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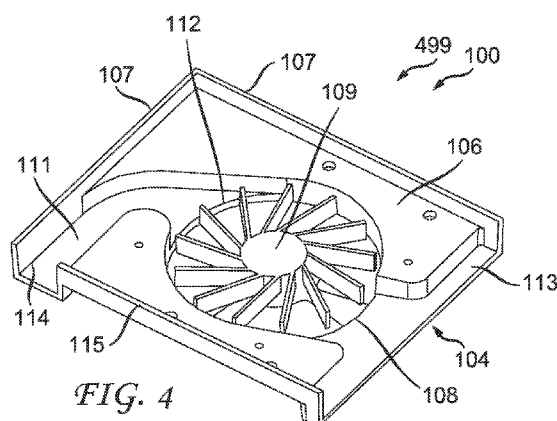
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(57) Abstract: A cooling system (100) for a heat generating device (101) includes the device (101) and an air current generating assembly (104). The device (101) has an air current generating mounting surface (103). The assembly (104) has an air current generating device (109) having blades (148), a top side having an intake opening (117), a bottom side (106) that faces and connects to the mounting surface (103), a periphery (107) that surrounds the top and bottom sides, an air opening (108) on a first side (113) of the periphery (107), and curved air duct (111). The curved air duct (111) has a proximate end (112) adjacent to the air current generating device (109) and a distal end (114) on a second side (115) of the periphery (107) that is adjacent the first side (113). The air opening (108) and curved air duct (111) are respectively configured to permit at least one of cooling air to be drawn into the blades (148) and exhausted air from the air current generating device (109) to exit there through.



HARD DRIVE SYSTEM WITH BLOWER OR FAN

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application claims the benefit of U.S. Provisional Application Serial No. 61/684,931, filed August 20, 2012, which is incorporated by reference herein in its entirety.

TECHNICAL FIELD

10 The present principles relate generally to hard drives and, more particularly, to a hard drive system with a blower or fan.

BACKGROUND

15 Consumer/market preference for set top boxes and the like (such as computers, game consoles, DVD players, CD player, etc.) is to have such devices be small/compact.

20 Also, there is a need in set top boxes and the like to have long term performance capabilities and a need for product versatility/high functionality. This product versatility/high functionality requirement implies that numerous components such as hard drives, smart cards, printed circuit boards, light sources for panel buttons and light pipes, panel jacks, fans/blowers, heat sinks, etc., need to be in the device. Long term performance generally implies that heat generated in such devices be effectively managed or dissipated to keep the device at safe operating temperatures.

25 With the small size preference and high functionality requirement, set top boxes and the like must be densely packed with internal components, which causes space to be at a premium.

30 In particular, hard drives take up substantial space and generate significant heat. Thus, a need exists to manage and remove the heat generated by hard drives while avoiding an increase in the need for more space in set top boxes and like.

SUMMARY

These and other drawbacks and disadvantages of the prior art are addressed by the present principles, which are directed to a hard drive system, or other heat generating device, with a blower or fan.

5 According to an aspect of the present principles, there is provided a cooling system for a heat generating device. The cooling system includes a heat generating device having an air current generating device mounting surface through which heat from the heat generating device can be released. The cooling system further includes an air current generating device assembly. The air current generating
10 device assembly has an air current generating device having blades, a top side having a cooling air intake opening, a bottom side that faces and connects to the air current generating device mounting surface, a periphery that surrounds the top and bottom sides and substantially follows a periphery of the heat generating device, an air opening and a curved air duct. The air opening is on a first side of the periphery.
15 The curved air duct has a proximate end adjacent to the air current generating device and a distal end on a second side of the periphery that is adjacent to the first side. The air opening and the curved aid duct are respectively configured to permit at least one of cooling air to be drawn into the blades of the air current generating device and exhausted air from the air current generating device to exit there through.

20 According to another aspect of the present principles, there is provided a hard drive system. The hard drive system includes a hard drive having an air current generating device mounting surface through which heat from the hard drive can be released. The hard drive system further includes an air current generating device assembly. The air current generating device assembly includes an air current
25 generating device having blades, a top side having a cooling air intake opening, a bottom side that faces and connects to the air current generating device mounting surface, a periphery that surrounds the top and bottom sides and substantially follows a periphery of the hard drive, an air opening and a curved aid duct. The air opening is on a first side of the periphery. The curved air duct has a proximate end
30 adjacent to the air current generating device and a distal end on a second side of the periphery that is adjacent to the first side. The air opening and the curved aid duct are respectively configured to permit at least one of cooling air to be drawn into the blades of the air current generating device and exhausted air from the air current generating device to exit there through.

These and other aspects, features and advantages of the present principles will become apparent from the following detailed description of exemplary embodiments, which is to be read in connection with the accompanying drawings.

5 BRIEF DESCRIPTION OF THE DRAWINGS

The present principles may be better understood in accordance with the following exemplary figures, in which:

FIG. 1 shows a top view 199 of a hard drive system 100, in accordance with an embodiment of the present principles;

10 FIG. 2 shows a bottom view 299 of the hard drive system 100 of FIG. 1, in accordance with an embodiment of the present principles;

FIG. 3 shows a bottom view 399 of the blower assembly 104 where the blower 109 can sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles;

FIG. 4 shows a top view 499 of the blower assembly 104 where the blower 109 can sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles;

20 FIG. 5 shows a bottom view 599 of the blower assembly 104 of FIG. 1 without the blower 109 attached, in accordance with an embodiment of the present principles;

FIG. 6 shows a top view 699 of the blower assembly 104 of FIG. 1 without the blower 109 attached, in accordance with an embodiment of the present principles;

25 FIG. 7 shows a bottom view 799 of the blower 109 alone that will sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles;

FIG. 8 shows a top view 899 of the blower 109 alone that will sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles;

30 FIG. 9 shows a perspective view 999 of the hard drive system 100 of FIG. 1 with the hard drive 101 and the blower assembly 104 attached, in accordance with an embodiment of the present principles;

FIG. 10 shows a top view 1099 of the hard drive 101 without the blower assembly 104 attached, in accordance with an embodiment of the present principles;

FIG. 11 shows a bottom view 1199 of the hard drive 101 without the blower assembly 104 attached, in accordance with an embodiment of the present principles;

5 FIG. 12 shows a perspective interior view 1299 illustrating the hard drive system 100 of FIG. 1 incorporated in a set top box 1240, in accordance with an embodiment of the present principles;

10 FIG. 13 shows a configuration 1399 of the hard drive system 100 of FIG. 1 incorporated into a set top box 1240 where the curved air duct 111 is directed at the smart card reader 1288, in accordance with an embodiment of the present principles; and

15 FIG. 14 shows another configuration 1499 of the hard drive system 100 of FIG. 1 incorporated into a set top box 1240 where the air opening 108 is directed at the smart card reader 1288, in accordance with an embodiment of the present principles; and

20 FIG. 15 shows yet another configuration 1599 of the hard drive system 100 of FIG. 1 incorporated into a set top box 1240 where air is exhausted from the set top box 1240 and not blown across or directed at the smart card reader 1288, in accordance with an embodiment of the present principles.

DETAILED DESCRIPTION

The present principles are directed to a hard drive system with a blower or fan.

25 The present description illustrates the present principles. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the present principles and are included within its spirit and scope.

30 All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the present principles and the concepts contributed by the inventor(s) to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions.

Moreover, all statements herein reciting principles, aspects, and embodiments of the present principles, as well as specific examples thereof, are

intended to encompass both structural and functional equivalents thereof.

Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

5 Reference in the specification to “one embodiment” or “an embodiment” of the present principles, as well as other variations thereof, means that a particular feature, structure, characteristic, and so forth described in connection with the embodiment is included in at least one embodiment of the present principles. Thus, the appearances of the phrase “in one embodiment” or “in an embodiment”, as well
10 any other variations, appearing in various places throughout the specification are not necessarily all referring to the same embodiment.

 It is to be appreciated that the use of any of the following “/”, “and/or”, and “at least one of”, for example, in the cases of “A/B”, “A and/or B” and “at least one of A and B”, is intended to encompass the selection of the first listed option (A) only, or
15 the selection of the second listed option (B) only, or the selection of both options (A and B). As a further example, in the cases of “A, B, and/or C” and “at least one of A, B, and C”, such phrasing is intended to encompass the selection of the first listed option (A) only, or the selection of the second listed option (B) only, or the selection of the third listed option (C) only, or the selection of the first and the second listed
20 options (A and B) only, or the selection of the first and third listed options (A and C) only, or the selection of the second and third listed options (B and C) only, or the selection of all three options (A and B and C). This may be extended, as readily apparent by one of ordinary skill in this and related arts, for as many items listed.

 Initially, an embodiment of the present principles will be described with
25 respect to FIG. 1, which is directed to a hard drive system having a hard drive with a blower or fan. However, it is to be appreciated that the present principles are not limited to solely a hard drive system having a hard drive with a blower or fan and, thus, another heat generating device can be substituted in place of the hard drive, while maintaining the spirit and scope of the present principles. Moreover, it is to be
30 appreciated that the while a blower or fan may be used in accordance with various embodiments of the present principles, the term “air current generating device” is interchangeably used to refer to any of a fan, blower, or other air circulating element.

FIG. 1 shows a top view 199 of a hard drive system 100, in accordance with an embodiment of the present principles. FIG. 2 shows a bottom view 299 of the

hard drive system 200 (also, 100 of FIG. 1), in accordance with an embodiment of the present principles.

The hard drive system 100 can include a hard drive 101 and a fan or blower assembly (hereinafter “blower assembly” for the sake of brevity) 104. The hard drive
5 101 can include a fan or blower mounting surface (hereinafter “blower mounting surface” for the sake of brevity) 103 opposite a top surface 102. Heat from the hard drive 101 can be released from the blower mounting surface 103.

The hard drive 101 can include a printed circuit board 116 (see FIG. 11) that can cover a portion of the blower mounting surface 103 of the hard drive 101.

10 FIG. 3 shows a bottom view 399 of the blower assembly 104 where the blower 109 can sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles. FIG. 4 shows a top view 499 of the blower assembly 104 where the blower 109 can sit in the pocket of the blower assembly 104 in between the air
15 opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles.

The blower assembly 104 can include a fan or blower (hereinafter “blower” for the sake of brevity) 109, a top side 118, a bottom side 106, a periphery 107, an air opening 108, a curved air duct 111, and a top cooling air intake opening 117. The
20 bottom side 106 faces and connects to the blower mounting surface 103 of the hard drive 101. The periphery 107 surrounds the top side 109 and the bottom side 106 and substantially follows a periphery of the hard drive 101. The air opening 108 is on a first side 113 of the periphery 107. The air opening 108 can be an exhaust opening that permits air from the blower to exhaust out and/or can be a cooling air
25 intake opening that permits cooling air to be drawn into the blower 109 (e.g., into the blades 148 of the blower 109). The curved air duct 111 has a proximate end 112 adjacent to the blower 109 and a distal end 114 on a second side 115 of the periphery 107 that is adjacent to the first side 113. The curved air duct 111 can be an intake to and/or can be an exhaust from the blower 109. A plane in which the
30 blower 109 rotates is parallel to the blower mounting surface 103.

It is to be appreciated that the printed circuit board 116 (Fig. 11) can generate much or most of the heat in the hard drive 101.

FIG. 5 shows a bottom view 599 of the blower assembly 104 of FIG. 1 without the blower 109 attached, in accordance with an embodiment of the present

principles. FIG. 6 shows a top view 699 of the blower assembly 104 of FIG. 1 without the blower 109 attached, in accordance with an embodiment of the present principles.

The blower assembly 104 can have a top side 118 and a bottom side 106 that
5 faces and connects to the blower mounting side 103 of the hard drive 101. The bottom side 106 can face and connect to the blower mounting surface 103 of the hard drive 101. The top cooling air intake opening 117 can permit cooling air to be drawn into the blades 148 of the blower 109. The curved air duct 111 can be curved to have air exhaust on a second side 115 of the periphery 107 that is adjacent to the
10 first side 113 and the system 100 can permit air to exhaust also through straight through air opening 108 on a first side of the periphery 107 that is adjacent to the first side 113. Such a configuration in which the entrance of air (e.g., into the air opening 108) and exit of air (e.g., out of the curved air duct 111) are perpendicular can dampen noise from the blower 109. Here, the air opening 108 and the curved
15 air duct 111 can be surrounded by side walls 121 and 122 and cover walls 119 and 120 and the air opening 108 and curved air duct 111 can have no base cover or wall. It is preferred that the curved air duct 111 and the top cooling air intake opening 117 be exhaust means.

In other embodiments, the blower assembly 104 shown in FIG. 2 can also
20 have one of either the air opening 108 or curved air duct 111 be an air intake or have either the air opening 108 or the curved air duct 111 behave as both an intake and an exhaust.

FIG. 7 shows a bottom view 799 of the blower 109 alone that will sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved
25 air duct 111, in accordance with an embodiment of the present principles. FIG. 8 shows a top view 899 of the blower 109 alone that will sit in the pocket of the blower assembly 104 in between the air opening 108 and the curved air duct 111, in accordance with an embodiment of the present principles.

A fan is intended to be an implementation in which the blades of the rotating
30 device are tilted from vertical and intended to draw air in through the openings on the cover wall 120. This pushes air directly onto the hard drive 101 and heated air out to the curved air duct 111 and/or the air opening 108.

A blower is intended to be an implementation in which the blades of the rotating device are not tilted and are vertically oriented. The blades can draw air

from the air opening 108 or curved air duct 111 and push air or skim air more across the surface of the hard drive. In some configuration, this can push heated air out to the curved air duct 111 and/or the air opening 108.

FIG. 9 shows a perspective view 999 of the hard drive system 100 of FIG. 1 with the hard drive 101 and the blower assembly 104 attached, in accordance with an embodiment of the present principles. In FIGs. 2 and 9, it can be seen that the system 100 can have only one fan or blower that is centrally located on or over the hard drive 101.

FIG. 10 shows a top view 1099 of the hard drive 101 without the blower assembly 104 attached, in accordance with an embodiment of the present principles. FIG. 11 shows a bottom view 1199 of the hard drive 101 without the blower assembly 104 attached, in accordance with an embodiment of the present principles.

FIG. 12 shows a perspective interior view 1299 illustrating the hard drive system 100 of FIG. 1 incorporated in a set top box 1240, in accordance with an embodiment of the present principles. In an embodiment, the set top box 1240 may have other thermal management systems that can include a thermal partition wall 1224 that partitions a hard drive section having the hard drive system 100 from a smart card section having the smart card reader 1488 and smart card 1428. The set top box 1240 has a rear wall 1235 and a front surface 1234 which can be adjacent to the side of the hard drive 101 opposite the first side 113 thereof (see FIG. 1), wherein a main circuit board (not shown) for the set top box 1240 can span between the front surface 1234 and the rear wall 1235. The set top box 1240 can have a generalized front panel 1232, wherein the top of the set top box 1240 and the door to the smart card bay or port 1239 are removed to show the interior features. The main printed circuit board can have thermal pad (not shown) that assists with heat extraction from heat generating components on or near the printed circuit board. The thermal pad assists with heat extraction when a heat sink such as top broad heat sink 1223 is placed on the thermal pad. This heat extraction feature can be important, since the smart card 1228 in the smart card reader generally generates substantial heat. Top broad heat sink 1223 has proven to be an effective way to cool the main integrated circuit board of the set top box. The top broad heat sink 1223 can be a generally contoured plate that has a generally planar periphery 1226 and a contoured central feature 1225 such as a pocket, central depression, notch, recess, multilevel depression, or mesa extending from and/or into a plane of the

planar periphery 1226, wherein the planar periphery 1226 preferably surrounds the contoured central feature 1225. In the illustrated embodiment, the planar periphery 1226 surrounds three or four sides of the contoured central feature 1225.

5 In at least one embodiment, there is no complete partition wall 1224 and one of either the air opening 108 or the curved air duct 111 is directed at the smart card/reader and has exhaust (or intake) directed at the smart card/reader (or drawn directly from) the smart card/reader.

10 The set top box 1240 can further have a lateral side wall 1229 that can be parallel to the partition wall 1224 (if there a partition wall). The lateral side wall 1229 can be where the first side 113 or the second side 115 of the blower assembly 104 is positioned and is where the exhaust of the air opening 108 or curved air duct 111 exits.

15 The set top box 1240 can further have a rear wall 1235 that can be perpendicular to the partition wall 1224 (if there a partition wall). The rear wall 1235 can be where the first side 113 or the second side 115 of the blower assembly 104 is positioned and is where the exhaust of the air opening 108 or curved air duct 111 exits.

The overall thermal management of the two sides can effectively mitigate heat and permit dense packing of a plurality of internal components.

20 Regarding clearance requirements for the top cooling air intake opening 117, it is preferred that the top (if the blower 109 is over the hard drive 101) or bottom (if the blower 109 is under the hard drive 101) of the set top box 1240 be sufficiently spaced from the top cooling air intake opening 117 to permit substantial air flow in the blower 109.

25 However, it is preferred that the blower 109 face down and that there are vents on the bottom of the set top box 1240 adjacent to and under the top cooling air intake opening 117 to draw cooling air from outside the set top box 1240. In this manner, cooling air is drawn up and beneficially spread laterally.

30 FIG. 13 shows a configuration 1399 of the hard drive system 100 of FIG. 1 incorporated into a set top box 1240 where the curved air duct 111 is directed at the smart card reader 1288, in accordance with an embodiment of the present principles. FIG. 14 shows another configuration 1499 of the hard drive system 100 of FIG. 1 incorporated into a set top box 1240 where the air opening 108 is directed at the smart card reader 1288, in accordance with an embodiment of the present

principles. In FIGs. 13 and 14, exhaust (or intake) is directed at the smart card/reader (or drawn directly from) the smart card/reader at the front surface 1234. Here, the other of the air opening 108 or the curved air duct 111 can be directed out of a side of the set top box 1240 or out of the back of the set top box 1240. These
5 embodiments can include the feature of the smart card/information card being at/or near a corner of the set top box 1240 and the hard drive assembly being at/or near an adjacent corner of the set top box 1240.

FIG. 15 shows yet another configuration 1599 of the hard drive system 100 of FIG. 1 incorporated into a set top box 1240 where air is exhausted from the set top
10 box 1240 and not blown across or directed at the smart card reader 1288, in accordance with an embodiment of the present principles. In the configuration 1599, the air is exhausted to the exterior of the set top box 1240 without blowing any of the air across the components in the set top box such as the smart card reader 1288. The idea is to avoid blowing exhausted and pre-heated air across a component to be
15 cooled.

A description will now be given of some of the many attendant advantages/features of the present invention, some of which have been mentioned above. For example, one advantage/feature is a cooling system for a heat
20 generating device, the cooling system including a heat generating device having an air current generating device mounting surface through which heat from the heat generating device can be released. The cooling system further has an air current generating device assembly. The air current generating device assembly has an air current generating device having blades, a top side having a cooling air intake
25 opening, a bottom side that faces and connects to the air current generating device mounting surface, a periphery that surrounds the top and bottom sides and substantially follows a periphery of the heat generating device, an air opening and a curved air duct. The air opening is on a first side of the periphery. The curved air duct has a proximate end adjacent to the air current generating device and a distal end on a second side of the periphery that is adjacent to the first side. The air
30 opening and the curved aid duct are respectively configured to permit at least one of cooling air to be drawn into the blades of the air current generating device and exhausted air from the air current generating device to exit there through.

Another advantage/feature is the cooling system as described above, wherein a plane in which the air current generating device rotates is parallel to the air current generating device mounting surface.

Yet another advantage/feature is the cooling system as described above,
5 wherein the air opening is configured be directly open, on at least one side thereof, to the air current generating device mounting surface.

Still another advantage/feature is the cooling system as described above, wherein the curved air duct is configured be directly open, on at least one side thereof, to the air current generating device mounting surface.

10 Moreover, another advantage/feature is the cooling system as described above, wherein the air current generating device is a fan in which the blades thereof are tilted from vertical to draw the cooling air in through at least the cooling air intake opening so as to push the cooling air onto the air current generating device mounting surface and the exhausted air out at least one of the air opening and the
15 curved air duct.

Further, another advantage/feature is the cooling system as described above, wherein the air current generating device is a fan in which the blades thereof are tilted from vertical to draw the cooling air in through at least one of the air opening and the curved air duct and across the air current generating device mounting
20 surface, and the exhausted air out at least the cooling air intake opening.

Also, another advantage/feature is the cooling system as described above, wherein the air current generating device is a blower in which the blades thereof are un-tilted and are vertically oriented to draw the cooling air in from at least one of the air opening and the curved air duct and push or skim the cooling air across the air
25 current generating device mounting surface.

Additionally another advantage/feature is the cooling system as described above, wherein the air current generating device is a blower in which the blades thereof are un-tilted and are vertically oriented to push the exhausted air out through at least one of the air opening and the curved air duct.

30 Moreover, another advantage/feature is the cooling system as described above, wherein the hard drive system is included within a set top box.

Further, another advantage/feature is the cooling system wherein the hard drive is included within a set top box as described above, wherein the hard drive

system is separated from a card reader section of the set top box by a thermal partition wall.

Also, another advantage/feature is the cooling system wherein the hard drive is included within a set top box as described above, wherein the set top box includes
5 a main printed circuit board having a thermal pad and a heat sink disposed on the thermal pad to remove heat from the main printed circuit board.

Additionally, another advantage/feature is the cooling system wherein the set top box includes a main printed circuit board having a thermal pad and a heat sink disposed on the thermal pad to remove heat from the main printed circuit board as
10 described above, wherein the heat sink is a contoured plate having a planar periphery and a contoured central feature.

Moreover, another advantage/feature is the cooling system wherein the heat sink is a contoured plate having a planar periphery and a contoured central feature as described above, wherein the contoured central feature is at least one of a
15 pocket, a central depression, a notch, a recess, a multi-level depression, and a mesa, extending at least one of from and to a plane of the planar periphery.

Also, another advantage/feature is the cooling system wherein the heat sink is a contoured plate having a planar periphery and a contoured central feature as described above, wherein the planar periphery surrounds the contoured central
20 feature.

Additionally, another advantage/feature is the cooling system as described above, wherein the cooling system has a top surface, and wherein the air generating electric device mounting surface is opposite the top surface.

Moreover, another advantage/feature is the cooling system as described
25 above, wherein the heat generating device is a hard drive.

These and other features and advantages of the present principles may be readily ascertained by one of ordinary skill in the pertinent art based on the teachings herein. It is to be understood that the teachings of the present principles may be implemented in various forms of hardware, software, firmware, special
30 purpose processors, or combinations thereof.

Although the illustrative embodiments have been described herein with reference to the accompanying drawings, it is to be understood that the present principles is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one of ordinary skill in the pertinent art

without departing from the scope or spirit of the present principles. All such changes and modifications are intended to be included within the scope of the present principles as set forth in the appended claims.

CLAIMS:

1. A cooling system for a heat generating device, comprising:
5 a heat generating device (101) having an air current generating device mounting surface (103) through which heat from the heat generating device (101) can be released;
an air current generating device assembly (104) having:
an air current generating device (109) having blades (148);
10 a top side having a cooling air intake opening (117);
a bottom side (106) that faces and connects to the air current generating device mounting surface (103);
a periphery (107) that surrounds the top and bottom sides and substantially follows a periphery of the heat generating device;
15 an air opening (108) on a first side (113) of the periphery (107); and
a curved air duct (111) having a proximate end (112) adjacent to the air current generating device (109) and a distal end (114) on a second side (115) of the periphery (107) that is adjacent to the first side (113),
wherein the air opening (108) and the curved aid duct (111) are respectively
20 configured to permit at least one of cooling air to be drawn into the blades (148) of the air current generating device (109) and exhausted air from the air current generating device (109) to exit there through.
2. The cooling system of claim 1, wherein a plane in which the air current
25 generating device (109) rotates is parallel to the air current generating device mounting surface (103).
3. The cooling system of claim 1, wherein the air opening (108) is
configured be directly open, on at least one side thereof, to the air current generating
30 device mounting surface (103).
4. The cooling system of claim 1, wherein the curved air duct (111) is
configured be directly open, on at least one side thereof, to the air current generating
device mounting surface (103).

5. The cooling system of claim 1, wherein the air current generating device (109) is a fan in which the blades (148) thereof are tilted from vertical to draw the cooling air in through at least the cooling air intake opening (117) so as to push the cooling air onto the air current generating device mounting surface (103) and the exhausted air out at least one of the air opening (108) and the curved air duct (111).

6. The cooling system of claim 1, wherein the air current generating device (109) is a fan in which the blades (148) thereof are tilted from vertical to draw the cooling air in through at least one of the air opening (108) and the curved air duct (111) and across the air current generating device mounting surface (103), and the exhausted air out at least the cooling air intake opening (117).

7. The cooling system of claim 1, wherein the air current generating device (109) is a blower in which the blades (148) thereof are un-tilted and are vertically oriented to draw the cooling air in from at least one of the air opening (108) and the curved air duct (111) and push or skim the cooling air across the air current generating device mounting surface (103).

8. The cooling system of claim 1, wherein the air current generating device (109) is a blower in which the blades (148) thereof are un-tilted and are vertically oriented to push the exhausted air out through at least one of the air opening (108) and the curved air duct (111).

9. The cooling system of claim 1, wherein the hard drive system (100) is comprised within a set top box (1240).

10. The cooling system of claim 9, wherein the hard drive system (100) is separated from a card reader section of the set top box (1240) by a thermal partition wall (1224).

11. The cooling system of claim 9, wherein the set top box (1240) comprises a main printed circuit board having a thermal pad and a heat sink (1223) disposed on the thermal pad to remove heat from the main printed circuit board.

12. The cooling system of claim 11, wherein the heat sink (1223) is a contoured plate having a planar periphery (1226) and a contoured central feature (1225).

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13. The cooling system of claim 12, wherein the contoured central feature (1225) is at least one of a pocket, a central depression, a notch, a recess, a multi-level depression, and a mesa, extending at least one of from and to a plane of the planar periphery (1226).

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14. The cooling system of claim 12, wherein the planar periphery (1226) surrounds the contoured central feature (1225)

15. The cooling system of claim 1, wherein the cooling system has a top surface (102), and wherein the air generating electric device mounting surface (103) is opposite the top surface (102).

16. The cooling system of claim 1, wherein the heat generating device is a hard drive (101).

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17. A hard drive system, comprising:

a hard drive (101) having an air current generating device mounting surface (103) through which heat from the hard drive (101) can be released;

an air current generating device assembly (104) having:

25 an air current generating device (109) having blades (148);

a top side having a cooling air intake opening (117);

a bottom side (106) that faces and connects to the air current generating device mounting surface (103);

30 a periphery (107) that surrounds the top and bottom sides and substantially follows a periphery of the hard drive;

an air opening (108) on a first side (113) of the periphery (107); and

a curved air duct (111) having a proximate end (112) adjacent to the air current generating device (109) and a distal end (114) on a second side (115) of the periphery (107) that is adjacent to the first side (113),

wherein the air opening (108) and the curved aid duct (111) are respectively configured to permit at least one of cooling air to be drawn into the blades (148) of the air current generating device (109) and exhausted air from the air current generating device (109) to exit there through.

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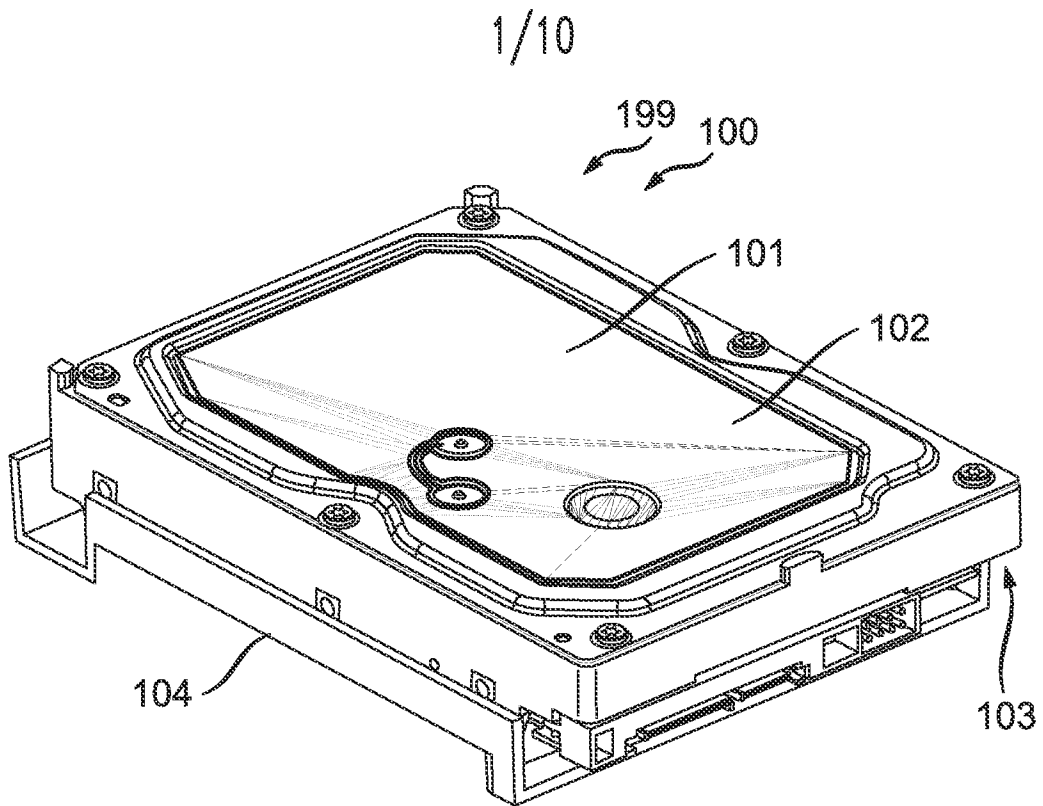


FIG. 1

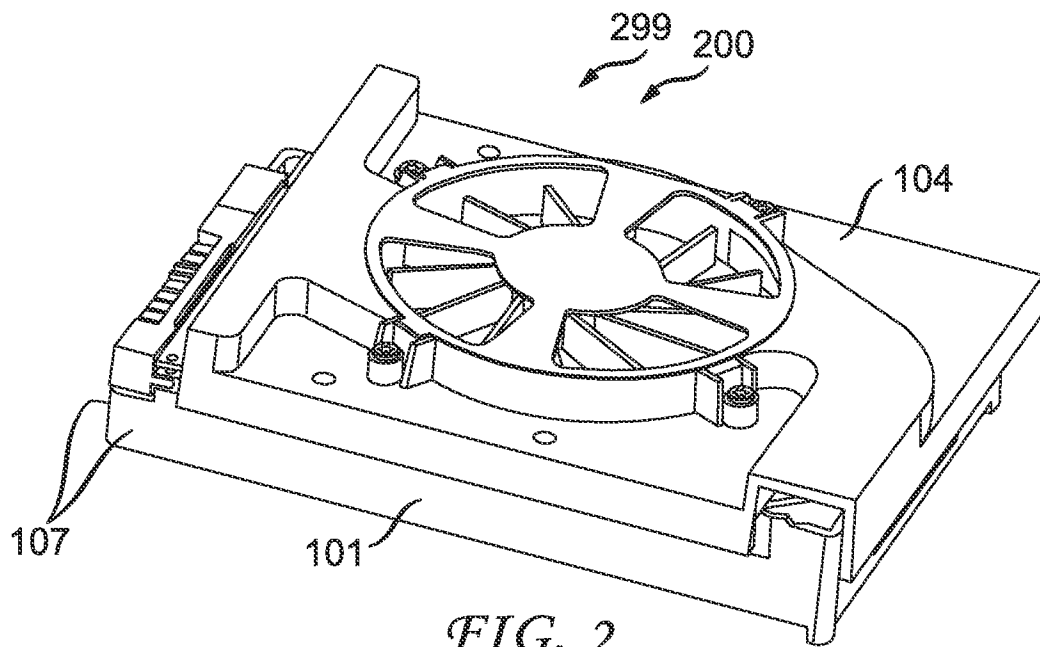
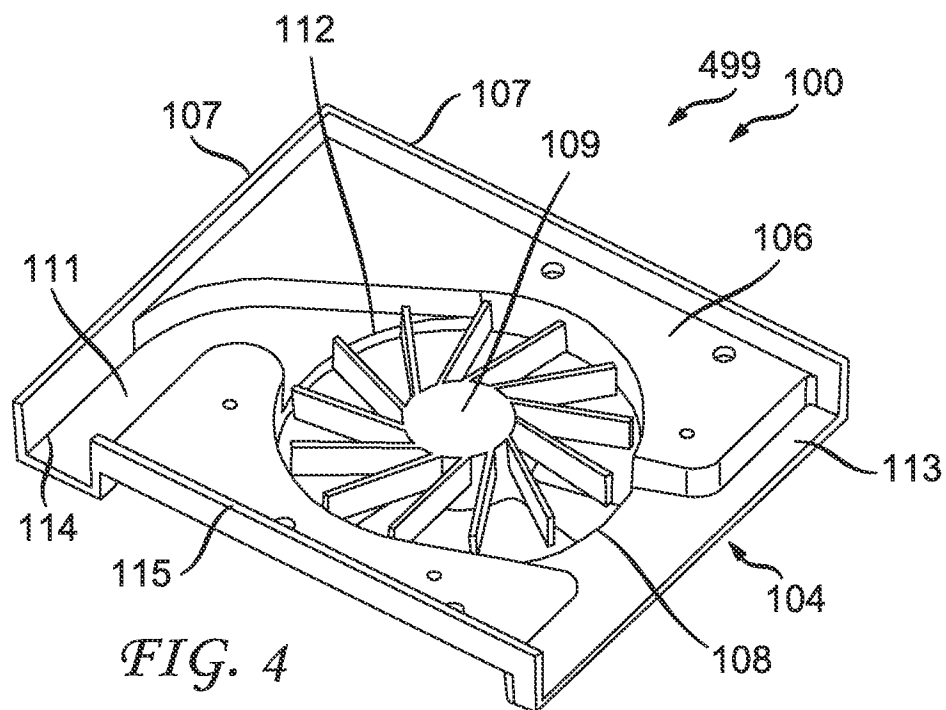
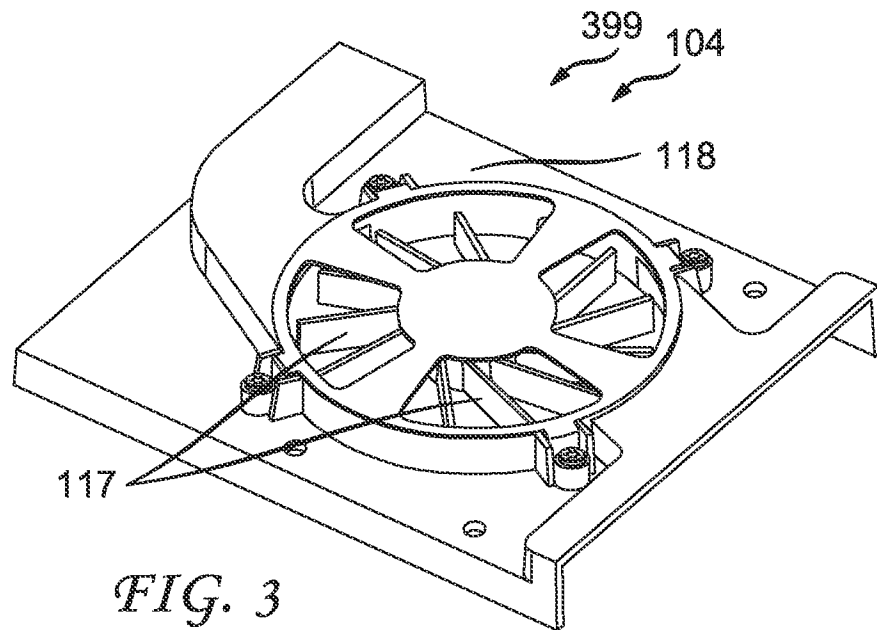
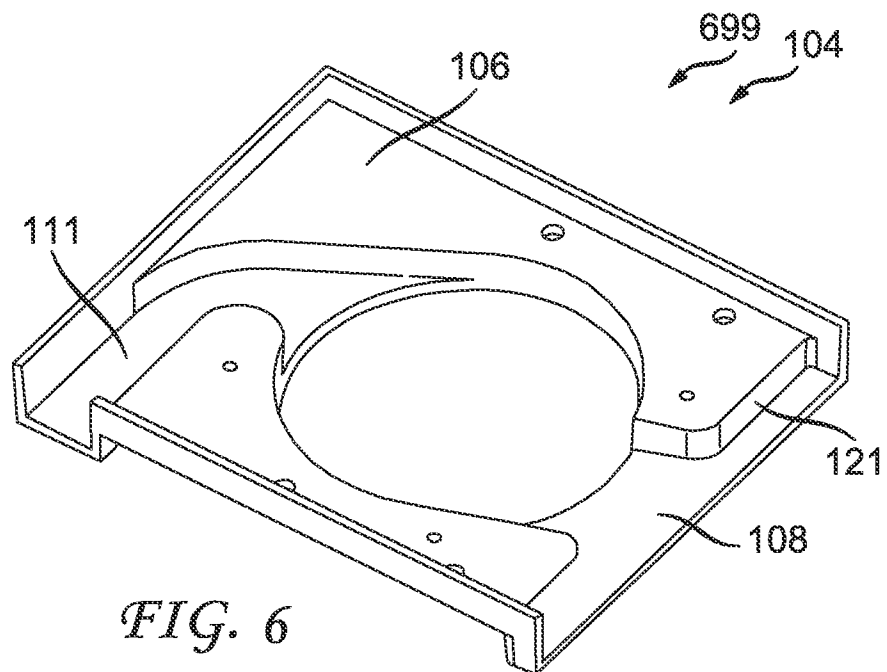
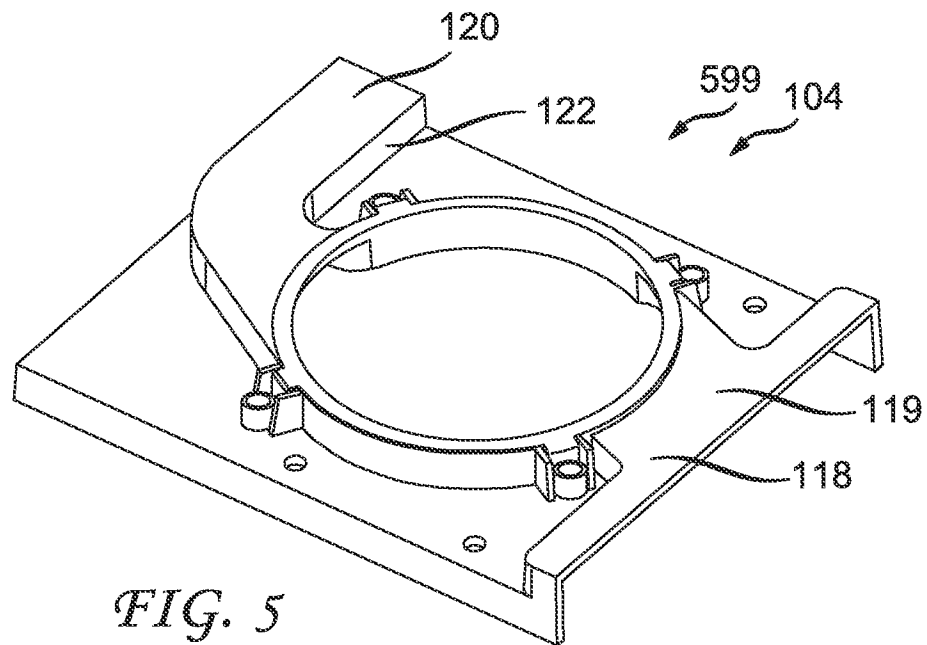


FIG. 2

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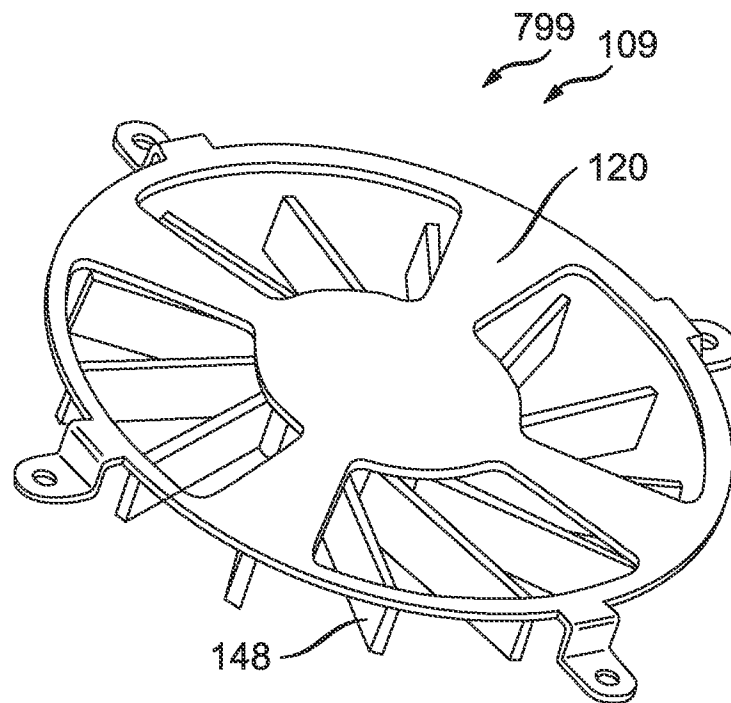


FIG. 7

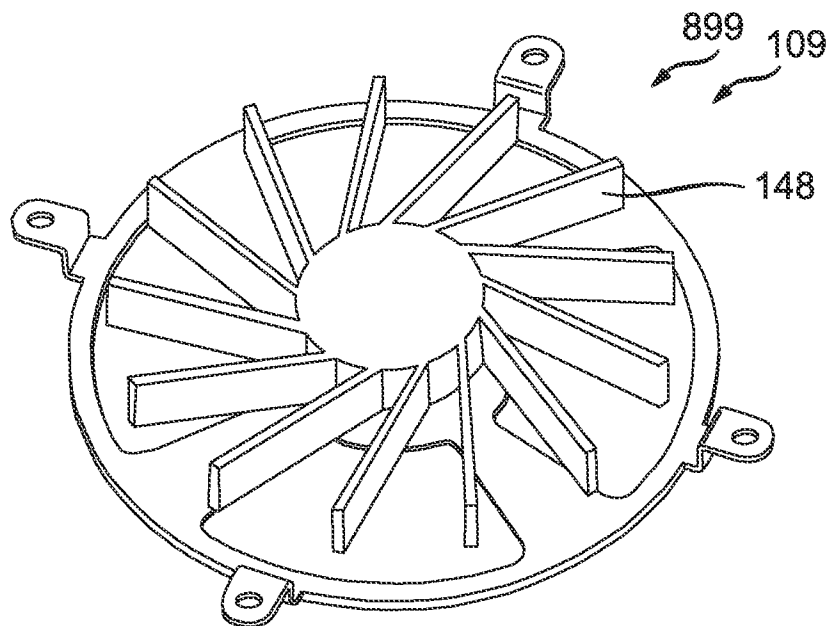


FIG. 8

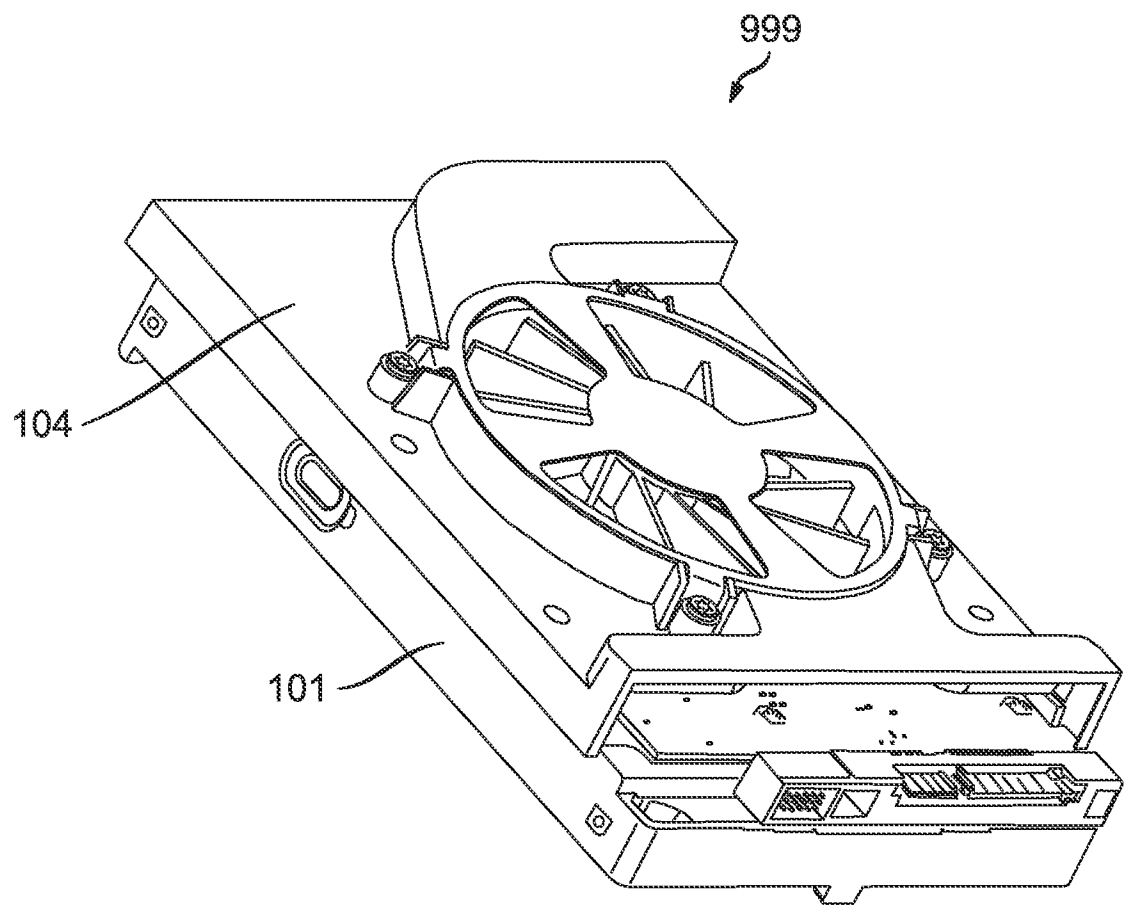


FIG. 9

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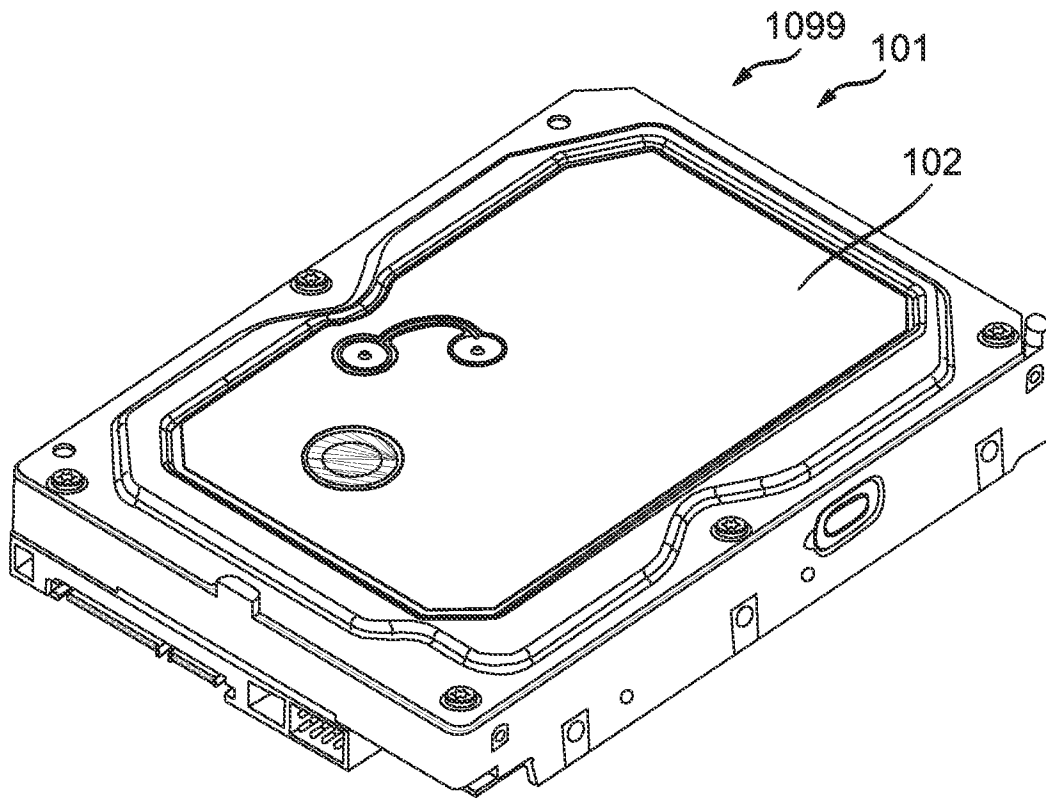


FIG. 10

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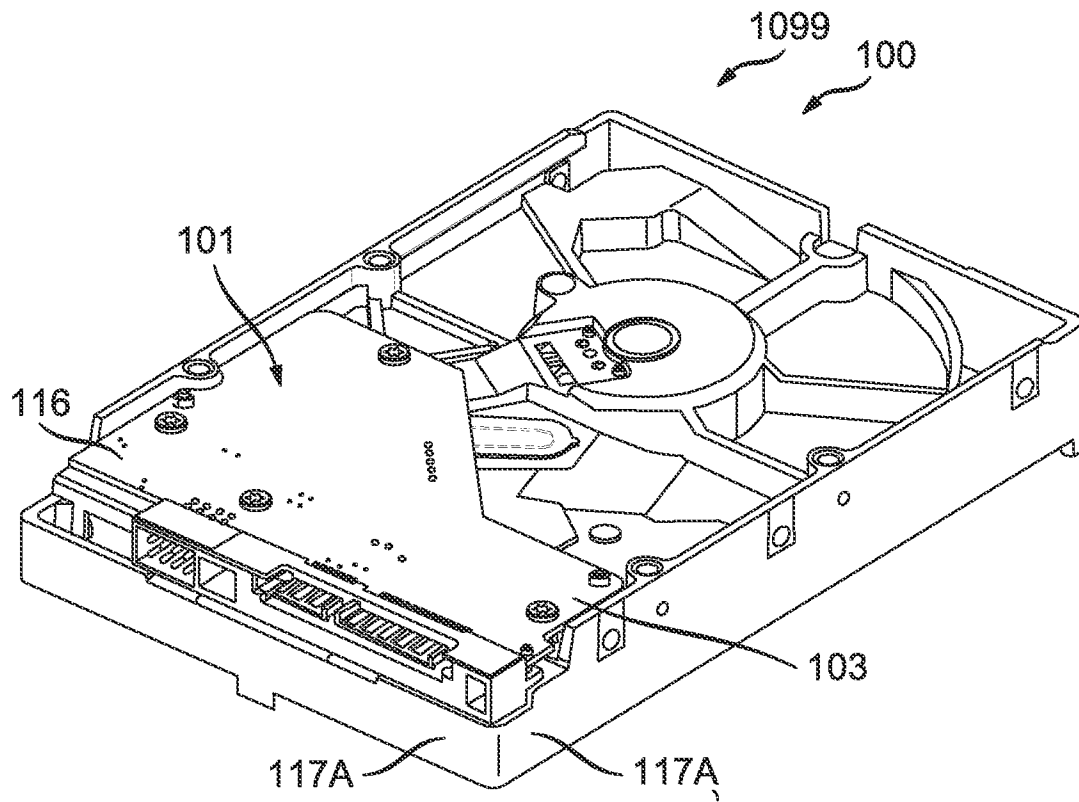


FIG. 11

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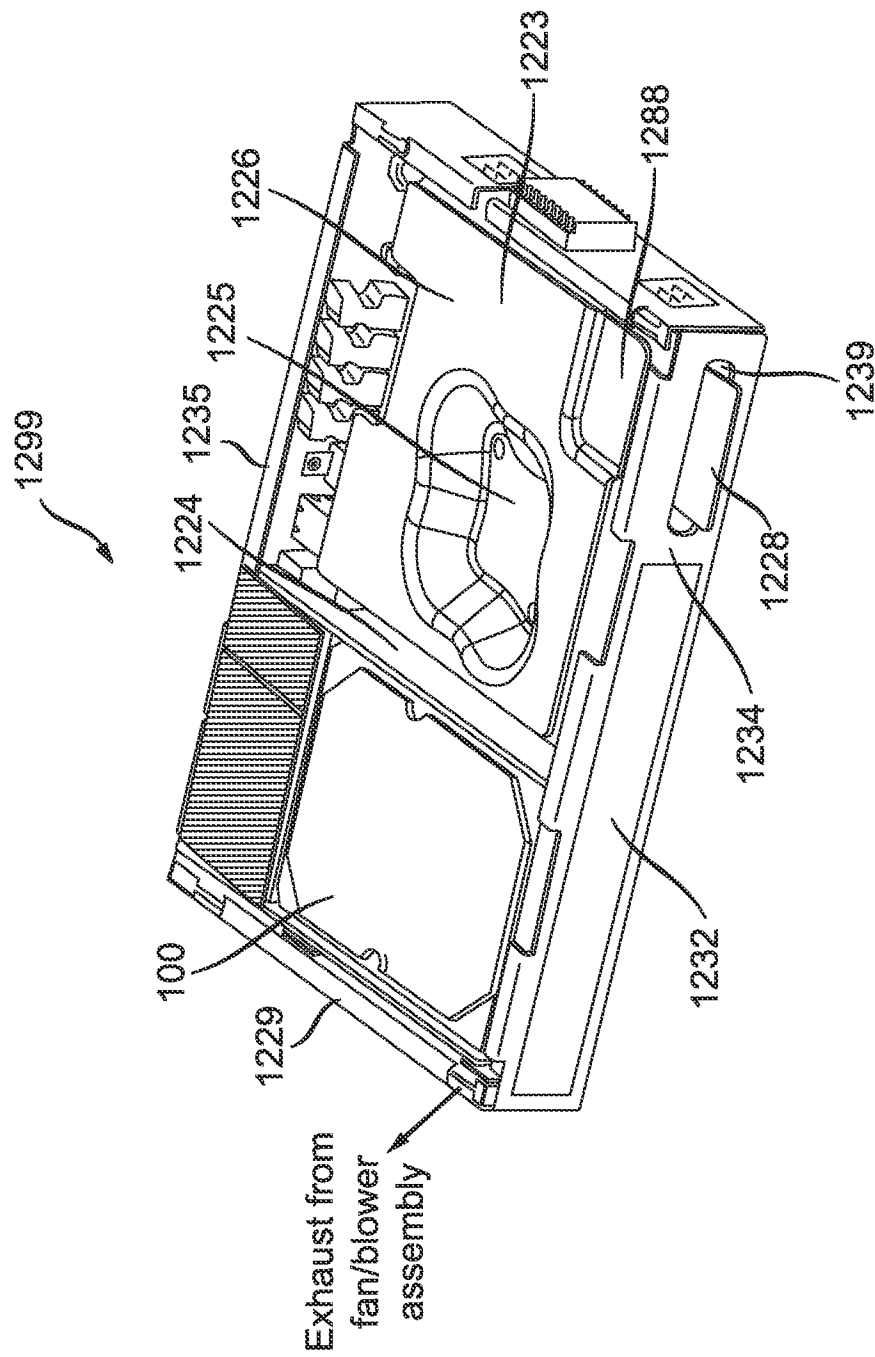
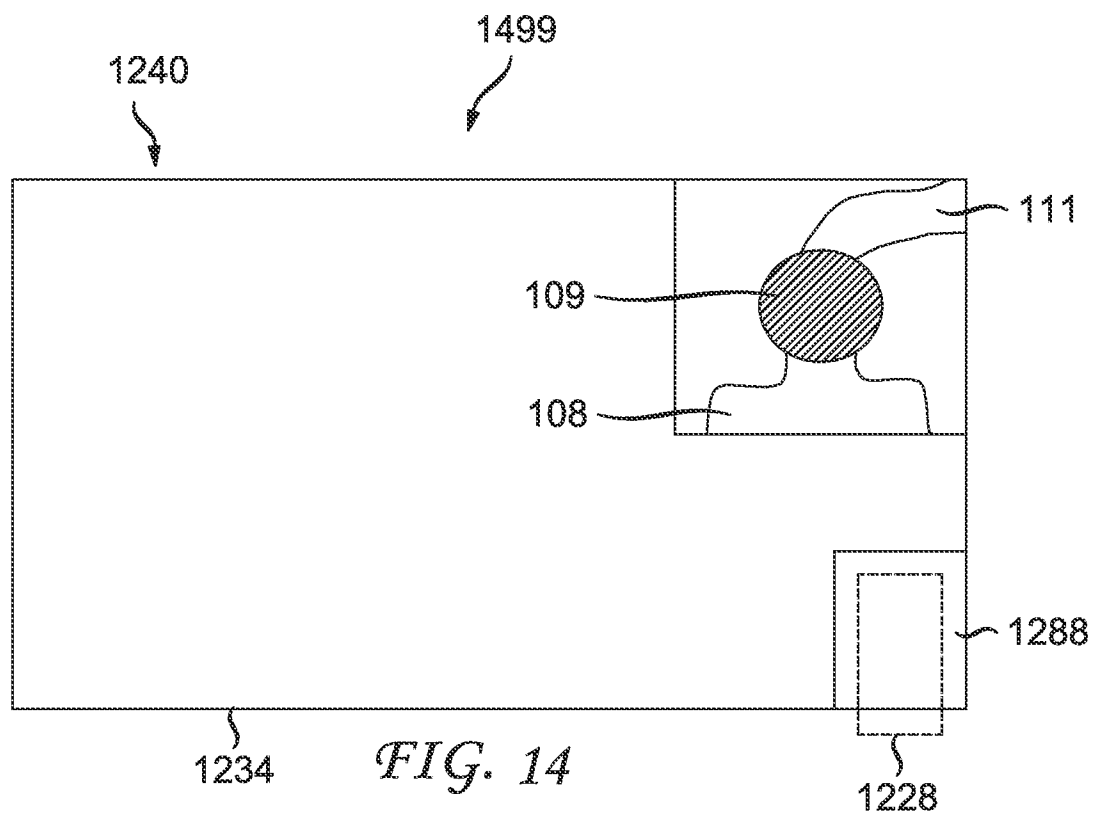
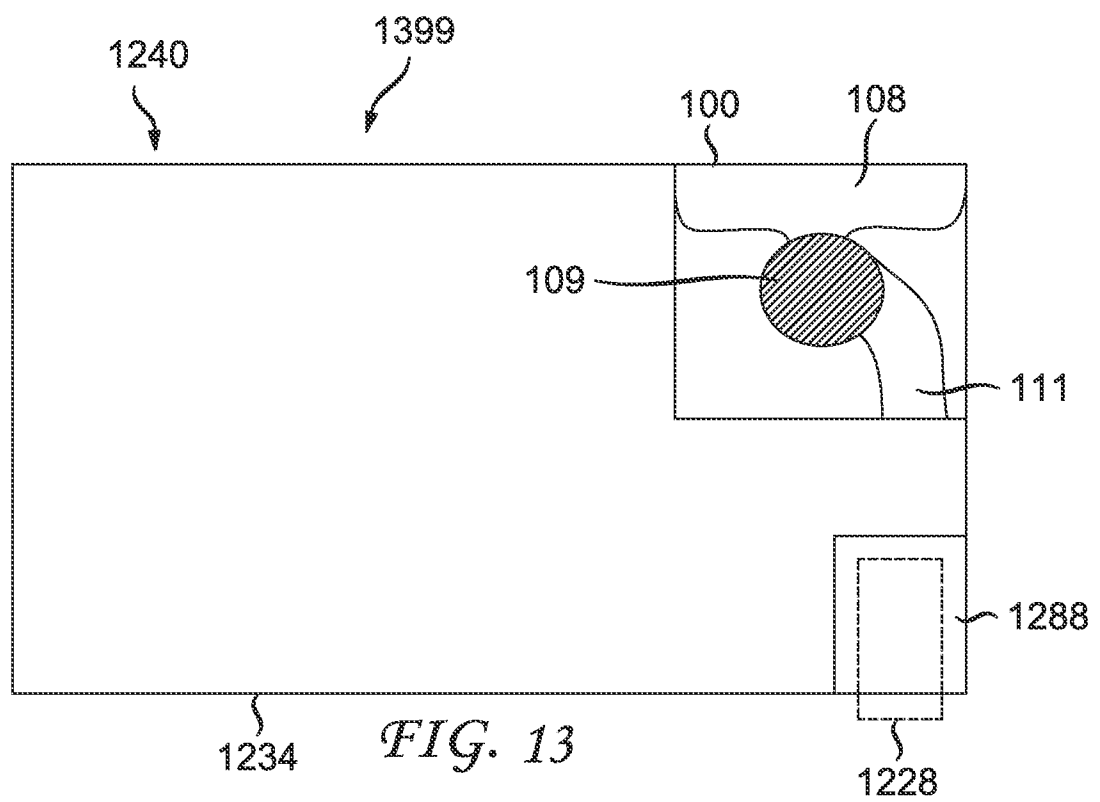


FIG. 12

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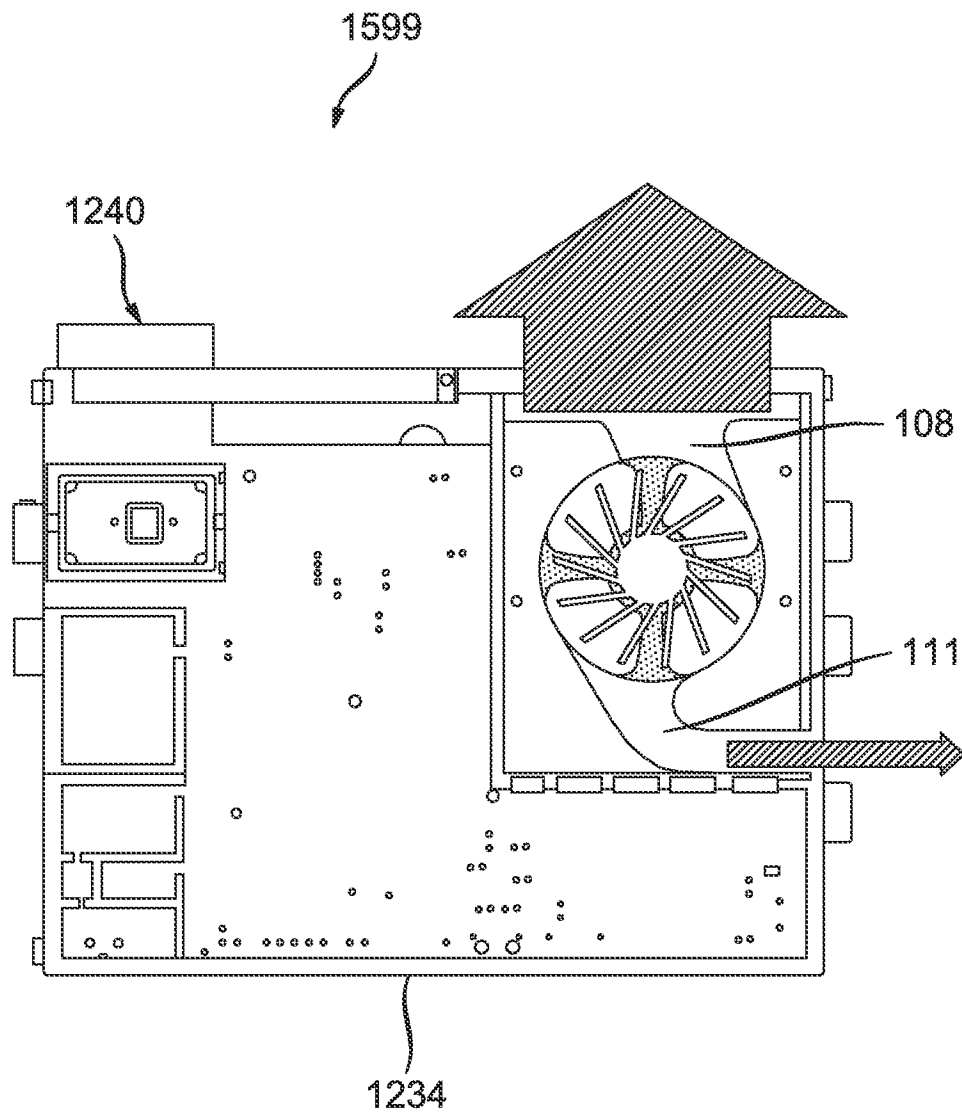


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/055770

A. CLASSIFICATION OF SUBJECT MATTER INV. G06F1/20 G11B33/14 H05K7/20 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) G06F G11B H05K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 538 629 A1 (THOMSON LICENSING SA [FR] THOMSON LICENSING [FR]) 8 June 2005 (2005-06-08) abstract figures 5,6 paragraph [0003] paragraph [0034] - paragraph [0036]	1-17
A	WO 98/52397 A1 (INTEL CORP [US]) 19 November 1998 (1998-11-19) figures 3,4A	1-17
A	US 6 233 148 B1 (SHEN TSAN JUNG [TW]) 15 May 2001 (2001-05-15) abstract page 1, line 1 - line 48	1-17
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 26 November 2013		Date of mailing of the international search report 03/12/2013
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Dhondt, Erik

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/055770

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 6233148	B1	15-05-2001	NONE
