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(54) **EXTERNAL ATTACHABLE HEAT EXCHANGER**

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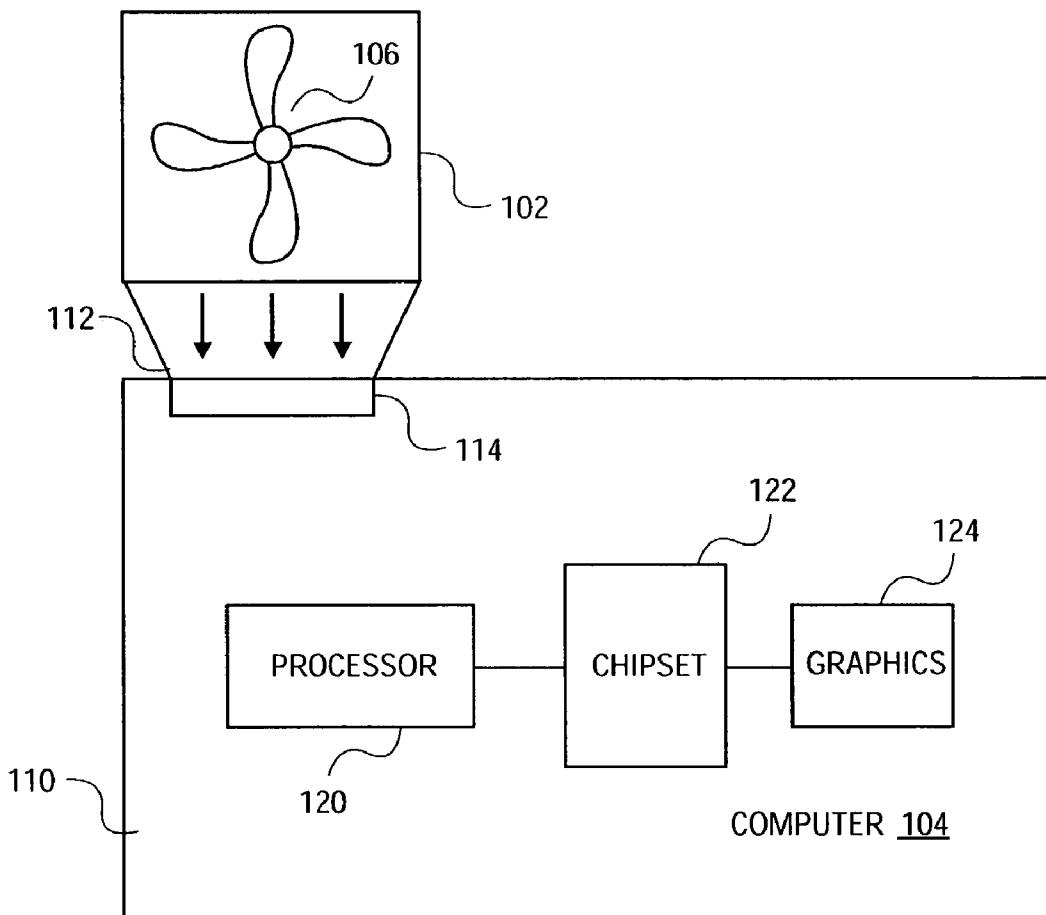
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(57) **ABSTRACT**

An external heat exchanger to be attached external to a computer to force air into an internal chamber of the computer, to reduce an ambient temperature within the chamber of the computer.

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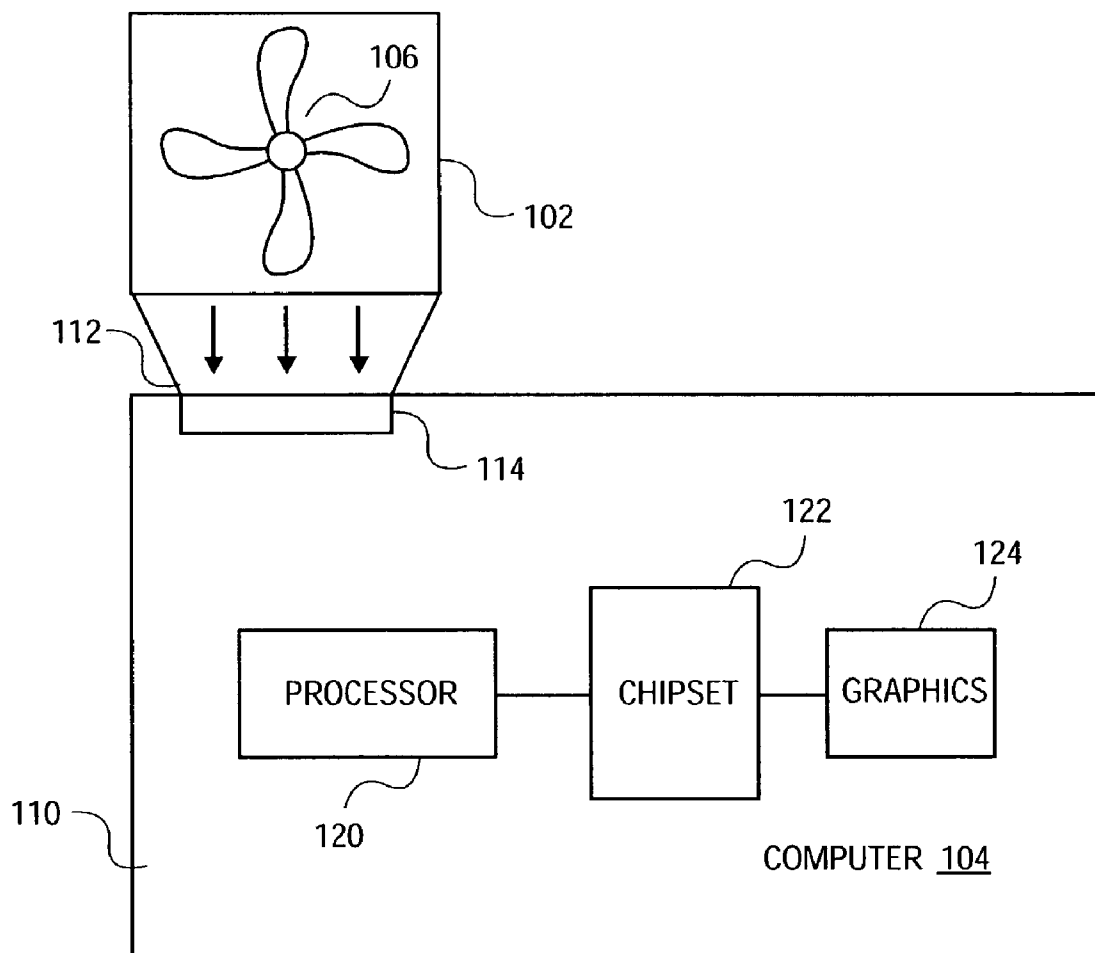


FIG. 1

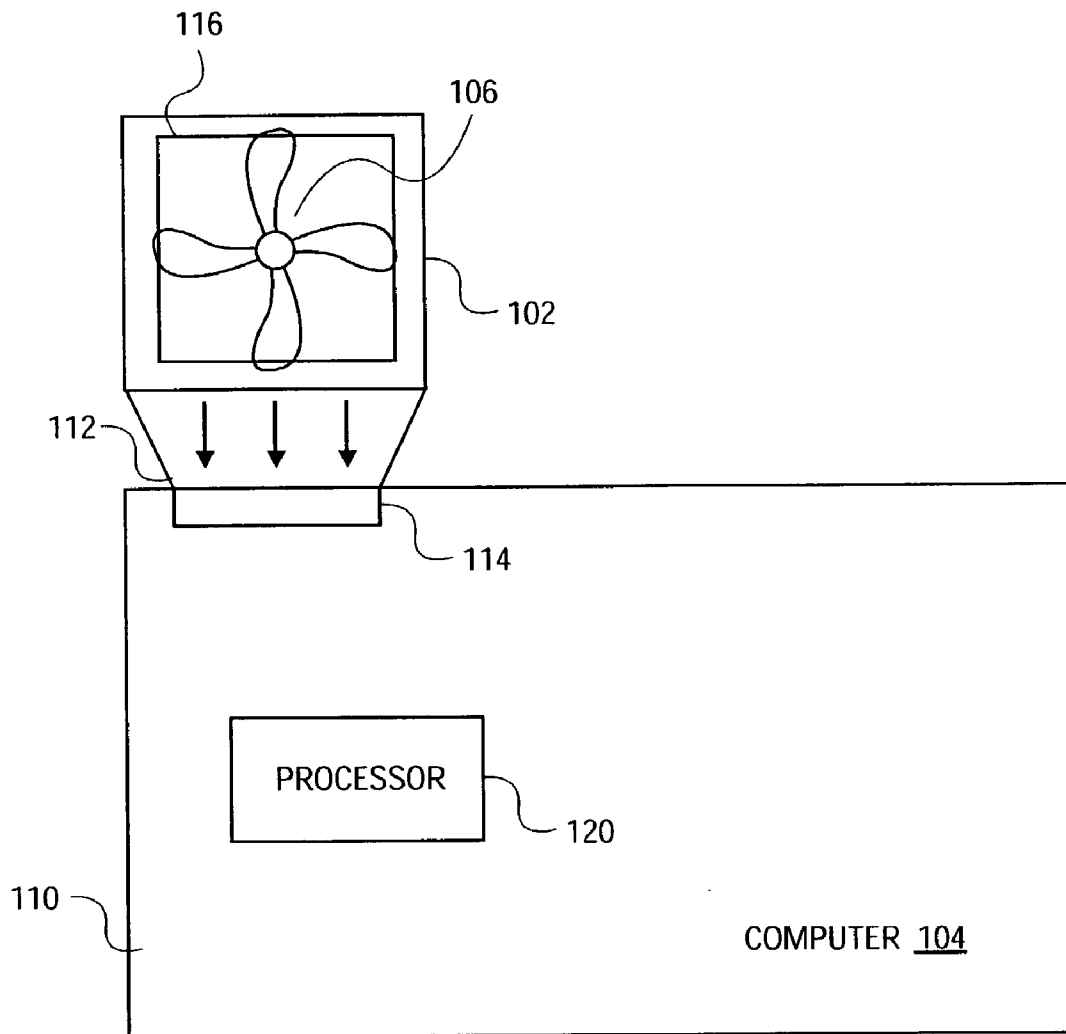


FIG. 2

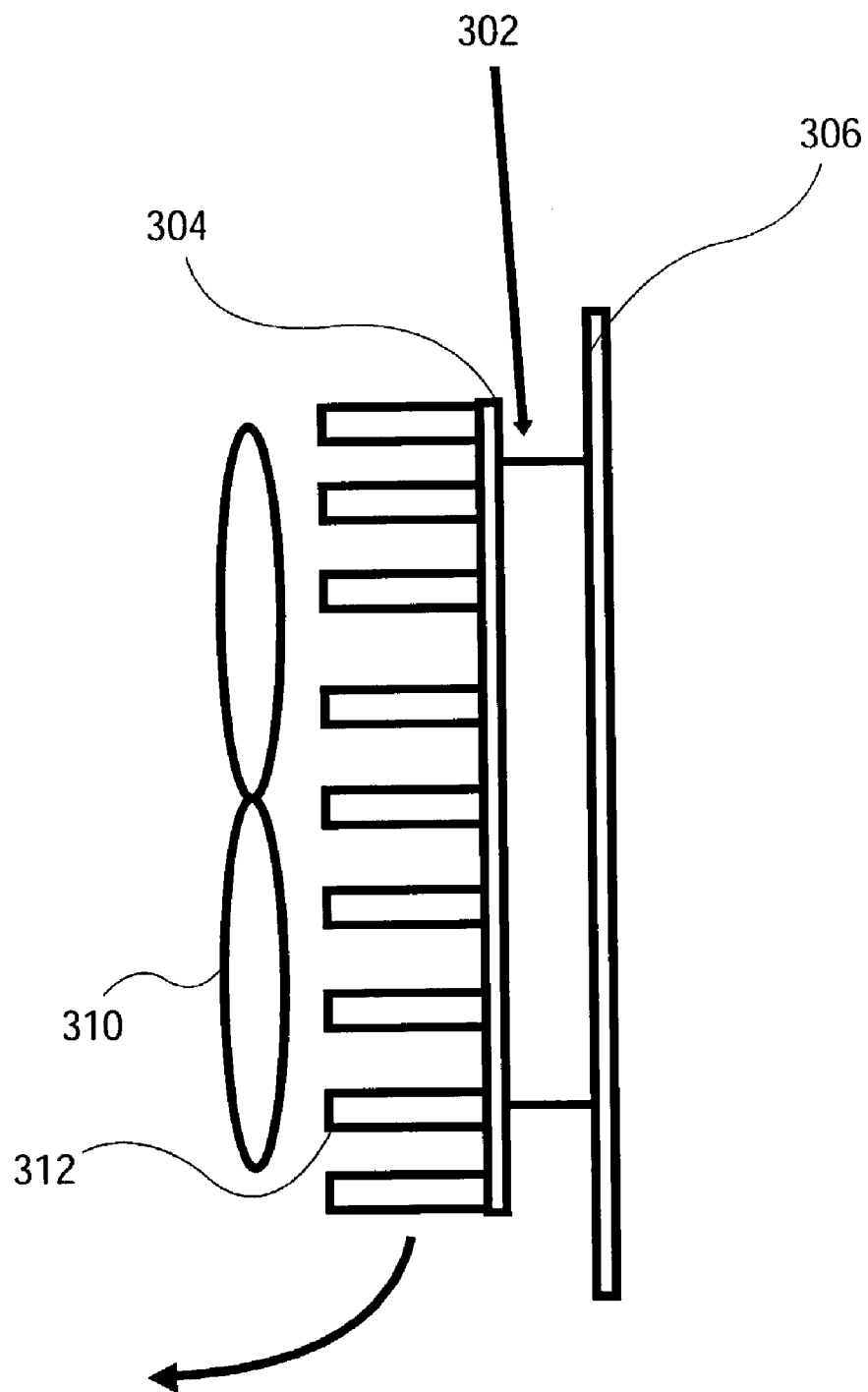


FIG. 3

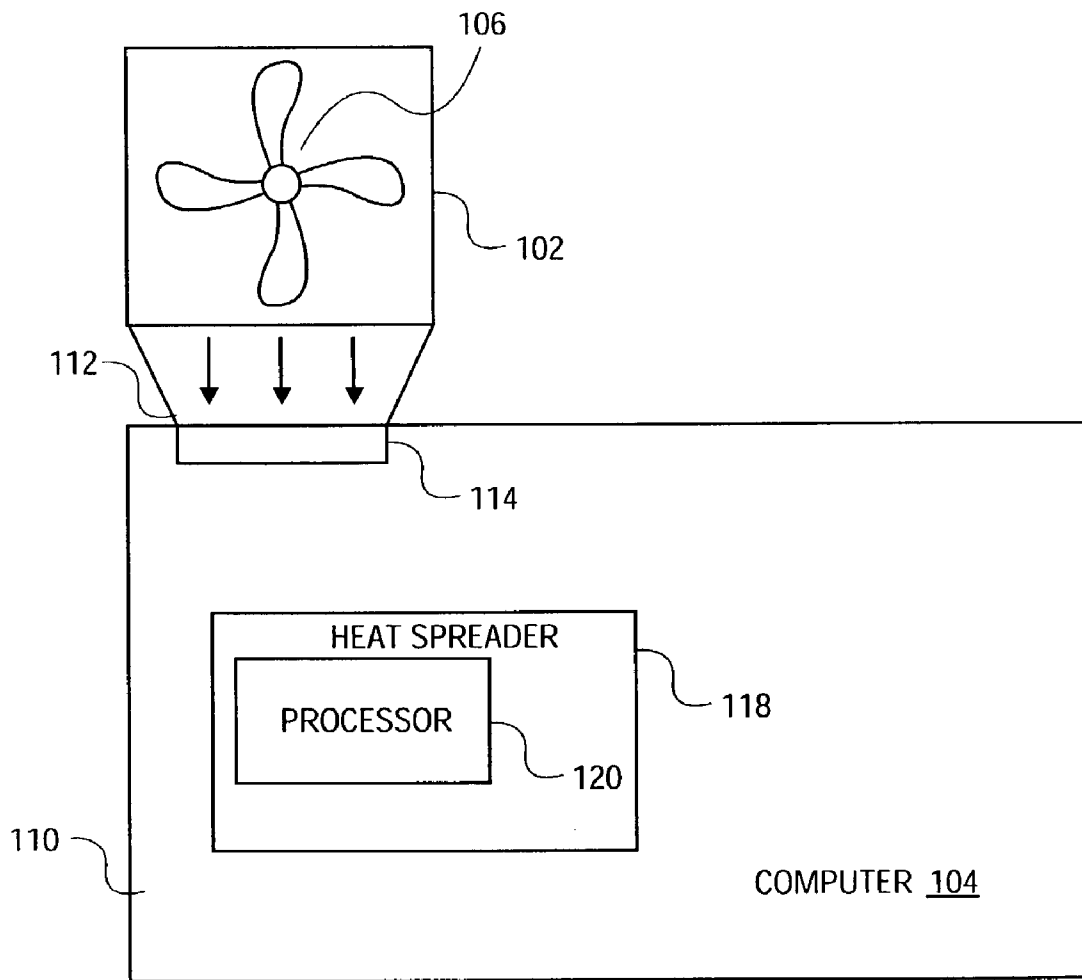


FIG. 4

EXTERNAL ATTACHABLE HEAT EXCHANGER

BACKGROUND

[0001] Faster and more powerful computer components allow the design and construction of higher performance portable computing devices such as laptop or notebook computers. Unfortunately, the use of such faster and more powerful computer components often results in increased heat generation by such computing devices. Thus, improved heat dissipation technology is often needed to maintain operating temperatures of portable computing devices within the same range as their predecessors or some other acceptable range.

[0002] A portable computing device typically includes a base and a screen which are rotatably attached by a hinge. The base usually has an input device such as a keyboard or a touchpad as well as a number of electronic components. Integrated circuits with the highest clock frequency are typically located in close proximity to each other within the computer base.

[0003] Many heat generating computer system components take the form of integrated circuits. Such integrated circuits are typically mounted on a motherboard or another circuit board within the base of the portable computer system. A processor is one component that generates a large amount of heat in a typical processor system. Other electrical components which also generate heat include memory circuits, power supply circuits, and circuit boards such as a video card.

[0004] Maintaining operating temperatures of computer system components below certain levels is important to performance, reliability, and safety. Most integrated circuits have specified maximum operating temperatures, above which the manufacturer does not recommend operation. Transistors, the building blocks of integrated circuits, tend to slow down as operating temperature increases. Thus, a computer system that operates its integrated circuits close to or beyond recommended timings may fail as temperature increases.

[0005] Additionally, integrated circuits may be physically damaged if temperatures elevate beyond those recommended. Such physical damage obviously can impact system reliability. Finally, the computer system casing should be kept at a temperature which is safe for human contact. This may necessitate dissipation of heat throughout a computer system base or efficiently expelling heat to avoid hot spots near certain components such as a processor.

[0006] Typically, heat sinks, fans, and heat pipes are employed to dissipate heat from integrated circuits and other electronic components. Increases in heat generation are often accommodated by simply increasing the quantity or size of these heat dissipation elements. The relatively small size of a portable computing device, however, complicates heat dissipation by limiting airflow, crowding heat generating components, and reducing the space available for heat dissipation devices.

[0007] Since the computer base size is generally kept to a minimum, and the computer base contains both the input device and numerous other electronic components, there may be inadequate space to dissipate enough heat to keep the electronic components within their acceptable range of

operating temperatures. Additionally, heat dissipation through the bottom of the base is limited because the computer is usually operated on a relatively flat low conductance surface.

[0008] One prior art method for removing heat from the base of a portable computing device involves transferring heat from the base of the device to the display. The technique of transferring heat to the display is limited due to the thermal and mechanical difficulties involved with transferring heat through the hinge of the computing device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention, in one embodiment, is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements, and in which:

[0010] **FIG. 1** illustrates an external heat exchanger attached to a computer, in accordance with one embodiment.

[0011] **FIG. 2** illustrates an external heat exchanger attached to a computer, in accordance with an alternative embodiment.

[0012] **FIG. 3** illustrates a thermoelectric module according to one embodiment.

[0013] **FIG. 4** illustrates an external heat exchanger attached to a computer, in accordance with an alternative embodiment.

DETAILED DESCRIPTION

[0014] An external attachable heat exchanger is disclosed for cooling a computer. In the following description, for purposes of explanation, specific details are set forth to provide a thorough understanding of the description. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the description.

[0015] In one embodiment, as illustrated in **FIG. 1**, a heat exchanger **102** is provided to be attached external to a computer **104**. In one embodiment, the heat exchanger includes a fan **106** to generate a flow of air that is to be forced into the internal chambers **110** of the computer to reduce an ambient temperature within the computer. For example, in the one embodiment illustrated in **FIG. 1**, the heat exchanger generates a flow of air into the internal chambers **110** of the computer to help cool components including a processor **120**, a chipset **122**, and/or a graphics device **124**.

[0016] In one embodiment, when the heat exchanger is attached/mounted to the computer, an aperture **112** of the heat exchanger is aligned with openings/apertures **114** in the computer **104**. The external heat exchanger, in an alternative embodiment, may be provided within a docking station, port replicator, or other comparable devices.

[0017] The heat exchanger may be attached to the computer using one of several different attachment techniques. For example, the heat exchanger may be attached using a snap-fit interconnection, a male/female interconnection, or the heat exchanger may use screw instruments to be attached to the computer.

[0018] As further illustrated in **FIG. 1**, the apertures of the computer are located on the back side of the notebook computer. In alternative embodiments, the heat exchanger can be attached/mounted to the computer at different locations.

[0019] In one embodiment, the external heat exchanger forces air into the computer to positively pressurizes the internal chamber of the computer by forcing air into the computer with an air pressure higher than air is released by the computer. In one embodiment, the computer may include vents (not shown) that decrease the release of air from the internal chamber of the computer to assist in creating positively pressurizing the internal chamber of the computer.

[0020] In one embodiment, the external heat exchanger is to receive power from a local power supply of the computer, to which the exchanger may be attached. For example, if the external heat exchanger is attached/mounted to computer that is receiving power from a battery source, the external heat exchanger would also receive power from the battery source.

[0021] In one embodiment, as illustrated in **FIG. 2**, the external heat exchanger includes a unit **116** to generate sub-ambient temperature air to be forced into the computer (wherein the air forced into the computer is of a lower temperature than the ambient air within the internal chamber of the computer).

[0022] In one embodiment, the unit **116** to generate the sub-ambient temperature is a thermoelectric module. One embodiment of the thermoelectric module **302**, as illustrated in **FIG. 3**, includes one side **304** that generates cool temperature (i.e., below the ambient air). The thermoelectric module also includes a second side **306** that generates warmer temperatures, as a result of energy pumped from the first cool side.

[0023] In one embodiment, as illustrated in **FIG. 3**, the fan **310** of the external heat exchanger generates a flow of air against the first cool side of the thermoelectric module. The flow of cool air that is generated by the fan blowing against the cool side **304** of the thermoelectric module is forced into the computer via one or more of the fore mentioned vents of the computer.

[0024] In addition, in one embodiment, the first side of the thermoelectric unit may include fins **312** to conduct the cooler temperature away from the first side of the thermoelectric unit. The fan of the heat exchanger could be positioned parallel to the fins of the heat exchanger (as shown in **FIG. 3**), or alternatively perpendicular, to generate a flow of air across the fins of the heat exchanger.

[0025] In one embodiment, when the external heat exchanger attached/mounted to the computer, a thermometer (not shown) from the external heat exchanger may extend into the internal chamber of the computer via the aligned apertures. The thermometer from the external heat exchanger may measure the ambient temperature within the computer to have the thermoelectric unit **302** within the external heat exchanger generate sub-ambient temperature air accordingly (e.g., if the ambient air within the notebook computer is warmer, cooler air would be generated). A controller (not shown) to receive a signal from the thermometer could be included in the external heat exchanger to monitor the temperature within the computer and to control

when and to what extent additional cooling is to be generated. For example, when the internal ambient temperature of the computer reached and/or exceeded a predetermined threshold, the thermoelectric module may be used to generate cooler air feed into the computer.

[0026] In an alternative embodiment, in addition to monitoring the ambient temperature inside a computer, the humidity may also be monitored. For example, when the humidity and temperature, reach and/or exceed some predetermined combination threshold, the thermoelectric unit may be used to reduce the ambient temperature of the computer to reduce possible condensation within the computer.

[0027] Alternatively, a thermal diode may be included in a unit (e.g., a processor) of computer, to monitor the temperature of the unit, and have the ambient air of the computer reduced when a temperature of the unit is at least equal to predetermined threshold (e.g., 100 Celsius for a central processing unit). In alternative embodiments, alternative techniques for determining the ambient air temperature within the computer and adjusting the temperature of the air forced into the computer may be implemented.

[0028] In one embodiment, as illustrated in **FIG. 4**, the external heat exchanger is to be attached to the aperture **114** of the computer to generate a flow of air across a heat spreader **118** mounted on a heat generating device **120** within the computer. For example, a copper heat spreader (e.g., 0.5 mm thick) may be mounted on a processor within the computer. The flow of air generated by the external heat exchanger (to flow across the heat spreader), will assist in dissipating the heat from the heat spreader. In alternative embodiments, additional heat spreaders could be placed on additional heat generating devices (e.g., chipset, graphics device) within the computer system.

[0029] In one embodiment, the external heat exchanger is a module unit that is mobile. For example, the external heat exchanger would have a form factor of a small size relative to a notebook computer. As a result, the external heat exchanger could be transported along with a notebook computer.

[0030] In the foregoing specification the techniques have been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto. The specification and drawings are, accordingly, to be regarded in an illustrative rather than restrictive sense.

What is claimed is:

1. A heat exchanger comprising:

a housing to be attached external to a computer;

a unit to force air into an internal chamber of the computer, to reduce an ambient temperature within the chamber of the computer.

2. The heat exchanger of claim 1, wherein the unit is to force air into the chamber of the computer at a pressure greater than air is to be released from the computer.

3. The heat exchanger of claim 1, wherein the unit includes a cooling unit to generate air to be forced into the computer that is of a lower temperature compared to an ambient air temperature within the computer.

4. The heat exchanger of claim 1, wherein the heat exchanger is to receive power from a local power source of the computer.

5. The heat exchanger of claim 1, wherein the heat exchanger is housed within a docking station.

6. The heat exchanger of claim 5, wherein the heat exchanger is a mobile module unit.

7. The heat exchanger of claim 5, wherein the heat exchanger is to be attached to an aperture of the computer, to generate a flow of air across a heat spreader mounted on a heat generating device within the computer.

8. A computer system comprising:

a processor within the system; and

a heat exchanger to be attached external to the computer, the exchanger including unit to force air into an internal chamber of the computer, to reduce an ambient temperature within the chamber of the computer.

9. The system of claim 8, wherein the unit is to force air into the chamber of the computer at a pressure greater than air is to be released from the computer.

10. The system of claim 8, wherein the unit includes a cooling unit to generate air to be forced into the computer that is of a lower temperature compared to an ambient air temperature within the computer.

11. The system of claim 8, wherein the heat exchanger is to receive power from a local power source of the computer.

12. The system of claim 8, wherein the heat exchanger is a mobile module unit.

13. The system of claim 8, wherein the heat exchanger is to be attached to an aperture of the computer, to generate a flow of air across a heat spreader mounted on a heat generating device within the computer.

14. A method comprising:

attaching a heat exchanger external to a computer;

a unit of the heat exchanger forcing air into an internal chamber of the computer, to reduce an ambient temperature within the chamber of the computer.

15. The method of claim 14, wherein the forcing air into the chamber of the computer includes forcing air into the chamber at a pressure greater than air is released from the computer.

16. The method of claim 14, wherein the forcing air into the chamber of the computer includes forcing air into the computer that is of a lower temperature compared to an ambient air temperature within the computer.

17. The method of claim 14, further including the heat exchanger receiving power from a local power source of the computer.

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