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Removable fan cartridges for electronic devices

Abstract

Systems, apparatus, articles of manufacture, and methods are disclosed for accessories for electronic devices and removable fan cartridges for electronic devices. An example electronic device accessory includes a backplate panel removably couplable to a first chassis of a first electronic device to replace a portion of a first cover of the first chassis and removably couplable to a second chassis of a second electronic device to replace a portion of a second cover of the second chassis. The example electronic device accessory also includes a mating device to releasably couple the backplate panel to the first chassis and independently releasably couple the backplate panel to the second chassis and a fan coupled to the backplate panel. The fan is to increase a Z height of the first electronic device when the backplate panel is coupled to the first electronic device and increase a Z height of the second electronic device when the backplate panel is coupled to the second electronic device.

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Background/Summary

FIELD OF THE DISCLOSURE
(1) This disclosure relates generally to thermal solutions for electronic devices and, more particularly, to removable fan cartridges for electronic devices.
BACKGROUND
(2) Many electronic devices are cooled with fans. The cooling capability of the electronic devices is dependent on the size of the fan.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is an exploded view of an example cover of an example electronic device and example fans.
(2) FIG. **2** is an assembled view of the cover and fans of FIG. **1**.
(3) FIG. **3** is a perspective view of an example fan cartridge coupled to an example cover of an example electronic device.
(4) FIG. **4** is a partially exploded view of the example fan cartridge of FIG. **3** being assembled with an example electronic device.
(5) FIG. **5** is an assembled view of the fan cartridge and electronic device of FIG. **4**.
(6) FIG. **6** is a perspective view of an example fan cartridge cover.
(7) FIG. **7** is an exploded view of the example fan cartridge cover of FIG. **6** with example auxiliary heat dissipation components.
(8) FIG. **8** is an assembled view of the fan cartridge and auxiliary heat dissipation components of FIG. **7**.
(9) FIG. **9** is a partially exploded view of the example fan cartridge of FIG. **8** being assembled with an example electronic device.
(10) FIG. **10** is an assembled view of the fan cartridge and electronic device of FIG. **9**.
(11) FIG. **11** is a cross-sectional comparative schematic illustration of an electronic device with two types of fan cartridges.
(12) FIG. **12** is a perspective view of an electronic device with example fan cartridge connectors.
(13) FIG. **13** is a side view of a portion of a partially assembled electronic device with example fan cartridge connectors.
(14) FIG. **14** is a detailed view of the example fan cartridge connectors of FIG. **13**.
(15) FIG. **15** is a perspective view of a portion of the electronic device of FIG. **13** with an example release mechanism for releasing the fan cartridge.
(16) FIG. **16** is a cross-sectional schematic illustration of example internal connectors of the fan cartridge of FIG. **13**.

(17) FIG. **17** is a cross-sectional view of a portion of the electronic device with the fan cartridge of FIG. **13**.
(18) FIG. **18**A is a side view of an example electronic device with a first example fan cartridge.
(19) FIG. **18**B is a side view of the electronic device of FIG. **18**A with a second example fan cartridge.
(20) FIGS. **19**A and FIG. **19**B are cross-sectional schematic illustrations of example air flow through the electronic device of FIG. **18**A.
(21) FIGS. **20**A and FIG. **20**B are cross-sectional schematic illustrations of example air flow through the electronic device of FIG. **18**B.
(22) FIG. **21**A is an illustration of an example chassis with a first fan cartridge and a second fan cartridge.
(23) FIG. **21**B is an illustration of an example fan cartridge in a first chassis and a second chassis.
(24) In general, the same reference numbers will be used throughout the drawing(s) and accompanying written description to refer to the same or like parts. The figures are not necessarily to scale. Instead, the thickness of the layers or regions may be enlarged in the drawings.

DETAILED DESCRIPTION

(25) Electronic devices such as, for example, laptop computers and personal computers (PCs), increasingly include more heat generating components as the electronic devices become more powerful and versatile. Thermal solutions to cool the electronic devices are important to maintain target or desired operational parameters and avoid overheating. One example thermal solution includes fans to generate air flow to exhaust warm air from electronic devices.
(26) The thickness of an electronic device is known as system Z height or simply Z height. In some electronic devices such as, for example, laptops, the Z height is a challenging factor in designing laptops. Thin laptops are desirable consumer products. However, on modern laptops the thickest key component inside the system base is the fan. The cooling or thermal dissipation capability and noise level of such laptops are highly dependent on the fan height. If the base Z height of the electronic device is limited, the fan height and cooling capability could be directly affected because the fan height and, thus, fan power is constrained by the Z height of the electronic device.
(27) Prior efforts to increase cooling or thermal dissipation capacity of electronic devices include fan-based accessories that clip onto smartphones or cooling pads for laptop computers. However, these solutions have deficiencies. Smartphone clip accessories may only cool the skin of the back of the phone because the air flow from the fans in the clip accessories do not contact the heat source. In addition, the glass or metal chassis that are common with smartphones blocks effective cooling of the heat generating components inside the smartphone. Also, cooling pads for laptop computers are not customized for specific models, the cooling capability of cooling pads is limited, and the cooling pads cannot be moved out of the way away during usage.
(28) Examples disclosed herein introduce removable fan cartridges that can be removed and swapped out (i.e., replaced) with alternative fan cartridges to enhance the thermal solutions to electronic devices. Examples disclosed herein may be implemented in electronic devices with evacuative cooling and/or with cooling with hyperbaric chambers, though hyperbaric flow architecture is described more frequently in this disclosure. With the examples disclosed herein, the cooling capabilities of electronic devices such as, for example, thin laptops are not limited by the fan height. Users could easily swap the fan cartridge from a cartridge with relatively less powerful fans to a cartridge with relatively more powerful fans to enhance the cooling capability of the electronic device, and/or users can swap the fan cartridge from a cartridge with relatively more powerful fans to a cartridge with relatively less powerful fans to run the electronic device at lower noise level.
(29) FIG. **1** is an exploded view of an example cover **100** of an example electronic device and example fans **102**. In some examples, the cover **100** forms part of the chassis such as, for example, a D cover of an electronic device. The fans **102** of FIG. **1** are a hyperbaric fan design. The fans **102**

include an example fan base plate **104** that covers one side of the fan **102** to cover the motor and fan blade. The cover **100** includes example fan inlets **106** and example cutwaters **108** that are coupled to or formed with the cover **100**. In some examples, the cover **100** includes stamped aluminum. In some examples, the cutwaters **108** include a plastic material and are bonded to the cover **100**. In some examples, the plastic and aluminum parts are made separately. In such examples, different cutwater designs and/or changes in designs can be made without affecting the appearance or construction of the aluminum part.

(30) FIG. **2** is an assembled view of the cover **100** and fans **102** of FIG. **1**. In this example, there is only the base plate **104** on one side of the fans **102**. Without a base plate on the other side of the fans **102**, the space that would be occupied by the base plate can be used for a larger or taller fan blade in the same volume of space. Compared to regular fan designs, the hyperbaric design with on-chassis fan does not need to reserve the air gap between the D cover and the fan bottom cover. Because air is completely pumped toward the system core area with hyperbaric designs, a gap is not needed for attracting the hot air from the system core area. Therefore, at least a part of the gap could be used for increasing the fan blade height. The fan performance could be scaled directly according to an increased motor and blade thickness. Thus, in such examples, fans with larger thickness or heights and, thus, more cooling capacity, can be used. The fans **102** are removable with the cover **100**. Though two fans are shown in this and other examples in this disclosure, in other examples, there may be other numbers of fans such as, for example, one, three, four, etc.

(31) FIG. **3** is a perspective view of an example fan cartridge **300** that includes a fan cartridge cover **302** to which the example fans **102** are coupled. The fan cartridge **300** is coupled to an example cover **304** of an electronic device. In this example, the fan cartridge **300** does not extend over the entire cover **304** but forms a removable portion of the cover **304**. FIG. **4** is a partially exploded view of the example fan cartridge **300** of FIG. **3** being assembled with an example electronic device **400**. In this example, the electronic device is a tablet or a portion of a laptop computer. FIG. **5** is an assembled view of the fan cartridge **300** and the electronic device **400**. In the example of FIGS. **3-5**, the fan cartridge **300** is smaller than the cover **304**. Thus, a user only replaces a portion of the area of the cover **304** when removing and replacing the fan cartridge **300**. For example, the fan cartridge **300** can be replaced with a fan cartridge with small fans for less noise. Alternatively, the fan cartridge **300** can be replaced with a fan cartridge with larger fans for more cooling capability and higher performance.

(32) FIG. **6** is a perspective view of an example fan cartridge cover **600**. The fan cartridge cover **600** includes the fan inlets **106**. In some examples, the fan inlets **106** may have a different shape or dimension than shown (e.g., the fan inlets **106** can form a larger diameter than shown in FIG. **1**). The fan cartridge cover **600** also includes example cutwaters **602**. In some examples, the fan cartridge cover **600** includes aluminum and the cutwaters **602** are a plastic material bonded to the fan cartridge cover **600**. The cutwaters **602** have a higher Z height to accommodate larger fans than the example of FIG. **1**. The fan cartridge cover **600** includes an example first wall **604**, an example second wall **606** opposite the first wall **604**, an example a third wall **608** extending between the first wall **604** and the second wall **606**, and example fourth wall **610** opposite the third wall **608**. The fan cartridge cover **600** also includes an example backplate **612** that extends between the first wall **604**, the second wall **606**, the third wall **608**, and the fourth wall **610**. In the illustrated examples, the cutwaters **602** are coupled to the backplate **612**. Also, in the illustrated examples, the fan inlets **106** are formed in the backplate **612**. An example cavity **614** is formed by the first wall **604**, the second wall **606**, the third wall **608**, the fourth wall **610**, and the backplate **612**. The fan cartridge cover **600** with the cavity **614** can house a taller fan than a fan cartridge cover that does not include the cavity **314**. Thus, the fan cartridge cover **600** can accommodate a fan with higher performance capabilities than the fans **102** of FIG. **1**.

(33) FIG. **7** is an exploded view of the example fan cartridge **600** with example fans **700** and example auxiliary or additional heat dissipation components **700**. Because of the cavity **614**, the

fans **700** can be high performance fans. In other words, the fans **700** can have a higher Z height, taller blades, larger motor, and can produce a larger air flow output for greater cooling or thermal dissipation capability than the fans **102** of FIG. **1**.

(34) In some examples, the fan cartridge **600** includes the additional heat dissipation components **702** beyond the fans **700**. For example, within the cavity **614**, the fan cartridge **600** can house or support one or more heat dissipation components. In some examples, the heat dissipation components include one or more of a heat pipe, a heat sink, and/or a vapor chamber (VC). The heat dissipating components are coupled within the fan cartridge **600** via example sealing gaskets **704**. The dissipation components **702** are able to conduct additional heat from the heat generating components of the electronic device and share the thermal load of the fans **700**.

(35) FIG. **8** is an assembled view of the fan cartridge **600** with the fans **700** and the heat dissipation components **702** of FIG. **7** in the cavity **614**. FIG. **9** is a partially exploded view of the fan cartridge **600** being assembled with an example electronic device **900** adjacent a portion of an example cover **902** of the electronic device **900**. FIG. **10** is an assembled view of the fan cartridge **600** and electronic device **900** of FIG. **9**. The second wall **606** and third wall **608** of the fan cartridge **600** are visible in FIG. **10**. The first wall **604**, the second wall **606**, the third wall **608**, and the fourth wall **610** add a thickness or Z height to the electronic device **900**. In this example, the backplate **612** the fan cartridge **600** is in a first plane, and the cover **902** is in a second plane parallel and displaced from the first plane such that the fan cartridge **600** adds Z height to the electronic device **900** or, as shown, to a portion of the electronic device **900**. The electronic device **900** include example surface support **1002** such as, for example rubber feet, to maintain support and positioning of the electronic device **900** on a surface.

(36) FIG. **11** is a cross-sectional comparative schematic illustration of an example electronic device **1100** with two types of fan cartridges that are removable from a cover of the electronic device **1100** and interchangeable. The electronic device **1100** may represent any or all of the electronic devices **400**, **900** (or others disclosed herein). The electronic device **1100** includes an example chassis **1102**, an example keyboard **1104**, an example main printed circuit board (PCB) **1106**, and one or more example heat generating components **1108** such as, for example, a central processing unit (CPU) and/or graphics processing unit (GPU). The electronic device **1100** also includes one or more example heat dissipation components **1110** such as, for example a heat pipe or VC. Also, the electronic device **1100** includes example surface support **1112** such as, for example, rubber feet.

(37) The electronic device **1100** also includes an example pocket **1114** into which removable fan cartridges are interchangeably couplable. In the illustrated example, a first example fan cartridge **1116** includes a first example fan **1118** and a second example fan **1120**. The first fan cartridge **1116** may represent the fan cartridge **300**. When the first fan cartridge **1116** is combined with the chassis **1102** of the electronic device **1100**, the combination has a first Z height **1122**. In some examples, the Z height **1122** is approximately 9.8 millimeters (mm). In some examples, the electronic device **1100** with the first fan cartridge **1116** may form the electronic device **400** of FIGS. **4** and **5**.

(38) The first fan cartridge **1116** may be removed from the chassis **1102** and replaced with an example second fan cartridge **1124** and vice versa. The second example fan cartridge **1124** includes a third example fan **1126** and a fourth example fan **1128**. The second fan cartridge **1124** may represent the fan cartridge **900**. The second fan cartridge **1124** also includes an example auxiliary heat dissipation device **1130** such as, for example, a heat pipe or VC. In the illustrated example, the auxiliary heat dissipation device **1130** is couplable to the heat dissipation components **1110** via, for example, an example metal block **1132** (such as, for example, a copper block) and an example thermal pad **1134**.

(39) When the second fan cartridge **1124** is combined with the chassis **1102** of the electronic device **1100**, the combination has a second Z height **1136**. In some examples, the second Z height **1136** is approximately 17.8 mm. In some examples, the electronic device **1100** with the second fan cartridge **1124** may form the electronic device **900** of FIGS. **9** and **10**.

(40) The third fan **1126** and the fourth fan **1128** are larger and thicker and/or taller than the first fan **1118** and the second fan **1120**. Thus, the electronic device **1100** with the second fan cartridge **1124** has higher performance characteristics than the electronic device **1100** with the first fan cartridge **1116**. In some examples, the electronic device **1100** with the second fan cartridge **1124** may be used for high power computing purposes such as, for example, gaming, simulation workload, and/or lower fan acoustics at the same power level usages. In some examples, the electronic device **1100** with the first fan cartridge **1116** is suitable for lower power consumption usages and/or increased mobility.
(41) The first fan cartridge **1116** and the second fan cartridge **1124** are removable and swappable or interchangeable. In some examples, the first fan cartridge **1116** and the second fan cartridge **1124** may be sold separately from the electronic device **1100**. For example, the second fan cartridge **1124** may be sold as a performance booster kit. In some examples, the first fan cartridge **1116** and the second fan cartridge **1124** may be sold as a package for users to select and attach their preferred fan cartridge based on their usages.
(42) Different means or mating devices for connecting fan cartridges to electronic devices may be used. Examples disclosed herein may show means for connecting the fan cartridge **600**, but the same connecting means may be used for any fan cartridge disclosed herein. FIG. **12** is a perspective view of the electronic device **900** with the fan cartridge **600** coupled thereto. The fan cartridge **600** is coupled to the electronic device with one or more magnetic connectors **1200**. In the illustrated example, the magnetic connectors **1200** are positioned around the perimeter of at least three sides of the fan cartridge **600**. In other examples, the magnetic connectors **1200** are positioned around fewer sides of the fan cartridge **600** or around all sides of the fan cartridge **600**. In some examples, magnets of the magnetic connectors **1200** are positioned on both the fan cartridge **600** and the electronic device **900**. In other examples, only one of the fan cartridge **600** or the electronic device **900** includes a magnet that is attracted to a magnetic material on the other of the fan cartridge **600** or the electronic device **900**. In some examples, one or more mechanical latches are used in addition or alternative to the magnetic connectors **1200**.
(43) The fan cartridge **600** also includes example electrical connectors such as electrical pins or pogo pin probes **1202** that engage complementary pogo pads on the electronic device **900**. The pogo pin probes **1202** are used to electronically couple the fan cartridge **600** to the electronic device **900** so that the fan cartridge **600** can receive instructions and power for operating the fans **700**.
(44) FIG. **13** is a side view of a portion of the electronic device **900** partially assembled with the fan cartridge **600**. The fan cartridge **600** includes mechanical connectors such as an example plurality of retention snaps **1300** that releasably engage corresponding ones of an example plurality of retention slots **1302** on the electronic device **900**. In other examples, the fan cartridge **600** includes an example plurality of retention slots that are releasably engageable by corresponding ones of a plurality of retention snaps on the electronic device **900**.
(45) To assemble or attach the fan cartridge **600**, the user aligns the fan cartridge **600** with the cover **902** (e.g., the D cover) of the electronic device **900**. The rear edge (e.g., fourth wall **610**) of the fan cartridge **600** is engaged with the electronic device **900** to cause the retention snaps **1300** to engage the retention slots **1302**. The retention snaps **1300** and the retention slots **1302** form a snap feature that holds the fan cartridge **600** in place in the Z direction. The other edges of the fan cartridge **600** (e.g., the first wall **604**, the second wall **606**, and the third wall **608**) are attached and releasably fixed to the electronic device **900** via the magnetic connectors **1200**. FIG. **14** is a detailed cross-sectional view of the fan cartridge **600** coupled to the electronic device **900** with the magnetic connectors **1200**, the retention snaps **1300**, and the retention slots **1302**. FIG. **13** also illustrates the pogo pads **1304** on the electronic device that to which respective pogo pin probes **1202** engage.
(46) FIG. **15** is a perspective view of a portion of the electronic device **900** of FIG. **13** with an example release mechanism **1500** for releasing the fan cartridge **600**. In some examples, the release

mechanism **1500** is a slidable ejection knob or ejection latch. In such examples, the release mechanism **1500** includes a spring loaded latch that is engaged with a slot in the electronic device **900** in the locked position. In such examples, the spring loaded latch is retracted against the force of the spring with the slidable knob is slid, which pulls the latch from the slot and overcomes at least some of the force of the magnetic connectors **1200** to lift and separate at least a portion of the fan cartridge **600** from the electronic device **900**. In some examples, the release mechanism **1500** includes a rotatable cam. In such examples, when the knob is slid, the cam rotates and presses against the electronic device, which overcomes at least some of the force of the magnetic connectors **1200** to lift and separate at least a portion of the fan cartridge **600** from the electronic device **900**. In other examples, other releasable mechanisms may be used. In addition, in some examples, there may be a plurality of release mechanisms.

(47) FIG. **16** is a cross-sectional schematic illustration of example internal connectors of the fan cartridge **600** of FIG. **13**. The first and second fans **700** are connected to the pogo pin probes **1202** via an example wire or flex cable **1600**. The pogo pin probes **1202** engage with complementary ones of the pogo pin pads **1304**. The pogo pin pads are coupled via an example wire or flex cable **1602** to an example PCB **1604**. Thus, the pogo pin probes **1202** and the pogo pin pads **1304** electrically couple the fans **700** to an example PCB **1604**. With this connection, the fans **700** can receive power and operational commands. In the example of FIG. **16**, the pogo pins **1202** (male side) are fixed to the fan cartridge **600**, and the pogo pin pads **1304** (female side) are fixed to the base D cover **902**. In other examples, the pogo pins **1202** (male side) are fixed to the base D cover **902** and coupled to the PCB **1604** via the flex cable **1602**, and the pogo pin pads **1304** (female side) are fixed to the fan cartridge **600** and coupled to the fans **700** via the flex cable **1600**.

(48) FIG. **17** is a cross-sectional view of a portion of the electronic device **900** with the fan cartridge **600** of FIG. **13**. The cross-sectional view illustrates the cavity **614** and the additional cooling capacity that the fan cartridge **600** adds to the electronic device **900**. The cavity **614** provides an enlarged air flow chamber for the fans **700** (not shown in FIG. **17**). The fans **700** expel or exhaust air from the electronic device **900** through a first exhaust area or vents **1700** on a side of the electronic device **900** as shown by the arrow A. In addition, the fans **700** expel or exhaust air from a second exhaust area or vents **1702** on the fourth wall **610** of the fan cartridge **600** as shown by the arrow B. In other examples, the first exhaust area **1700** may be included on one or more other sides of the electronic device **900** in addition or alternative to the side shown in FIG. **17**. Also, in other examples, the second exhaust area **1702** may be included on or more other sides of the fan cartridge **600** in addition or alternative to the side shown in FIG. **17** (i.e., the fourth wall **610**). The example of FIG. **17** also includes the heat pipe **702** that offers additional cooling capacity.

(49) FIG. **18**A is a side view of the example electronic device with the first example fan cartridge **300**. The first exhaust areas **1700** provide the openings for air to be expelled from the electronic device **900** by the fans **102**. FIG. **18**B is a side view of the electronic device **900** with the second example fan cartridge **600**. The first exhaust areas **1700** and the second exhaust areas **1702** provide the openings for air to be expelled from the electronic device **900** by the fans **700**. Thus, the electronic device **900** with the fan cartridge **600** accommodates the larger, higher performance fans **700** that can produce more air flow and more exhaust.

(50) In some examples, the electronic device **900** with the first fan cartridge **300** is about 13.95 mm in Z height. In some examples, the electronic device **900** with the second fan cartridge **600** is about 21.95 mm in Z height.

(51) FIG. **19**A and FIG. **19**B are cross-sectional schematic illustrations of example air flow through the electronic device of FIG. **18**A. FIG. **19**A is an example front view and FIG. **19**B is an example rear view. However, in other examples, the air flow can be directed through other sides of the device **900**. FIG. **19**A shows internal airflow through the electronic device **900**. Though the electronic device **900** is described, the description applies to the electronic device **400** and/or the

electronic device **1100**. The electronic device **900** of FIGS. **19**A and **19**B includes the first fan cartridge **300** with the fans **102**. Air is attracted to the fans **102** and circulated within the electronic device **900**, as shown in FIG. **19**A.

(52) FIG. **19**B shows the air expelled or exhausted from the electronic device **900**. The air flow outlets include two fan outlets **1900** and a central chassis outlet **1902**. In some examples, the two fan outlets **1900** and the central chassis outlet **1902** correspond to the first exhaust area **1700**.

(53) FIG. **20**A and FIG. **20**B are cross-sectional schematic illustrations of example air flow through the electronic device of FIG. **18**B. FIG. **20**A is an example front view and FIG. **20**B is an example rear view. However, in other examples, the air flow can be directed through other sides of the device **900**. FIG. **20**A shows internal airflow through the electronic device **900**. Though the electronic device **900** is described, the description applies to the electronic device **400** and/or the electronic device **1100**. The electronic device **900** of FIGS. **20**A and **20**B includes the second fan cartridge **600** with the fans **700**. Air is attracted to the fans **700** and circulated within the electronic device **900**, as shown in FIG. **20**A.

(54) FIG. **20**B shows the air expelled or exhausted from the electronic device **900**. The air flow outlets include the two fan outlets **1900**, the central chassis outlet **1902**, and an example detachable fan cartridge outlet **2000**. In some examples, the two fan outlets **1900** and the central chassis outlet **1902** correspond to the first exhaust area **1700**, and the detachable fan cartridge outlet **2000** corresponds to second exhaust area **1702**. Compared with the electronic device **900** with the first fan cartridge **300**, the electronic device **900** with the second fan cartridge can exhaust a larger volume of air and increase cooling capacity.

(55) FIG. **21**A is an illustration of an example chassis reuse, which illustrates the swappable nature of the fan cartridges disclosed herein. For example, on the left, FIG. **21**A shows an example first chassis **2100** of an electronic device with a first fan cartridge **2102** having a first set of fans **2104** that have a first power capability with a first fan cartridge and a second fan cartridge. On the right, FIG. **21**A shows the first fan cartridge **2102** that can be removed from the first chassis **2100** and replaced with a second fan cartridge **2106** that has a second set of fans **2108** that have a second power capability. In some examples, the second power capability is different than the first power capability. For example, the second power capability can be greater than the first power capability. Additionally or alternatively, the first fan cartridge **2102** and the first set of fans **2104** may have a first Z height. In some examples, the second fan cartridge **2106** and the second set of fans **2108** may have a second Z height. In some examples, the second Z height may be different than the first Z height. In some examples, the second Z height is greater than the first Z height. The first fan cartridge **2102** and the second fan cartridge **2106** may be interchanged to change a performance and/or a cooling capability of the electronic device.

(56) FIG. **21**B is an illustration of an example fan cartridge reuse. For example, on the left, FIG. **21**B shows the first chassis **2100** of the electronic device with the first fan cartridge **2102** having the first set of fans **2104**. On the right, FIG. **21**B shows that the first fan cartridge **2102** can be removed from the first chassis **2100** and coupled to a second chassis **2110** of a second electronic device. In some examples, the first electronic device with the first chassis **2100** and the second electronic device with the second chassis **2110** are different types of devices with different form factors but that share an equivalent or substantially equivalent performance and/or cooling capability. Thus, the same fan design can be used in the different electronic devices. For example, the first electronic device with the first chassis **2100** has first exterior physical dimensions, and the second electronic device with the second chassis **2110** has second exterior physical dimensions larger than the first exterior physical dimensions.

(57) Example removable fan cartridges disclosed herein can be used with both evacuative flow and hyperbaric flow architectures to provide a powerful performance boost accessory. There are additional benefits with hyperbaric flow architecture. For example, evacuative flow architecture relies on a heat exchanger with fins to dissipate heat. The heat exchanger fins are fixed to the heat

pipes or VC and the added air flow is pushed toward the original fins with the same surface area.
(58) Hyperbaric designs could include direct heat exchanging on the existing heat pipes and/or VCs without adding heat exchangers fins. In other words, hyperbaric designs add inbound air that effect direct heat exchanging utilizing the original heat pipes and/or VC surface and without extending or increasing the effective fins that are thermally connected to the main heat pipes and/or vapor chambers. The increased airflow is pumped directly toward the PCB board and other heat generating components and exchanges an additional amount of heat. The increased air flow generated by the thicker high performance fan cartridge goes over the chassis skin, system components, and surfaces of the thermal module and provides improved cooling capability over a fan cartridge with standard sized fans.
(59) The ability to remove and replace fan cartridges with fan cartridges that have fans of different cooling capability allows a user to scale the cooling capability of the electronic device. In addition, examples disclosed herein enable power level scalability. For example, the package power of the CPU/GPU could be scaled with broad range by using different removable fan cartridges. For example, with the fan cartridge with standard size fans may be about 150 Watts (W). In some examples, the performance of thicker fans could boost the combined package power up to about 250 W with the additional amount of airflow.
(60) In addition, example fan cartridges disclosed herein are stiffer than a pure D-cover of a chassis of an electronic device. Thus, the electronic device with a removable fan cartridge installed has an increased stiffness than the traditional chassis of electronic devices. For example, a traditional aluminum D-cover with a 20 Newton (N) load may deflect 0.49 mm. An aluminum D-cover with a removable fan cartridge including, for example, a fan cartridge disclosed herein, with a 20 N load may deflect 0.39 mm.
(61) Examples disclosed herein include additional benefits such as, for example, some example cartridges with increased fan height show an increased in air flow rate with the same noise delta as fans without the increased height. In addition, the removable and swappable fan cartridges do not affect system mobility. Unlike the cooling pad solution, which is a separate part, the detachable fan cartridge solution disclosed herein is a part of the system (i.e., electronic device) after attached to the system. Thus, the fan cartridges are fully mobile with the electronic device. In addition, the swappable fan cartridge design does not just bring better performance and mobility to electronic devices (e.g., laptops), examples disclosed herein also lower the thermal solution cost and optimization efforts by leveraging the same fan cartridge on various systems. For example, the same fan cartridge can be leveraged on 14 inch, 16 inch, and 17 inch laptop designs of the same product line while maintaining consistent performance of these systems. Example fan cartridges disclosed herein also can be reused and recycled easily, which promotes better sustainability.
(62) “Including” and “comprising” (and all forms and tenses thereof) are used herein to be open ended terms. Thus, whenever a claim employs any form of “include” or “comprise” (e.g., comprises, includes, comprising, including, having, etc.) as a preamble or within a claim recitation of any kind, it is to be understood that additional elements, terms, etc., may be present without falling outside the scope of the corresponding claim or recitation. As used herein, when the phrase “at least” is used as the transition term in, for example, a preamble of a claim, it is open-ended in the same manner as the term “comprising” and “including” are open ended. The term “and/or” when used, for example, in a form such as A, B, and/or C refers to any combination or subset of A, B, C such as (1) A alone, (2) B alone, (3) C alone, (4) A with B, (5) A with C, (6) B with C, or (7) A with B and with C. As used herein in the context of describing structures, components, items, objects and/or things, the phrase “at least one of A and B” is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. Similarly, as used herein in the context of describing structures, components, items, objects and/or things, the phrase “at least one of A or B” is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. As used herein in the

context of describing the performance or execution of processes, instructions, actions, activities and/or steps, the phrase “at least one of A and B” is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. Similarly, as used herein in the context of describing the performance or execution of processes, instructions, actions, activities and/or steps, the phrase “at least one of A or B” is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B.

(63) As used herein, singular references (e.g., “a”, “an”, “first”, “second”, etc.) do not exclude a plurality. The term “a” or “an” object, as used herein, refers to one or more of that object. The terms “a” (or “an”), “one or more”, and “at least one” are used interchangeably herein. Furthermore, although individually listed, a plurality of means, elements, or actions may be implemented by, e.g., the same entity or object. Additionally, although individual features may be included in different examples or claims, these may possibly be combined, and the inclusion in different examples or claims does not imply that a combination of features is not feasible and/or advantageous.

(64) Unless specifically stated otherwise, descriptors such as “first,” “second,” “third,” etc., are used herein without imputing or otherwise indicating any meaning of priority, physical order, arrangement in a list, and/or ordering in any way, but are merely used as labels and/or arbitrary names to distinguish elements for ease of understanding the disclosed examples. In some examples, the descriptor “first” may be used to refer to an element in the detailed description, while the same element may be referred to in a claim with a different descriptor such as “second” or “third.” In such instances, it should be understood that such descriptors are used merely for identifying those elements distinctly within the context of the discussion (e.g., within a claim) in which the elements might, for example, otherwise share a same name.

(65) As used herein, “approximately” and “about” modify their subjects/values to recognize the potential presence of variations that occur in real world applications. For example, “approximately” and “about” may modify dimensions that may not be exact due to manufacturing tolerances and/or other real world imperfections as will be understood by persons of ordinary skill in the art. For example, “approximately” and “about” may indicate such dimensions may be within a tolerance range of +/−10% unless otherwise specified in the below description.

(66) As used herein, the phrase “in communication,” including variations thereof, encompasses direct communication and/or indirect communication through one or more intermediary components, and does not require direct physical (e.g., wired) communication and/or constant communication, but rather additionally includes selective communication at periodic intervals, scheduled intervals, aperiodic intervals, and/or one-time events.

(67) As used herein, “programmable circuitry” is defined to include (i) one or more special purpose electrical circuits (e.g., an application specific circuit (ASIC)) structured to perform specific operation(s) and including one or more semiconductor-based logic devices (e.g., electrical hardware implemented by one or more transistors), and/or (ii) one or more general purpose semiconductor-based electrical circuits programmable with instructions to perform specific functions(s) and/or operation(s) and including one or more semiconductor-based logic devices (e.g., electrical hardware implemented by one or more transistors). Examples of programmable circuitry include programmable microprocessors such as Central Processor Units (CPUs) that may execute first instructions to perform one or more operations and/or functions, Field Programmable Gate Arrays (FPGAs) that may be programmed with second instructions to cause configuration and/or structuring of the FPGAs to instantiate one or more operations and/or functions corresponding to the first instructions, Graphics Processor Units (GPUs) that may execute first instructions to perform one or more operations and/or functions, Digital Signal Processors (DSPs) that may execute first instructions to perform one or more operations and/or functions, XPUs, Network Processing Units (NPUs) one or more microcontrollers that may execute first instructions

to perform one or more operations and/or functions and/or integrated circuits such as Application Specific Integrated Circuits (ASICs). For example, an XPU may be implemented by a heterogeneous computing system including multiple types of programmable circuitry (e.g., one or more FPGAs, one or more CPUs, one or more GPUs, one or more NPUs, one or more DSPs, etc., and/or any combination(s) thereof), and orchestration technology (e.g., application programming interface(s) (API(s)) that may assign computing task(s) to whichever one(s) of the multiple types of programmable circuitry is/are suited and available to perform the computing task(s).

(68) From the foregoing, it will be appreciated that example systems, apparatus, articles of manufacture, and methods have been disclosed that introduce removable fan cartridges that can be removed and swapped out (i.e., replaced) with alternative fan cartridges to enhance the thermal solutions, power performance, and operation capabilities of electronic devices. Disclosed systems, apparatus, articles of manufacture, and methods improve the efficiency of using a computing device. Disclosed systems, apparatus, articles of manufacture, and methods are accordingly directed to one or more improvement(s) in the operation of a machine such as a computer or other electronic and/or mechanical device.

(69) Example systems, apparatus, articles of manufacture, and methods are disclosed for accessories for electronic devices and removable fan cartridges for electronic devices. Example 1 includes an electronic device accessory that includes a backplate panel removably couplable to a first chassis of a first electronic device to replace a portion of a first cover of the first chassis and removably couplable to a second chassis of a second electronic device to replace a portion of a second cover of the second chassis; a mating device to releasably couple the backplate panel to the first chassis and independently releasably couple the backplate panel to the second chassis; and a fan coupled to the backplate panel, the fan to increase a Z height of the first electronic device when the backplate panel is coupled to the first electronic device and increase a Z height of the second electronic device when the backplate panel is coupled to the second electronic device.

(70) Example 2 includes the electronic device accessory of Example 1, wherein the mating device includes a retention snap couplable to a retention slot.

(71) Example 3 includes the electronic device accessory of either of Examples 1 or 2, wherein the mating device includes a magnet.

(72) Example 4 includes the electronic device accessory of any of Examples 1-3 further including electrical pins to electrically couple the electronic device accessory to the first electronic device and independently to the second electronic device.

(73) Example 5 includes the electronic device accessory of any of Examples 1-4, wherein the first electronic device has first exterior physical dimensions and the second electronic device has second exterior physical dimensions larger than the first exterior physical dimensions.

(74) Example 6 includes the electronic device accessory of any of Examples 1-5, further including an ejection latch to release the electronic device accessory from either the first electronic device or the second electronic device.

(75) Example 7 includes the electronic device accessory of Example 6, wherein the ejection latch is slidable.

(76) Example 8 includes the electronic device accessory of any of Examples 1-7, wherein the backplate panel covers less than a surface area of a D cover of the first chassis.

(77) Example 9 includes the electronic device accessory of any of Examples 1-8, wherein the fan is a first fan, the electronic device accessory further including a second fan coupled to the backplate panel.

(78) Example 10 includes the electronic device accessory of any of Examples 1-9, further including a cutwater integrated with or coupled to the backplate panel to form a hyperbaric chamber when the electronic device accessory is coupled to the first electronic device or the second electronic device.

(79) Example 11 includes the electronic device accessory of any of Examples 1-10 and further including a heat pipe coupled to the backplate panel.

(80) Example 12 includes the electronic device accessory of Example 11, wherein the fan is a first fan, the electronic device accessory further including a second fan coupled to the backplate panel and the heat pipe extends between the first fan and the second fan.
(81) Example 13 includes the electronic device accessory of any of Examples 1-12, wherein the electronic device accessory adds Z height to only a portion of the first electronic device.
(82) Example 14 includes a fan cartridge for an electronic device, the fan cartridge including a first wall detachably couplable to a cover of an electronic device; a second wall opposite the first wall and detachably couplable to the cover; a backplate extending between the first wall and the second wall; a cavity formed by the first wall, the second wall, and the backplate; and a fan in the cavity coupled to the backplate to form a hyperbaric chamber in the cavity when the fan is coupled to the cover.
(83) Example 15 includes the fan cartridge of Example 14, further including a plurality of mechanical connectors and at least one electrical connector to couple the electronic device fan cartridge to the electronic device.
(84) Example 16 includes the fan cartridge of either of Examples 14 or 15, wherein the backplate is to be positioned in a first plane parallel to a second plane of the cover when coupled to the electronic device such that the electronic device fan cartridge adds Z height to a portion of the electronic device.
(85) Example 17 includes the fan cartridge of any of Examples 14-16, wherein the fan is to increase thermal dissipation capability of the electronic device.
(86) Example 18 includes the fan cartridge of any of Examples 14-17, wherein the electronic device fan cartridge is to increase processing power of the electronic device.
(87) Example 19 includes the fan cartridge of any of Examples 14-18, wherein the fan is a first fan, the electronic device fan cartridge further including a second fan coupled to the backplate.
(88) Example 20 includes the fan cartridge of any of Examples 14-19, wherein the electronic device is a first electronic device of a first form factor and the electronic device fan cartridge is removably couplable to a second electronic device of a second form factor, the second form factor different than the first form factor.
(89) The following claims are hereby incorporated into this Detailed Description by this reference. Although certain example systems, apparatus, articles of manufacture, and methods have been disclosed herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all systems, apparatus, articles of manufacture, and methods fairly falling within the scope of the claims of this patent.

Claims

1. An electronic device accessory comprising: a backplate panel removably couplable to a first chassis of a first electronic device to replace a portion of a first cover of the first chassis and removably couplable to a second chassis of a second electronic device to replace a portion of a second cover of the second chassis; a mating device to releasably couple the backplate panel to the first chassis and independently releasably couple the backplate panel to the second chassis; a fan coupled to the backplate panel, the fan to increase a Z height of the first electronic device when the backplate panel is coupled to the first electronic device and increase a Z height of the second electronic device when the backplate panel is coupled to the second electronic device; and a cutwater integrated with or coupled to the backplate panel to form a hyperbaric chamber when the electronic device accessory is coupled to the first electronic device or the second electronic device.
2. The electronic device accessory of claim 1, wherein the mating device includes a retention snap couplable to a retention slot.
3. The electronic device accessory of claim 1, wherein the mating device includes a magnet.
4. The electronic device accessory of claim 1, including electrical pins to electrically couple the

electronic device accessory to the first electronic device and independently couple the electronic device accessory to the second electronic device.
5. The electronic device accessory of claim 1, wherein the first electronic device has first exterior physical dimensions and the second electronic device has second exterior physical dimensions larger than the first exterior physical dimensions.
6. The electronic device accessory of claim 1, including an ejection latch to release the electronic device accessory from either the first electronic device or the second electronic device.
7. The electronic device accessory of claim 6, wherein the ejection latch is slidable.
8. The electronic device accessory of claim 1, wherein the backplate panel covers less than a surface area of a D cover of the first chassis.
9. The electronic device accessory of claim 1, wherein the fan is a first fan, the electronic device accessory including a second fan coupled to the backplate panel.
10. The electronic device accessory of claim 1, including a heat pipe coupled to the backplate panel.
11. The electronic device accessory of claim 10, wherein the fan is a first fan, the electronic device accessory including a second fan coupled to the backplate panel and the heat pipe extends between the first fan and the second fan.
12. The electronic device accessory of claim 1, wherein the electronic device accessory adds Z height to only a portion of the first electronic device.
13. A fan cartridge for an electronic device, the fan cartridge comprising: a first wall detachably couplable to a cover of an electronic device; a second wall opposite the first wall and detachably couplable to the cover; a backplate extending between the first wall and the second wall; a cavity formed by the first wall, the second wall, and the backplate; and a fan in the cavity coupled to the backplate to form a hyperbaric chamber in the cavity when the fan is coupled to the cover.
14. The fan cartridge of claim 13, including a plurality of mechanical connectors and at least one electrical connector to couple the electronic device fan cartridge to the electronic device.
15. The fan cartridge of claim 13, wherein the backplate is to be positioned in a first plane parallel to a second plane of the cover when coupled to the electronic device such that the electronic device fan cartridge adds Z height to a portion of the electronic device.
16. The fan cartridge of claim 13, wherein the fan is to increase thermal dissipation capability of the electronic device.
17. The fan cartridge of claim 13, wherein the electronic device fan cartridge is to increase processing power of the electronic device.
18. The fan cartridge of claim 13, wherein the fan is a first fan, the electronic device fan cartridge including a second fan coupled to the backplate.
19. The fan cartridge of claim 13, wherein the electronic device is a first electronic device of a first form factor and the electronic device fan cartridge is removably couplable to a second electronic device of a second form factor, the second form factor different than the first form factor.