as schematically illustrated by the bypass tube 151 in FIG. 1.

[0046] From the above it should be clear that the heated tempering liquid enables the spray tempering system 100 to heat the electronic components as well as cool the components as previously described.

[0047] Heating of electronic components is particularly advantageous when the components are powered up in cool environments, e.g. during power up in winter conditions or on high altitudes. A heating is also advantageous when an operative electronic component is exposed to environment temperatures and/or operational conditions that lower the working temperature of the component to an unsatisfactory level. On the whole, the heating ability of the spray tempering system 100 is generally advantageous whenever the temperature of an electronic component falls below or is near the allowed lower working temperature specified by the manufacturer of the electronic component.

A Second Embodiment

Structural Elements

[0048] FIG. 2 is a schematic illustration of a closed loop two-phase spray tempering system 200 according to a second exemplifying embodiment of the present invention. The exemplifying spray tempering system 200 comprises a pump 210, a filter 215, a spray module 220, a heat remover 230 and a reservoir 240. The tempering system 200 also comprises a tube system 250 for connecting said components in a suitable manner, i.e. said reservoir 240 to said pressurizing device 210 and furthermore to said spray module 220 and to said heat remover 230, and back again to said pressurizing device 110.

[0049] The pump 210, the spray module 220, the heat remover 230, the reservoir 240 and the tube system 250 operates in the same or similar way as the corresponding components described above in connection with the first embodiment of the present invention.

[0050] Hence, e.g. the pump 210 is arranged to pressurize a suitable tempering liquid 242 in the same or similar way as described above in connection with the pump 110 in the first embodiment.

[0051] Similarly, the spray module 220 is preferably provided with at least one nozzle. More than one spray module 220 may be used within the spray tempering system 200 and each spray module may comprise a plurality of nozzles.

[0052] In addition, the heat remover 230 may be a heat exchanger or some other suitable condensing means arranged to operatively condense the resulting mixture to a liquid.

[0053] However, in the second embodiment the tempering liquid 242 is defined as being any well known electronic tempering liquids such as e.g. Fluorinert™, which is the brand name for the line of electronics coolant liquids sold commercially by 3M. This is an electrically insulating, inert perfluorocarbon fluid which is used in various cooling appli-
cations. Different molecular formulations are available with a variety of boiling points, allowing it to be used in “single phase” applications wherein it remains a fluid, or for “two-phase” applications wherein the liquid boils to remove additional heat via evaporative cooling. An example of one of the formulations 3M uses would be for instance, FC-72, or per-fluorohexane (CF$_3$F$_5$) which is used for low temperature heat transfer applications due to its boiling point of 56°C. Fluorinert™ is often used in situations where air would not carry away enough heat, or where airflow is so restricted that some sort of forced pumping is required anyway. Generally it is preferred that the tempering liquid 242 is in liquid form at the temperature when the electronic component is switched on.

Function of and Co-Operation Between the Structural Elements

[0054] In operation the tempering liquid 242 is pressurized by the pump 210 so as to be moved from the reservoir 240 via the tube system 250 through the filter 215 and into the spray module 220.

[0055] Preferably the spray module 220 in the spray tempering system 200 comprises a substantially closed space—e.g. a substantially closed box—arranged to receive the pressurized tempering liquid 242 from the pump 210. Internally the spray module 220 is arranged to operatively spray the received tempering liquid 242 onto at least one electronic component 224. The spraying is preferably accomplished by means of a nozzle arrangement 221 provided with at least one nozzle 222. The nozzle 222 is arranged so as to operatively direct a spray 223 of mist and/or droplets onto the electronic component 224 when the spray module 220 receives pressurized tempering liquid 242 from the pump 210.

[0056] When the electronic component 224 is cooled by the spray 223 a mixture of liquid, mist (i.e. small droplets of the liquid floating through air or some other gas) and vapor (i.e. the gas state of the liquid) is created within the spray module 220. The liquid and the mist are essentially created by the spraying activity of the nozzle 222, whereas the vapor is essentially created from the liquid being gasified by absorbing energy from the hot component 224.

[0057] The resulting mixture of liquid, mist and vapor is cooled by the heat remover 230 arranged in the spray module 220. The heat remover 230 in FIG. 2 is arranged at an upper end of the spray module 220 under the assumption that the vapor is rising within the module 220. Other positions are clearly conceivable to meet other distributions of the vapor within the module 220. It is preferred that the heat remover 230 is a thermally conductive helix or some other thermally conductive structure through which a coolant can be circulated so as to condense the resulting mixture of liquid, mist and vapor to a liquid 242. However, other well known cooling arrangements are clearly conceivable. The circulation of the coolant in the heat remover 230 is illustrated by two opposite arrows at the top of FIG. 2.

[0058] The condensed liquid 242 flows downwards in the spray module 220 in FIG. 2 by means of gravity to a lower end of the module 220, from where it is collected in the reservoir 240 via a part of the tube system 250. The tempering liquid 242 is subsequently retrieved from the reservoir 240 to be pressurized again by the pump 210.

[0059] The spray-cooling function of the exemplifying spray tempering system 100 in FIG. 1 has now been discussed in some detail and the description proceeds with a discussion of the spray-heating capability of the spray tempering system 200 in FIG. 2.

[0060] The heating capability of the spray tempering system 200 in FIG. 2 requires a heating device, i.e. similar to the first embodiment discussed above with reference to FIG. 1. Hence, an exemplifying heating device 245 is schematically illustrated in FIG. 2. The heating device 245 is arranged in the reservoir 240 so as to operatively heat the tempering liquid 242 therein. It is preferred that the heating device 245 is an electrically powered immersion heater or similar, even if other heat sources are conceivable. The electrical feeding of the heating device 245 is illustrated by two opposite arrows at the bottom of FIG. 2.

[0061] The heated tempering liquid 242 in the reservoir 240 is moved by the pump 210 to the spray module 220. The spray module 220 is arranged to operatively spray the received heated tempering liquid onto at least one electronic component 224. The spraying is preferably accomplished by utilizing the same spraying means (e.g. the same nozzle) that is used for spray-cooling the electronic component as previously described.

[0062] When the electronic component 224 is heated by the spray 223 a heat mixture of liquid and mist (i.e. small droplets floating through air or similar gas) is created in the spray module 220. However, since the temperature of the electronic component 224 is assumed to be below the temperature of the heat mixture, there will be no thermal energy transported from the component 224 to the mixture. Consequently, there is no creation of vapor. Instead the heat mixture will be cooled by the electronic component 224 in the spray module 220, at the same time as the mixture will assume a liquid state as it hits the cold component 224 and other objects in the spray module 220.

[0063] The liquefied mixture is received by the heat remover 230 and then collected in the reservoir 240, wherein the liquid 242 is re-heated. In general it is preferred that the tempering liquid 242 is heated to a temperature that ensures to a suitable working temperature specified by the manufacturer of the electronic component 224 to be heated. However, as already mentioned above, due to losses in the tube system 250 and in other components of the spray tempering system 200 it may be necessary to heat the tempering liquid 242 even further, e.g. heated an additional 5–20°C.

[0064] From the above it should be clear that the heated tempering liquid enables the spray tempering system 200 to heat the electronic component 224 as well as cool the component 224 as previously described.

[0065] It should be added that the invention is by no means limited to one or several single electronic components 224. On the contrary, the electronic component may be a full circuit board comprising a plurality of different electronic and non-electronic components. The electronic component may even be a rack provided with a plurality of such circuit boards comprising a plurality of different electronic and non-electronic components. A spray cooling system designed to operate on circuit boards in a rack is described in e.g. U.S. Pat. No. 5,718,117 granted to McDunn et. al. However, the McDunn patent does not provide for a heating capability and in particularly not a heating capability that is integrated in the spray cooling system as in the present invention.

[0066] Furthermore, even if the spray tempering system 200 in FIG. 2 has been illustrated with a single nozzle 222 this does not prevent other embodiment from utilizing two or
several different nozzle types. A first nozzle type may e.g. be adapted to be used when the tempering system operates as a cooling system and a second nozzle type may be adapted to be used when the system operates as a heating system.

Moreover, even if the nozzle 222 in the spray module 220 delivers the spray 223 directly onto the electronic component 224 is should be emphasised that the spray may be delivered to a cooling flange or some other cooling surface or cooling arrangement that is thermally coupled to the electronic component in question, i.e. the spray is delivered directly to the cooling arrangement and possibly indirectly to the electronic component to be cooled or heated. In that case, the cooling flange or other cooling surface or cooling arrangement should be regarded as the “electronic component”.

The present invention has now been described with reference to exemplifying embodiments. However, the invention is not limited to the embodiments described. On the contrary, the full extent of the invention is determined by the scope of the appended claims.

1-11. (canceled)

12. An arrangement for managing a temperature of an electronic component, said arrangement comprising:
   a reservoir for holding a tempering liquid;
   a pressurizing device connected to the reservoir for pressurizing the tempering liquid;
   a spraying device for receiving the pressurized liquid from the reservoir and spraying the liquid onto the electronic component so as to create a thermal coupling between the sprayed liquid and the component;
   a heat remover for cooling the tempering liquid when thermal energy is to be removed from the component, wherein the tempering liquid is in at least one of a liquid, a vapor, or a mist form after spraying; and
   a heating device in the reservoir for heating the tempering liquid before spraying when thermal energy is to be provided to the component when powering up the component in low temperatures.

13. The temperature managing arrangement according to claim 12, wherein the spraying device sprays the tempering liquid on a cooling flange or a cooling surface thermally coupled to the electronic component to be heated or cooled by the liquid.

14. The temperature managing arrangement according to claim 12, wherein the spraying device sprays the tempering liquid on an electronic component in the form of a circuit board or a rack provided with a plurality of circuit boards.

15. The temperature managing arrangement according to claim 12, wherein the heating device heats the tempering liquid to a temperature approximately at the middle of a temperature range specified by a manufacturer for the electronic component to be provided with thermal energy.

16. The temperature managing arrangement according to claim 12, wherein the spraying device sprays the tempering liquid on a cooling flange or a cooling surface thermally coupled to the electronic component to be heated or cooled by the liquid.

17. The temperature managing arrangement according to claim 12, wherein the spraying device sprays the tempering liquid on an electronic component in the form of a circuit board or a rack provided with a plurality of circuit boards.

18. The temperature managing arrangement according to claim 12, wherein the spraying device includes a first spraying device type for use when the temperature managing arrangement operates as a cooling arrangement and a second spraying device type for use when the temperature managing arrangement operates as a heating arrangement.

19. A method of managing a temperature of an electronic component, said method comprising the steps of:
   holding a tempering liquid in a reservoir;
   pressurizing the tempering liquid utilizing a pressurizing device connected to the reservoir;
   providing the pressurized liquid from the reservoir to a spraying device;
   spraying the liquid onto the electronic component so as to create a thermal coupling between the sprayed liquid and the component;
   cooling the tempering liquid utilizing a heat remover when thermal energy is to be removed from the component, wherein the tempering liquid is in at least one of a liquid, a vapor, or a mist form after spraying; and
   heating the tempering liquid before spraying utilizing a heating device in the reservoir when thermal energy is to be provided to the component when powering up the component in low temperatures.

20. The method according to claim 19, wherein the step of heating the tempering liquid includes heating the tempering liquid to a temperature approximately at the middle of a temperature range specified by a manufacturer for the electronic component to be heated.

21. The method according to claim 19, wherein the step of spraying the liquid onto the electronic component includes spraying the tempering liquid on a cooling flange or a cooling surface thermally coupled to the electronic component to be heated or cooled by the liquid.

22. The method according to claim 19, wherein the step of spraying the liquid onto the electronic component includes spraying the tempering liquid on an electronic component in the form of a circuit board or a rack provided with a plurality of circuit boards.