

DESCRIPTION

TITLE

ELECTRONIC APPARATUS

FIELD

5 An embodiment of the present invention relates to an electronic apparatus.

BACKGROUND

 An electronic apparatus is already known, in which a cooling target such as a CPU and a cooling device that
10 cools the cooling target, for example, are provided inside a housing. An electronic apparatus is also already known, in which cooling targets are provided in a plurality of portions.

CITATION LIST

15 Patent Document 1: Jpn. Pat. Appln. KOKAI Publication No. H6-125187

 Patent Document 2: Jpn. Pat. Appln. KOKAI Publication No. 2010-198185

SUMMARY

20 It is an object of the embodiment of the present invention to provide an electronic apparatus with increased cooling property.

 According to an embodiment, an electronic apparatus comprises a cooling target unit and a flow path guide. The
25 cooling target unit is disposed in a housing and including a first cooling target and a second cooling target. The flow path guide is disposed on the cooling target unit.

The flow path guide includes a wall-like member that separates a space inside the housing into a plurality of segments, and forming a first flow path that runs through the first cooling target and a second flow path that runs through the second cooling target.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a configuration of an electronic apparatus according to an embodiment.

FIG. 2 is a plan view of the electronic apparatus.

FIG. 3 is a cross-sectional view showing a configuration of part of the electronic apparatus.

FIG. 4 is a perspective view showing a configuration of a flow path guide of the electronic apparatus.

FIG. 5 is a plan view showing a configuration of the flow path guide of the electronic apparatus.

DETAILED DESCRIPTION

Hereinafter, a configuration of an electronic apparatus 10, according to an embodiment of the present invention, will be described with reference to FIGS. 1-5.

FIG. 1 is a perspective view showing a configuration of the electronic apparatus 10 according to the embodiment, and FIG. 2 is a plan view of the electronic apparatus 10. FIG. 3 is a cross-sectional view showing a configuration of part of the electronic apparatus 10. FIG. 4 is a perspective view showing a configuration of a flow path guide 20, and FIG. 5 is a plan view showing a configuration of the flow path guide 20.

In the drawings, the top panel is omitted for the illustration purpose of showing the internal configuration of the housing. In the drawings, the arrows X, Y and Z represent three directions perpendicular to one another, with X being along a first direction, Y being along a second direction, and Z being along a third direction. In the present embodiment, an attitude with the bottom panel down is shown as an example to describe the directions such as up-down direction, right-left direction, and front-rear direction; however, such directions may suitably vary according to the attitude of the electronic apparatus 10.

As shown in FIGS. 1 and 2, the electronic apparatus 10 includes a housing 11, a board unit 12 as a cooling target unit, an HDD unit 13, an IC chip unit 15, a power-supply unit 16, a cooling unit 17, and a flow path guide 20.

The housing 11 includes, for example, a rectangular bottom panel 11a, a front side panel 11b, a pair of right and left side panels 11c and 11d, a rear side panel 11e, and a top panel 11f arranged to face the bottom panel 11a. The housing 11 forms a cuboid housing space 11g surrounded by the bottom panel 11a, the top panel 11f, and the two pairs of side panels 11b to 11e. The housing 11 houses, in the housing space 11g, various electronic components, such as the HDD unit 13, the cooling unit 17, and the board unit 12.

The front side panel 11b includes a ventilation structure 31 including a plurality of ventilation holes and

capable of sucking in air, and further includes a disc slot for an optical drive disc, an insertion slot for the HDD unit 13, and various terminals to which various cables such as USB cables are connected.

5 The rear side panel 11e includes a ventilation structure 31 including a plurality of ventilation holes, and includes various terminals to which various cables such as USB cables are connected.

10 A plurality of HDD units 13 are arranged side by side along X direction at one end side in the housing space 11g. In the housing space 11g, a cooling unit 17 is provided adjacent to the rear of the HDD unit 13. In the housing space 11g, a board unit 12 is arranged at the rear of the cooling unit 17.

15 The HDD unit 13 includes a plurality of HDDs and HDD housings that respectively hold the HDDs. The cooling unit 17 is arranged at the rear of the HDD unit 13, namely, on a secondary side of the flow path of air. A ventilation path, leading from the ventilation structure 31 of the front side
20 panel 11b to an air suction section of the cooling unit 17, is formed. Here, the upstream side in the air blow direction in the flow path of the air is referred to as "primary side", and the downstream side is referred to "secondary side".

25 As shown in FIGS. 1-4, the cooling unit 17 includes a fan holder 32 arranged on the bottom panel 11a of the housing 11, and a plurality of fan units 34a-34c supported

by the fan holder 32. In the present embodiment, three fan units, namely, a first fan unit 34a, a second fan unit 34b, and a third fan unit 34c are arranged in parallel along X direction.

5 The fan holder 32 is a frame arranged on the bottom panel 11a of the housing 11, and includes a plurality of fan housings that respectively hold the fan units 34a-34c.

Each of the fan units 34a-34c includes a fan case 35 including an air blow port 35a, and a blower fan 36
10 disposed inside the fan case 35. The blower fan 36 is connected to an output axis of a fan motor, and driven to rotate. The cooling unit 17 includes an air suction port on the side of the HDD unit 13, and an air blow port 35a on the opposite side. In the present embodiment, the first fan
15 unit 34a and the second fan unit 34b are arranged to face the board unit 12, and the third fan unit 34c is arranged to face the IC chip unit 15.

The board unit 12 includes a board 41 that forms the bottom of the housing 11 and that is disposed on the bottom
20 panel 11a, a first CPU unit 42 mounted on the board 41, a second CPU unit 43 disposed on the secondary side of the first CPU unit 42, and a RAID card unit 44 disposed laterally to the second CPU unit 43 at the rear of the first CPU unit 42. In the present embodiment, the board 41
25 and the first CPU unit 42 on the board 41 correspond to a first cooling target, the second CPU unit 43 corresponds to

a second cooling target, and the RAID card unit 44 corresponds to a third cooling target.

The board 41 is a printed circuit board (PCB) arranged in parallel to the bottom panel 11a along the XY plane.

5 The first CPU unit 42 is arranged in the neighborhood of the air blow port 35a of the second fan unit 34b. The first CPU unit 42 includes a first CPU 45 mounted on the board 41 and a first heat sink 47 mounted on the first CPU 45. The first heat sink 47 includes a plurality of heat
10 radiation fins standing at a predetermined pitch Pt1.

The second CPU unit 43 is arranged at a position at the rear of the first CPU unit 42, which is also at the rear of the first fan unit 34a.

The second CPU unit 43 includes a second CPU 46
15 mounted on the board 41, and a second heat sink 48 mounted on the second CPU 46. The second heat sink 48 includes a plurality of heat radiation fins standing at a predetermined pitch Pt2. An upper end of the second heat sink 48 is disposed at a predetermined position above the
20 first heat sink 47.

The RAID card units 44 are arranged at the rear of the first CPU unit 42. The RAID card unit 44 includes a plurality of RAID cards 44a which stand on the board 41 and on which various electronic components are mounted. The
25 upper end of the RAID card 44a has a height that is, for example, greater than that of the upper end of the first

heat sink 47, and that is substantially equal to that of the upper end of the second heat sink 48.

The flow path guide 20 is molded from a transparent resin material which demonstrates both excellent heat resistance and workability. The flow path guide 20 is formed to follow the outer shape of the board unit 12 and to cover the board unit 12, and is configured to integrally include a plurality of wall-like members that divide a flow path into a plurality of segments. Being arranged on the board unit 12, the flow path guide 20 forms a plurality of flow paths F1, F2, and F3 that lead from the cooling unit 17, through the board unit 12, and to the rear.

The flow path guide 20 continuously and integrally includes a first lid wall 21, which is a partition wall disposed on the first sink 47 on the secondary side of the second fan unit 34b, a duct 22 which partitions a second flow path that leads from the secondary side of the first fan unit 34a to the secondary heat sink 48, and a power-supply cover 23 which covers the power-supply unit.

The first lid wall 21 is a plate-like member that extends to intersect the height direction on the secondary side of the air blow port 35a of the second fan unit 34b, and partitions the space along the up-down direction. The first lid wall 21 is disposed at the height of the neighborhood of the center of the air blow port 35a of the second fan unit 34b in Z direction, and is disposed along the XY plane. The first lid wall 21 is arranged to face an

upper end of the first heat sink 47 with a small gap in between. A plurality of attachment pieces, fastened to the housing 11 by a fastening member, are provided at the end portion of the first lid wall 21.

5 The first lid wall 21 includes a constriction section 21a located slightly toward the front relative to the central portion of the first CPU 45. The constriction section 21a is formed of steps that are made continuous by a surface that is a part of the first lid wall 21 and that
10 descends obliquely. That is, the first lid wall 21 is configured in such a manner that surfaces with different heights are made continuous by a constriction section 21a, which is a tilted surface. The distance of a spacing between the first heat sink 47 and the first lid wall 21 is
15 shorter on the secondary side relative to the constriction section 21a. At the rear of the constriction section 21a, a distance S1 between the first heat sink 47 and the first lid wall 21, for example, is configured to be shorter than the pitch Pt1 of heat dissipation fins of the heat sink.

20 A first guide lib 21b and a second guide lib 21c are formed to stand upright on the upper surface of the first lid wall 21. The first guide lib 21b and the second guide lib 21c are wall-like members having a predetermined thickness and extending obliquely to the rear so as to be
25 displaced toward the center side. The first guide lib 21b and the second guide lib 21c are configured at a height equal to that of the second lid wall 24. The first guide

lib 21b and the second guide lib 21c are disposed to be distanced from each other at a predetermined distance, which forms a first opening 21d through which cooling air can pass.

5 A first flow path F1 that leads from the cooling unit 17 to the first heat sink 47 is formed below the first lid wall 21.

10 A duct 22 extends toward the rear by a predetermined distance from the vicinity of the air blow port 35a of the first fan unit 34a while keeping a constant width, and is obliquely displaced to the rear with an increased width dimension, thus covering, at the rear, both the portion above the second heat sink 48 and the portions lateral to the second heat sink 48.

15 The duct 22 includes a second lid wall 24 and a pair of guide sidewalls 25 and 26, which are disposed on both side edges of the second lid wall 24. The duct 22 forms a second flow path F2 that leads from the vicinity of the air blow port 35a of the first fan unit 34a to the second heat sink 48.

20 The second lid wall 24 is disposed in a forward direction from the air blow port 35a of the first fan unit 34a, at a height above the air blow port 35a. The second lid wall 24 is a wall-like member that is disposed to intersect the height direction, and partitions the space along the up-down direction. The second lid wall 24 is arranged above the first lid wall 21 by a predetermined

distance, and extends in parallel to the bottom panel 11a along the XY plane.

A constriction section 24a is formed in a portion that faces a predetermined position in front of the center of the second CPU unit 43 of the second lid wall 24. The
5 constriction section 24a is formed of steps that obliquely descend in such a manner that its position becomes lower in a predetermined portion of the second lid wall 24. The region of the second lid wall 24 at the rear of the
10 constriction section 24a is arranged to face an upper end of the second heat sink 48 with a small gap in between. On the secondary side relative to the constriction section 24a, a distance S2 between the second heat sink 48 and the second lid wall 24 is set to be shorter than a pitch Pt2 of
15 heat dissipation fins of the second heat sink 48.

The guide sidewalls 25 and 26 are wall-like members that extend along the ZY plane, and separate the space into a plurality of segments along X direction, which is the direction along which the blower fans are in parallel. The
20 guide sidewall 25 (first sidewall section) extends downward from one of the side edges of the second lid wall 24. The guide sidewall 25 is divided into two parts, and includes a front sidewall 25a and a rear sidewall 25b. A lower end of the front sidewall 25a of the guide sidewall 25 leads to a
25 part of one of the side edges of the first lid wall 21. In other words, the front sidewall 25a of the guide sidewall 25 rises from a side edge of the first lid wall 21. A

second opening 25c is formed with a predetermined width between the front sidewall 25a and the rear sidewall 25b. The second flow path F2 in the duct 22 communicates with the space above the first lid wall 21 via the second
5 opening 25c. The other guide sidewall 26 is formed over the entire length of the second lid wall 24.

The second flow path F2 is formed in a region surrounded by the guide sidewalls 25 and 26 below the duct 22, so as to lead from the first fan unit 34a to the second
10 heat sink 48.

The rear portion of the guide sidewall 25 is formed in a double structure, in which a rear sidewall 25b, which is an inner wall extending along the sidewall of the second heat sink 48, a bottom wall section 25d, which has a
15 predetermined width and extends outward of the rear sidewall 25b, and an outer wall section 25e, which rises from the other end of the bottom wall section 25d, are integrally provided. The guide sidewall 25 has a predetermined width. By narrowing the gap between the
20 second heat sink 48 and the RAID card unit 44, the guide sidewall 25 prevents the air from escaping into the gap, and guides the air blow direction in such a manner that the RAID card unit 44 is effectively cooled.

On the outer side of the guide sidewall 25, a third
25 flow path F3 that leads from the vicinity of the air blow port 35a of the second fan unit 34b, through a portion

above the first lid wall 21, and to the RAID card unit 44, is formed.

The guide sidewall 26 (second sidewall section) integrally includes an inner wall section 26c extending
5 along the lateral portion of the second heat sink 48, a bottom wall section 26d having a predetermined width, and an outer wall section 26e rising from the other end of the bottom wall section 26d and face the inner wall section 26c. The guide sidewall 26 has a predetermined width that fills
10 in a spacing between the second heat sink 48 and the power-supply unit 16. The guide sidewall 26 suppresses the air from escaping into the gap, and guides the air blow direction in such a manner that the second heat sink 48 is effectively cooled. The upper end edge of the outer wall
15 section 26e is continuous with the power-supply cover 23.

In the constriction section 24a, the inner wall section 26c of the guide sidewall 26 is tilted to be displaced toward the center of the duct 22. That is, in the
constriction section 24a, the flow path of the duct 22 is
20 configured to be narrowed as viewed in X direction, in addition to Z direction, by the inner wall section 26c, thereby increasing the flow velocity.

The power-supply cover 23 is a plate-like member fitted onto the power-supply unit 16 and facing thereto. A
25 plurality of attachment pieces, which are fastened to the housing 11 by a fastening member, are provided at an end edge portion of the power-supply cover 23.

The flow path guide 20 with the above-described configuration is fitted onto the board unit 12, and is fixed to the housing 11 by fastening members, such as bolts, at the attachment pieces 28 provided in an outer peripheral part.

The shape and size of each portion of the flow path guide 20 are determined on the basis of the air blow distribution ratio, which is determined according to the amount of heat generated by a plurality of cooling targets. That is, a setting is made in such a manner that the air volume from the two fan units 34a and 34b is guided to the three flow paths F1, F2, and F3 with a distribution corresponding to the amount of heat generated by the units 42, 43 and 44. Here, the amount of heat generated by the first CPU unit 42 is substantially equal to the amount of heat generated by the second CPU unit 43, and the amount of heat generated by the RAID card unit 44 is approximately 1/3 thereof.

In the present embodiment, when the fan motor 55 is driven by the control section to rotate, the air runs through a suction-side ventilation path formed in the up-down direction of the HDD unit 13, is sucked into a fan case from an air suction port, and is blown to the rear from the air blow port 35a toward the board unit 12.

At this time, the air transmitted from the air blow port 35a is guided by the flow path guide 20 provided forward of the air blow port 35a. That is, the air from the

two fan units 34a and 34b is divided along the up-down direction by the first lid wall 21 on one side, and is guided to the duct 22 on the other side.

The air guided onto the first lid wall 21 is further
5 guided by the first guide lib 21b and the second guide lib 21c, and a part of the air is guided from the first opening 21d to the third flow path F3, and another part of the air is guided from the second opening 25c into the duct 22. The air guided to the first flow path F1 cools the first CPU
10 unit 42. The air guided to the second flow path F2 cools the second CPU unit 43. In addition, the air guided to the third flow path F3 cools the RAID card unit 44.

At this time, by increasing the flow velocity of air by the constriction sections 21a and 24a formed in the
15 first lid wall 21 and the second lid wall 24, it is possible to increase the cooling property of a portion that generates a particularly large amount of heat.

According to the electronic apparatus 10 with the above-described configuration, by covering the board unit
20 12 and providing a flow path guide 20 that divides the flow path into a plurality of segments, it is possible to properly distribute the volume of air from the cooling unit 17 among a plurality of cooling targets, thereby achieving effective cooling.

25 Specifically, by dividing the air volume along the up-down direction and the right-left direction using the duct

22 and the first lid wall 21, it is possible to effectively guide air to heat sinks at different positions.

Also, by setting the height of the second heat sink 48 on the secondary side above the first heat sink 47 on the primary side, it is possible to distribute a desired air volume to the second heat sink 48 on the secondary side. That is, in an arrangement in which a plurality of heat sinks with the same height are aligned along the front-rear direction, for example, the cooling efficiency typically decreases, since the air warmed by the first heat sink 47 on the primary side is supplied to the heat sink on the secondary side. However, according to the present embodiment, it is possible to reliably supply cool air to the second heat sink 48 on the secondary side.

In addition, according to the present embodiment, by covering the heat sinks 47 and 48 using the first lid wall 21 and the second lid wall 24, it is possible to suppress the cooling air from escaping upward, thus increasing the cooling effect. Furthermore, by forming constriction sections 21a and 24a in the first lid wall 21 and the second lid wall 24 to increase the flow rate at a desired portion that generates a high amount of heat, it is possible to perform effective cooling.

In the present embodiment, by configuring the first flow path F1 and the second flow path F2 to respectively communicate with the fan units 34a and 34b, which are arranged in parallel, it is possible, in the event of a

failure in one of the fan units 34a and 34b, to distribute the cool air from the other of the fan units 34a and 34b, thereby maintaining the cooling property.

Moreover, according to the present embodiment, by
5 configuring the guide sidewalls 25 and 26 in a double structure to eliminate a dead space, the shape of the flow path guide 20 can be made to follow the outer shape of the board unit 12, thus suppressing the cooling air from escaping, and efficiently utilizing the cooling air.

10 Furthermore, by configuring the flow path guide 20 of a transparent resin, it is possible to confirm the wiring status even in a state in which the flow path guide 20 is attached. In addition, since a plurality of wall-like members provided in the flow path guide 20 allow not only
15 the flow path to be partitioned, but also the positions of various cables to be defined, it is possible to improve the workability of the wiring operation.

The present invention is not limited to the above-described embodiment.

20 For example, the flow path guide 20 has been described as being formed of a transparent resin material; however, the present invention is not limited thereto, and may be formed of other materials such as metal.

For example, in the above-described embodiment, the
25 flow path guide 20 has been described to have the above-described shape, according to the shape of the board unit 12 and the amount of heat generated by each portion;

however, the present invention is not limited thereto. For example, the position and the shape of the wall-like members may be suitably changed, according to the position relationship and the number of the units 42, 43, and 44.

5 Also, the number of the flow paths may be increased or decreased according to the position and the number of the cooling targets.

While certain embodiments have been described, these embodiments have been presented by way of example only, and
10 are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing
15 from the spirit. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit.

CLAIMS

1. An electronic apparatus comprising:

a cooling target unit disposed in a housing and including a first cooling target and a second cooling target; and

a flow path guide disposed on the cooling target unit, the flow path guide including a wall-like member that separates a space inside the housing into a plurality of segments, and forming a first flow path that runs through the first cooling target and a second flow path that runs through the second cooling target.

2. The electronic apparatus according to claim 1, comprising:

a blower device, wherein

the first cooling target is disposed on a downstream side of an air blow direction of the blower device,

the second cooling target is disposed on the downstream side of the air blow direction relative to the first cooling target,

the first cooling target and the second cooling target are disposed at overlapping positions as viewed toward the upstream side of the air blow direction relative to the blower device,

the flow path guide includes a first sidewall section which divides a space on the downstream side of the air blow direction of the blower device into a plurality of segments along a first direction intersecting the air blow

direction, a first lid wall extending toward one side of
the first direction of the first sidewall section and
covering the first cooling target, and a second lid wall
extending toward a portion of the first sidewall portion
5 located on another side of the first direction, and

the first sidewall section and the second lid wall
extend toward the downstream side of the air blow direction
relative to the first cooling target, in such a manner that,
in a portion on the downstream side of the air blow
10 direction, the second lid wall covers the second cooling
target and the first sidewall section covers a lateral
portion of the second cooling target located on the one
side of the first direction.

3. The electronic apparatus according to claim 2,
15 wherein

the blower device includes a plurality of blower fans
arranged in parallel along the first direction,

the cooling target unit is a board unit including a
board disposed on a bottom portion inside the housing,

20 the first cooling target is a first CPU unit including
a first CPU disposed on the board and a first heat
radiation fin disposed on the first CPU,

the second cooling target is a second CPU unit
including a second CPU disposed on the board on the
25 downstream side of the air blow direction relative to the
first CPU, and a second heat radiation fin disposed on the

second CPU at a height greater than that of the first heat radiation fin,

the second lid wall is disposed at a position above the first lid wall,

5 the first flow path is formed below the first lid wall so as to lead to the first cooling target,

the first sidewall section extends downward from a side edge of the second lid wall located on one side of the first direction, and is connected to a side edge of the first lid wall located on another side of the first direction,

a second sidewall section is provided so as to extend downward from a side edge of the second lid wall located on said another side of the first direction, and

15 the second flow path is formed by a duct including the second lid wall, the first sidewall section, and the second sidewall section, so as to lead from a portion of the first flow path on another side of the first direction, toward a portion on the downstream side of the air blow direction, to the second cooling target.

20 4. The electronic apparatus according to claim 2 or 3, wherein the first lid wall or the second lid wall includes, on the upstream side of the air blow direction relative to a center of the first cooling target or the second cooling target, a constriction section that is displaced downward in such a manner that the first flow path or the second flow path is narrowed.

5. The electronic apparatus according to any one of claims 2 to 4, comprising:

a third cooling target disposed on the downstream side of the air blow direction relative to the first lid wall and the first cooling target,

the first lid wall divides a space along a height direction, and

a third flow path is formed in a portion of the first sidewall section on the one side of the first direction so as to lead through an upper side of the first lid wall to the third cooling target.

6. The electronic apparatus according to any one of claims 3 to 5, wherein the first sidewall section is disposed between a space above the first lid wall and the second flow path and includes a front sidewall, a rear sidewall, and an opening, the opening being located between the front sidewall and the rear sidewall, and allowing the space above the first lid wall and a portion of the second flow path located below the second lid wall to be communicated with each other, and

a guide lib is provided on an upper surface of the first lid wall, the guide lib being a wall-like member extending upward, a portion of the guide lib on the downstream side of the air blow direction extending along the second flow path toward the opening in the first sidewall section.

7. The electronic apparatus according to any one of claims 1 to 6, wherein the flow path guide integrally includes a plurality of wall-like members formed of a transparent material, and

5 integrally includes an attachment section that is fastened to the housing in a state of being fitted onto the cooling target.