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Translator's Declaration: August 3, 2017

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That I possess advanced knowledge of the Japanese and English languages. My qualifications are as follows:

- over 25 years as a Japanese-English translator focusing primarily on patents, and technical and scientific documents;
- co-author of the *Japanese Patent Translator's Handbook*, published by American Translators Association;
- United States district court recognition as an expert in Japanese technical translation for patent litigation; and
- work experience including design and testing of electronic circuits for Research and Development Laboratories Waterloo Ltd.

I hereby certify that I have prepared the attached translation of Japanese Unexamine Patent Publication No. JP-11-053061-A, from Japanese to English and that, to the best of my ability, the English translation, attached hereto, is a true and correct translation.

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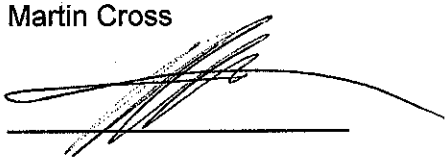

(19) **Japanese Patent Office (JP)**

(12) **Unexamined Patent Application Bulletin (A)**

(11) **Laid Open Patent Application No.**

11-53061

(43) **Publication Date** February 26, 1999

(51) **Int. Cl.**[6]	**Identification Code**	**FI**		
G06F 1/20		C06F 1/00	360C	

Examination Request: not yet made **Number of Claims:** 5 OL (Total 5 pages)

(21) **Application No.:** 9-208838

(22) **Application Date:** August 4, 1997

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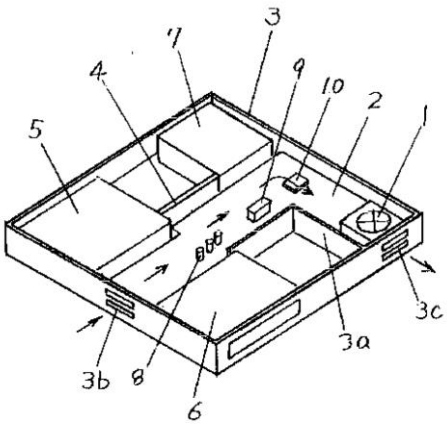
(54) **Title of the Invention: Electronic Device Having an Air-Cooling Structure**

(57) **[Abstract]**

[Problem to Be Solved] An object is to provide an electronic device having an air-cooling structure, which can increase the air-cooling effect in a simple manner, without changing the size of a cooling fan or a heatsink.

[Means for Solving the Problem] Air taken in from the exterior of an electronic device casing 3 through suction holes 3b is suctioned by a cooling fan 1, with an airflow flow-path constituted by the space formed by a rib 3a, a plate 4, as well as a hard disk drive 5, a CD-ROM drive 6, and a battery 7, which are functional-unit components, the ceiling of the electronic device casing 3, a circuit board 2 and the like, and after air-cooling a heatsink, the air that has become a warm airflow is discharged, from discharge holes 3c. Further, electronic components 8, 9 such as filter chokes and electrolytic capacitors, which have a volume that blocks the flow of the airflow in this space, are aligned along the direction of flow of the airflow, and the orientations of the shapes are arranged in a direction that decreases the flow resistance of the airflow, so as to maximize the airflow velocity of the inflow.



1 cooling fan
2 circuit board
3 electronic device casing
3a rib
3b suction hole
3c discharge hole
4 plate
5 hard disk drive
6 CD-ROM drive
7 battery
8, 9 electronic component
10 other heat generating component

[Claims]

[Claim 1] An electronic device having an air-cooling structure characterized: by a cooling fan, which is provided in the vicinity of a heat-generating component and cools the heat-generating component by suctioning and discharging air within the electronic device; and in that a path for the flow of air toward the cooling fan is constituted by a space that communicates with the cooling fan and is bounded by the sidewalls of a casing, ribs, structural members, constituent components or the like, while a plurality of electronic components that have been mounted on a printed circuit board, which is disposed in the space, are arrayed in a direction such as to have little resistance to the flow of air, or the orientations of the shapes of the individual electronic components are arranged in a direction such as to have little resistance to the flow of air.

[Claim 2] The electronic device having an air-cooling structure according to claim 1, characterized in that a heat-generating component requiring cooling is disposed midway in the air flow-path.

[Claim 3] An electronic device having an air-cooling structure, characterized: by a cooling fan provided within a casing; and in that surfaces other than the top surface and the bottom surface in an air flow-path communicating with the cooling fan are formed only by functional-unit components, or by functional-unit components and sidewalls of the casing.

[Claim 4] An electronic device having an air-cooling structure, characterized: by a cooling fan provided within a casing; and by being formed by bounding an air flow-path communicating with the cooling fan with an elastic structural material.

[Claim 5] An electronic device having an air-cooling structure, characterized by comprising: a cooling fan provided within a casing; a discharge hole provided in a side face of the casing; and a duct provided between the cooling fan and the discharge hole.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a thin, portable electronic device, and more particularly relates to an electronic device having a heat-generating component requiring cooling, at the interior, such as a so-called notebook computer.

[0002]

[Prior Art] In recent years, thin, portable electronic devices such as notebook computers have internal electronic components that generate heat, and with increases in performance over the years, the temperature of the heat generated has also become higher. Particularly when the casing of the electronic device is made thin, there is little internal space, and the impact of the malfunctions and the like due to the generated heat have become problematic. For this reason, cooling fans and heatsinks have come into use for dissipating the generated heat and for air-cooling.

[0003] A perspective view of the interior of a conventional electronic device having an air-cooling structure is show in FIG. 5. In FIG. 5, 51 is a CPU, which is a heat-generating component, constituting an object for cooling, which is mounted on a circuit board 52. [Reference numeral] 53 is a heatsink, made from a thermally conductive metallic material such as aluminum and mounted in close contact with the CPU 51, which conducts, diffuses and dissipates the heat generated by the CPU 51. [Reference numeral] 54 is a cooling fan, which is mounted on the heatsink 53, and serves to generate a flow of air and thus increase the cooling effect, by suctioning and discharging air within the electronic device.

[0004] In a conventional electronic device configured in this manner, heat generated by the CPU 51 is dissipated by the heatsink 53, but this will be further forcibly air-cooled by the

[0005]

[Problems to Be Solved by the Invention] However, in conventional electronic devices having an air-cooling structure such as described above, there were problems insomuch as, with increases to the heat generated by the CPU, the size of the cooling fan and the sizes of the heat dissipation components such as the heatsink or a heatpipe increased in order to increase the discharge capacity, making it difficult to reduce the weight and reduce the thickness of the electronic device.

[0006] An object of the present invention is to provide an electronic device having an air-cooling structure, which can increase the air-cooling effect in a simple manner, without changing the size of the cooling fan or the heatsink.

[0007]

[Means for Solving the Problems] In order to solve aforementioned problems, the electronic device of the present invention is such that an air flow-path is constituted by a space, which is bounded by the ribs of a casing, structural members, constituent components or the like, and which communicates with a cooling fan provided in close contact with a heat-generating component, and electronic components present within the air flow-path space are arrayed, or the orientations of the shapes thereof are arranged, in a direction that does not oppose the air flow.

[0008] By adopting the configuration described above, the airflow velocity of the inflow to the cooling fan can be maximized, and this air rapidly carries away the heat generated by the heat-generating component, which is an object for cooling, producing the effect of limiting temperature rises. Furthermore, not only heat-generating components that are objects for cooling in the vicinity of the cooling fan, but also other heat-generating components in the air flow-path space can be air-cooled together therewith.

[0009]

[Modes of Embodiment of the Invention] The invention according to claim 1 of the present invention is characterized: by a cooling fan, which is provided in the vicinity of a heat-generating component, and cools the heat-generating component by suctioning and discharging air within the electronic device; and in that a path for the flow of air toward the cooling fan is constituted by a space that communicates with the cooling fan and is bounded by the sidewalls of a casing, ribs, structural members, constituent components or the like, while a plurality of electronic components that have been mounted on a printed circuit board, which is disposed in the space, are arrayed in a direction such as to have little resistance to the flow of air, or the orientations of the shapes of the individual electronic components are arranged in a direction such as to have little resistance to the flow of air, whereby the airflow velocity of the inflow to the cooling fan can be maximized, and this air rapidly carries away the heat generated, which has the effect of limiting temperature rises of the heat-generating component, which is an object for cooling.

[0010] The invention according to claim 2 of the present invention is characterized in that, in the electronic device according to claim 1, a heat-generating component requiring cooling is disposed midway in the air flow-path, whereby not only heat-generating components that are objects for cooling in the vicinity of the cooling fan, but also other heat-generating components in the air flow-path space can be air-cooled.

[0011] The invention according to claim 3 of the present invention is characterized: by a cooling fan provided within

a casing; and in that surfaces other than the top surface and the bottom surface in an air flow-path communicating with the cooling fan are formed only by functional-unit components, or by functional-unit components and sidewalls of the casing, whereby dedicated structural members, casing ribs and the like for configuring the air flow-path become unnecessary, because the air flow-path can be configured by the arrangement of the functional-unit components and by the sidewalls of the casing.

[0012] The invention according to claim 4 of the present invention is characterized: by a cooling fan provided within a casing; and by being formed by bounding an air flow-path communicating with the cooling fan with an elastic structural material, whereby substantially no air leaks from the air flow-path, allowing for efficient cooling.

[0013] The invention according to claim 5 of the present invention is characterized by comprising: a cooling fan provided within a casing; a discharge hole provided in a side face of the casing; and a duct provided between the cooling fan and the discharge hole, whereby even if the cooling fan is in a position distant from the side face of the casing, the discharged warmed air will not be once again suctioned.

[0014] Hereafter, modes of embodiment of the present invention are described using drawings.

(Mode of Embodiment 1) FIG. 1 is a perspective view of the interior of the casing of an electronic device having an air-cooling structure of the present invention. In the figure, 1 is a cooling fan, which generates a flow of air, and thus increases the cooling effect, by suctioning and discharging air. A CPU, which is a heat-generating component constituting an object for cooling, is mounted on a circuit board 2, but it is not illustrated because it is under the cooling fan 1. Furthermore, while a heatsink may be mounted in close contact with the CPU, this is not illustrated. The mounting relationship for the CPU and the heatsink is the same as in the conventional example. [Reference numeral] 3a is a rib of an electronic device casing 3; 3b are suction holes provided in the electronic device casing for taking in outside air; and 3c are discharge holes. [Reference numeral] 4 is a plate that is mounted for the purpose of forming an air flow-path; 5 is a hard disk drive; 6 is a CD-ROM drive; and 7 is a battery; and portions of the side faces of these functional-unit components face the air flow-path, and constitute walls serving to form the flow-path. [Reference numeral] 8 is an electronic component mounted on the circuit board 2, such as a filter choke or an electrolytic capacitor, which has a volume that impacts the air flow; 9 is an electronic component with different lengthwise and crosswise lengths; and 10 is another heat-generating component.

[0015] The heat generated by the CPU is dissipated by a heatsink, but it will be further forcibly air-cooled by the cooling fan 1. The air taken in from the exterior of the electronic device casing 3 through the suction holes 3b is suctioned by the cooling fan 1, with an air flow-path constituted by the space formed by the side faces of the rib 3a, the plate 4, the hard disk drive 5, the CD-ROM drive 6, and the battery 7, as well as the ceiling of the electronic device casing 3 (not shown), the circuit board 2 and the like, and after air-cooling the heatsink, the warmed air is discharged to the exterior of the electronic device casing 3, from the discharge holes 3c. The direction of the air flow at this time is indicated by the arrows. As a result, an air flow-path is formed and the collected air flows therethrough, such that the airflow velocity of the inflow to the cooling fan 1 increases. Further, electronic components 8 having volumes such as will impact the air flow in this space are aligned along the air flow direction, and an electronic component 9 with a shape having different lengthwise and crosswise lengths is arranged with the longitudinal direction in the air flow direction, allowing the airflow velocity of the inflow to be maximized. This air rapidly carries away the heat generated by the CPU, such that CPU generating component 10 in the air flow-path space can also be air-cooled together therewith.

[0016] (Mode of Embodiment 2) FIG. 2 is a perspective view of the interior of an electronic device having an air-cooling structure in another mode of embodiment of the present invention. In the figure, the structure around the cooling fan 1 is the same as in Mode of Embodiment 1. The difference is that the surfaces other than the top surface and the bottom surface of the air flow-path are formed by the side faces of the functional-unit components, which are the hard disk drive 5, the CD-ROM drive 6, the battery 7, and the IC card unit 11, and by the sidewall 3d of the electronic device casing 3.

[0017] The air that is taken in through the suction holes 3b flows to the cooling fan 1 through the flow-path that is bounded by the hard disk drive 5, the CD-ROM drive 6, the battery 7, the IC card unit 11 and the sidewall 3d, as indicated by the arrows.

[0018] As a result, the air flow-path is formed only by arranging the functional-unit components, and thus there is no need to provide a rib on the casing, or to mount a dedicated plate, which allows for reductions in parts and materials.

[0019] (Mode of Embodiment 3) FIG. 3 (a) is an interior perspective view showing another mode of embodiment of an electronic device having an air-cooling structure of the present invention. In the figure, the structure around the cooling fan 1 is the same as in Mode of Embodiment 1. The difference is that the air flow-path is formed by enclosing it with elastic plates 12. As shown in the sectional view in FIG. 3 (b), the elastic plates 12 are mounted in pressing contact between the circuit board 2 and the ceiling 3e of the electronic device casing 3, and between the bottom surface 3f and the ceiling 3e of the electronic device casing 3.

[0020] The air that is taken in through the suction hole 3b passes through the flow-path that is bounded by the elastic plates 12, and flows to the cooling fan 1 as indicated by the arrows.

[0021] Because of the elastic plates 12, no gap occurs in the air flow-path between the ceiling 3e and the circuit board 2, and the bottom surface 3f and the ceiling 3e, such that substantially no air leaks from the air flow-path, allowing for efficient cooling.

[0022] (Mode of Embodiment 4) FIG. 4 is an interior perspective view of another mode of embodiment of an electronic device having an air-cooling structure of the present invention. The differences are: the mounting position of the cooling fan 1; and a duct 13 provided between the cooling fan 1 and the discharge holes 3c.

[0023] In the figure, the warmed air that is discharged by the cooling fan 1 passes through the duct 13 and is discharged from the discharge holes 3c.

[0024] As a result, in cases where the cooling fan 1 must be disposed at a position distant from the side face of the casing 3, due to the arrangement of the CPU, it is possible to prevent reductions in the cooling effect due to the warmed air that is discharged by the cooling fan 1 being discharged in the casing and once again suctioned by the cooling fan 1.

[0025]

[Effects of the Invention] With the present invention, as described above, an air flow-path is formed in a simple manner, without using high displacement cooling fans, heatsinks, [heatpipes] or the like, whereby the effect of air cooling heat-generating components can easily be increased, which is very useful.

[Brief Description of the Drawings]

[FIG. 1] Perspective view of the interior of an electronic device according to Mode of Embodiment 1 of the present invention

[FIG. 2] Perspective view of the interior of an electronic device according to Mode of Embodiment 2 of the present invention

[FIG. 3] (a) Perspective view of the interior of an electronic device according to Mode of Embodiment 3 of the present invention; (b) sectional view of the same

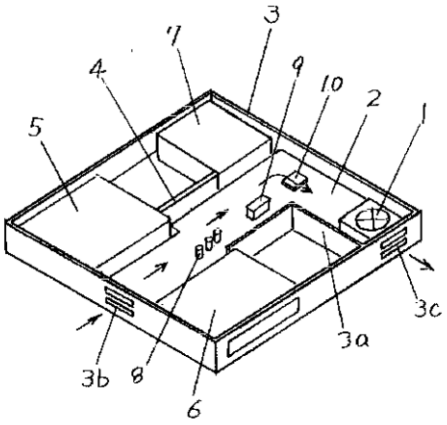
[FIG. 4] Perspective view of the interior of an electronic device according to Mode of Embodiment 4 of the present invention

[FIG. 5] Perspective view of the interior of a conventional electronic device

[Explanation of the Symbols]

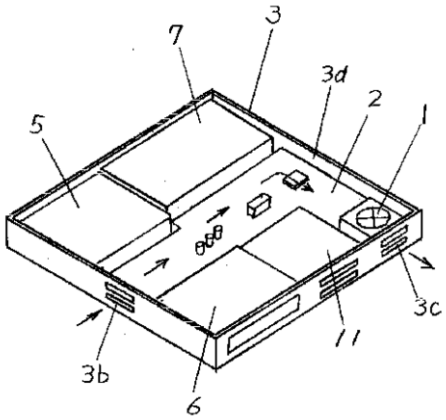
1 cooling fan
2 circuit board
3 electronic device casing
3a rib
3b suction hole
3c discharge hole
4 plate
5 hard disk drive
6 CD-ROM drive
7 battery
8, 9 electronic component
10 other heat-generating component

[FIG. 1]

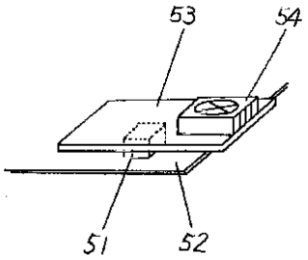


1 cooling fan
2 circuit board
3 electronic device casing
3a rib
3b suction hole
3c discharge hole
4 plate
5 hard disk drive
6 CD-ROM drive
7 battery
8, 9 electronic component
10 other heat generating component

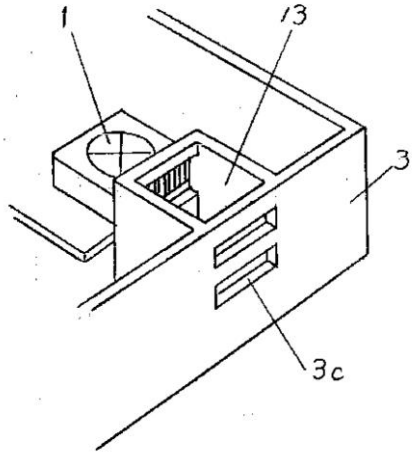
[FIG. 2]



[FIG. 5]



[FIG. 4]



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