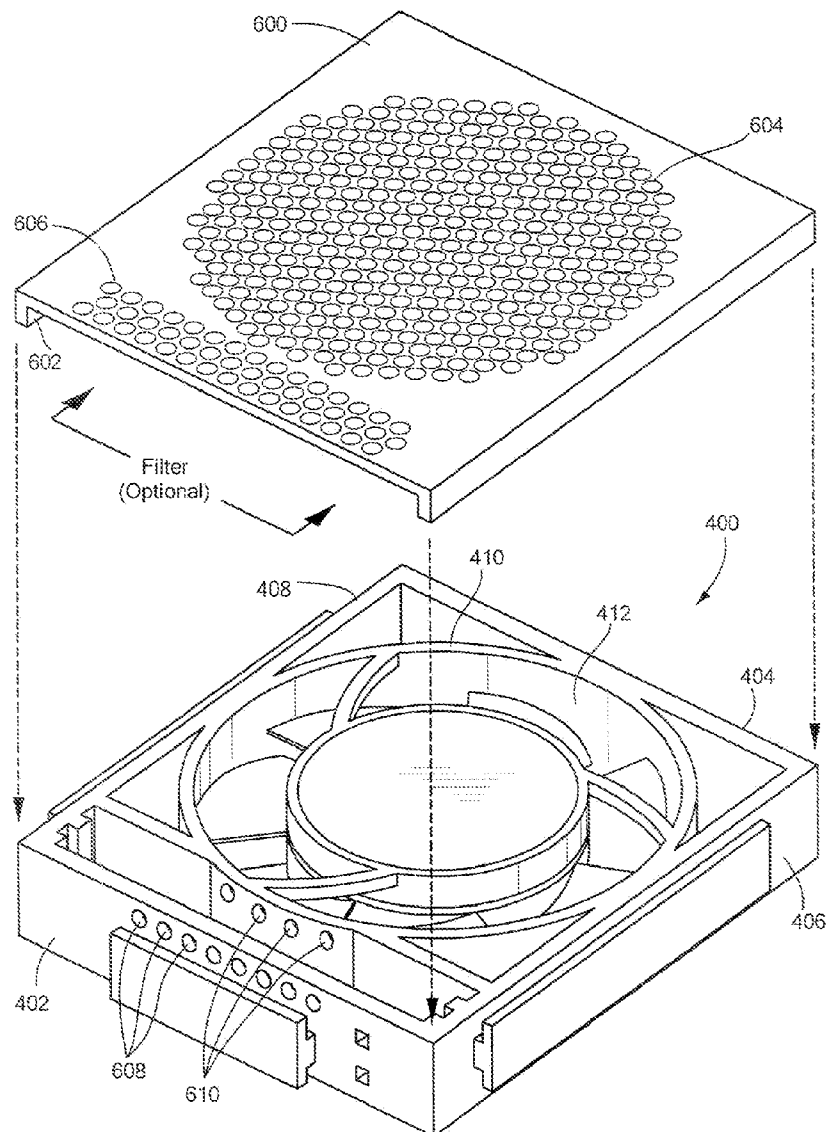


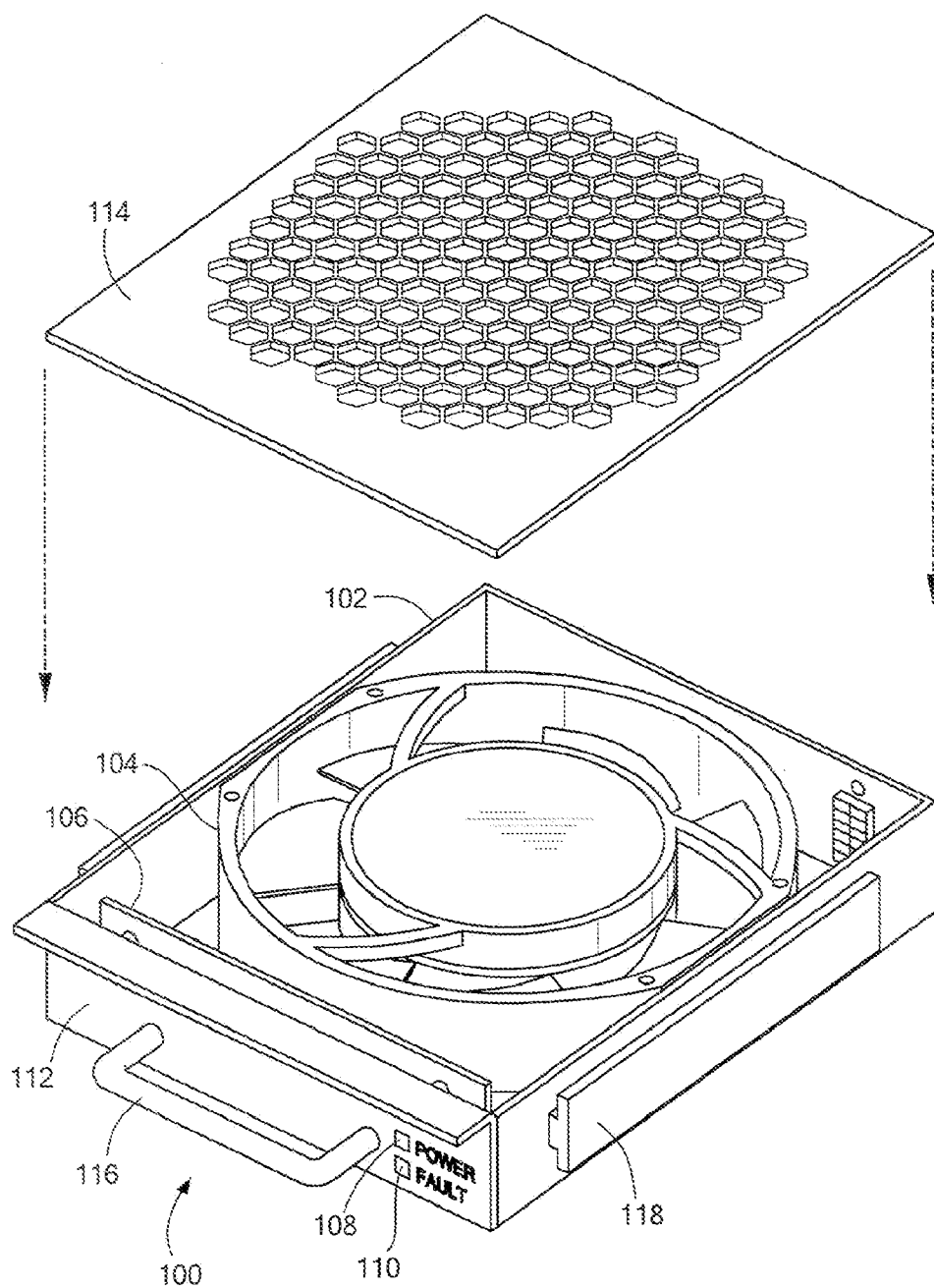


US 20080124234A1

(19) **United States**(12) **Patent Application Publication**
Echazarreta(10) **Pub. No.: US 2008/0124234 A1**(43) **Pub. Date: May 29, 2008**(54) **FAN TRAY ASSEMBLY SHAPED VENTURI**(52) **U.S. Cl. 417/423.14; 361/695; 417/360;**
417/424.1; 415/219.1(76) **Inventor: Jaime Echazarreta, Chula Vista,**
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BOSTON, MA 02110-1618(21) **Appl. No.: 11/592,030**(22) **Filed: Nov. 2, 2006****Publication Classification**(51) **Int. Cl.**
F04D 29/54 (2006.01)
H05K 7/20 (2006.01)(57) **ABSTRACT**

A fan trays assembly is made of one or small number of cast or injection molded (collectively "cast") components. Each component can be cast of plastic, metal or another material. One of the components of the fan tray includes a front wall, a back wall, two side walls, an inner wall defining a Venturi and a motor housing suspended within the Venturi by one or more structural members. The walls, the motor housing and the structural member(s) are all formed as a single casting. Casting these pieces together reduces the complexity and cost of manufacturing the fan trays. Multi-fan fan trays and modular fan trays can be similarly made.

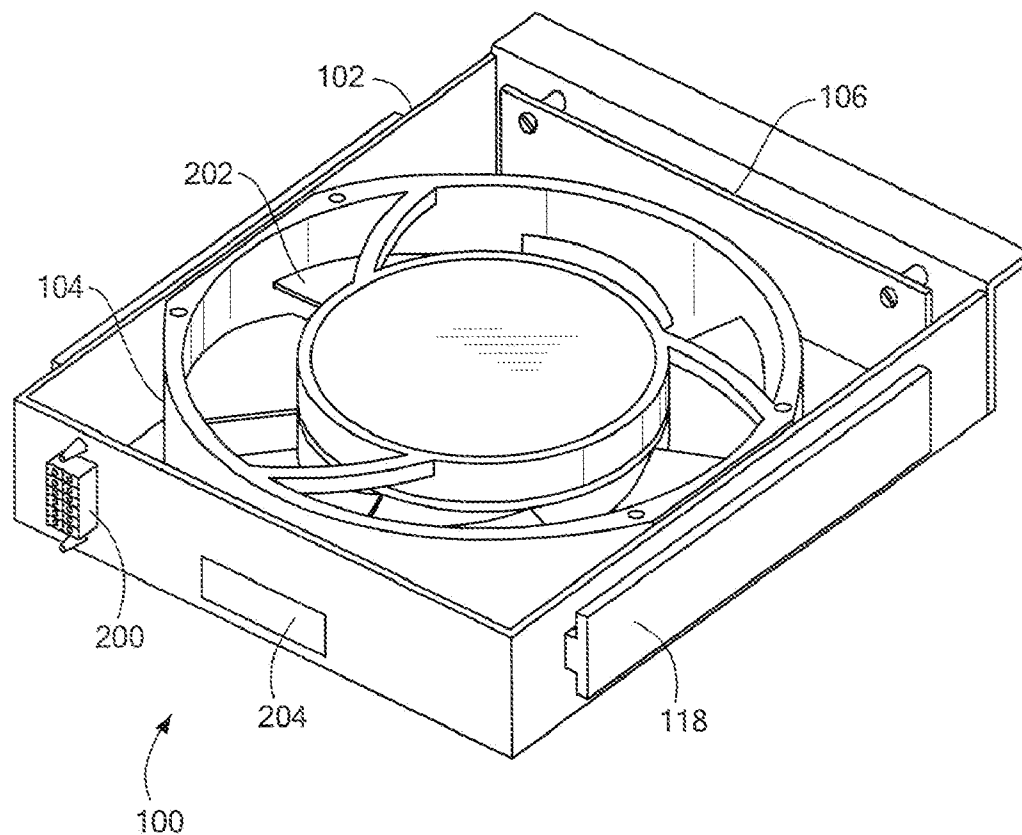




(Front)

FIG. 1

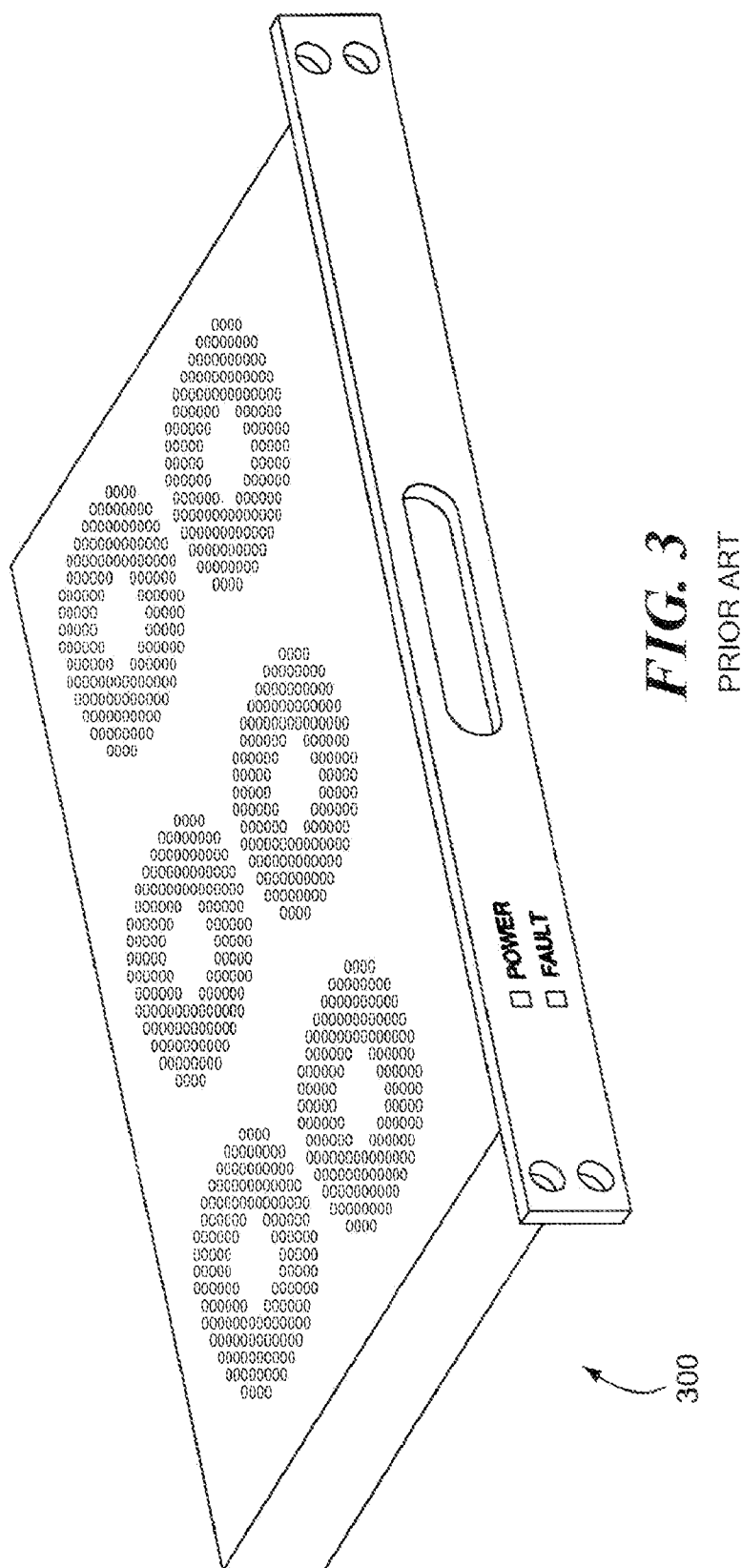
PRIOR ART

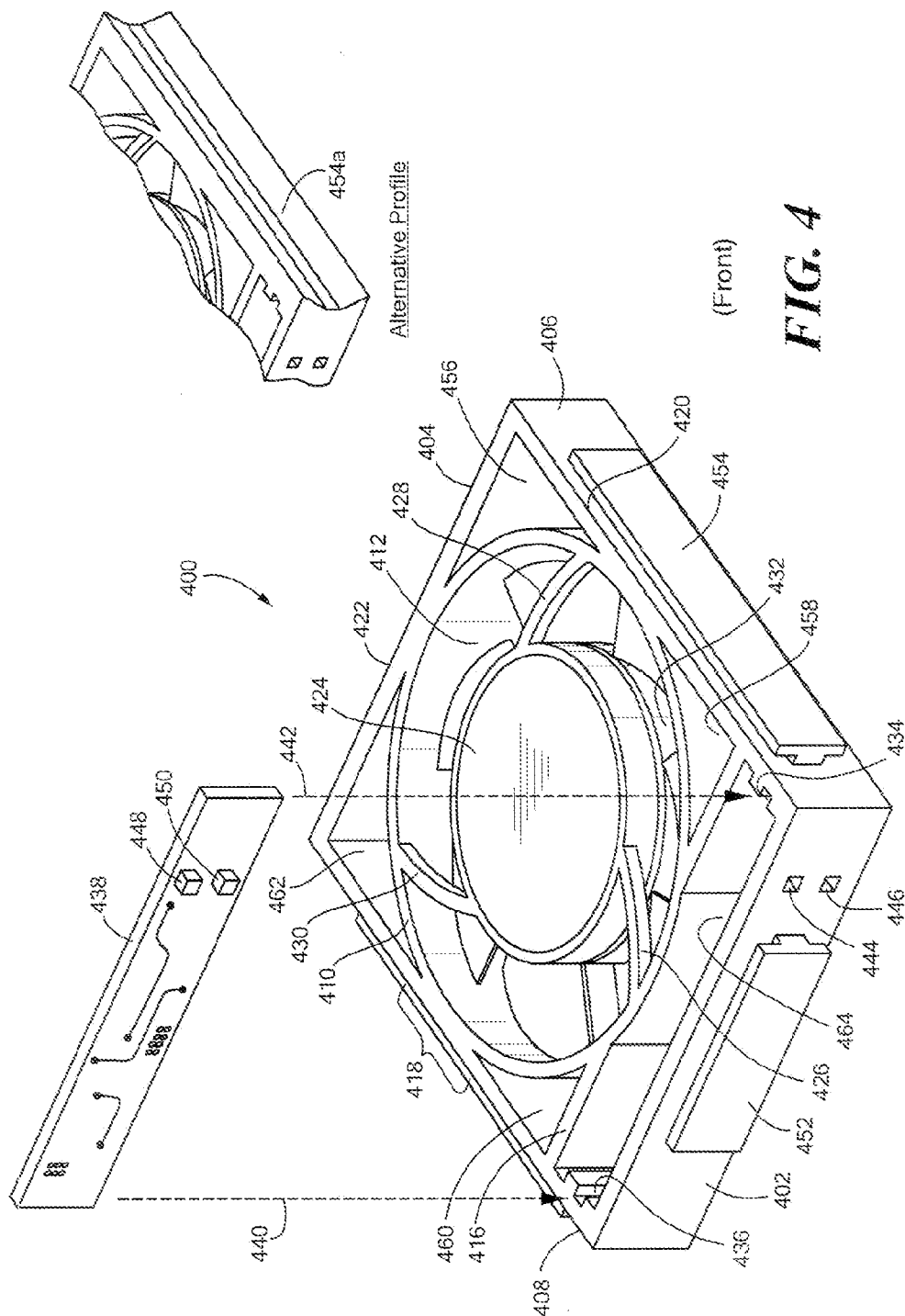


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FIG. 2

PRIOR ART





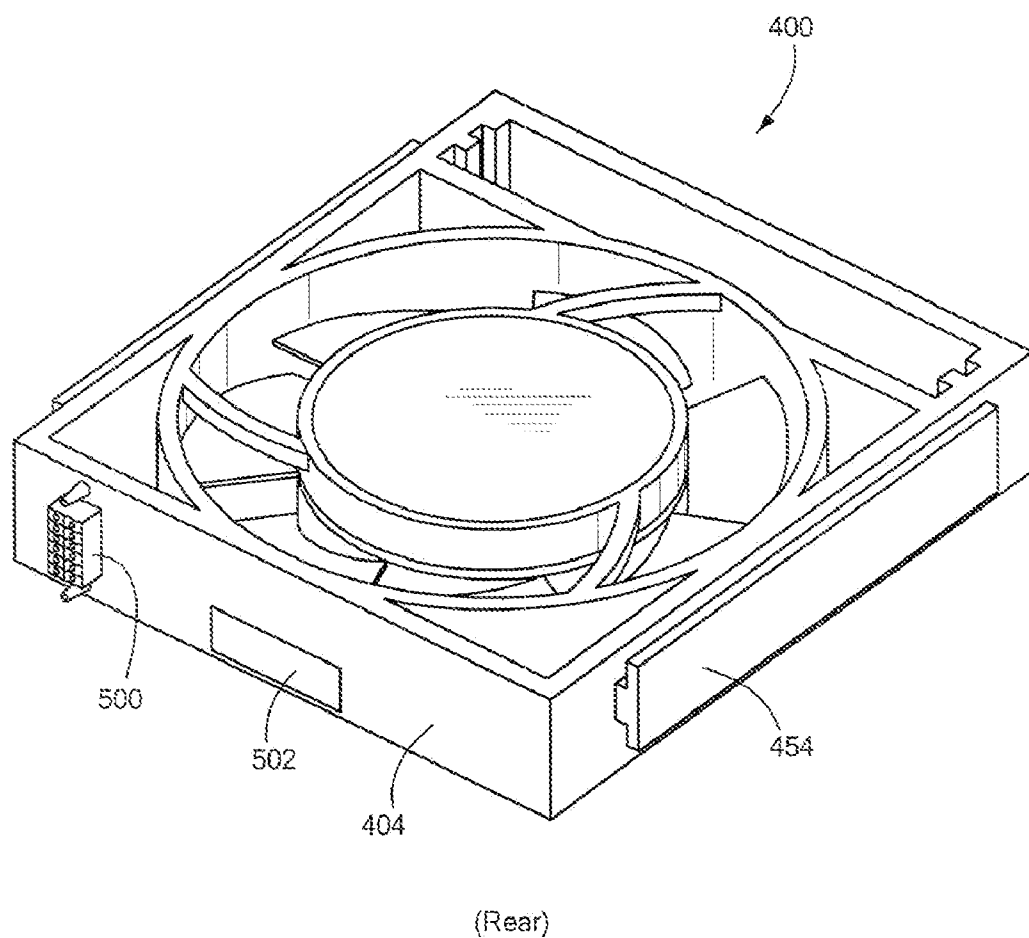


FIG. 5

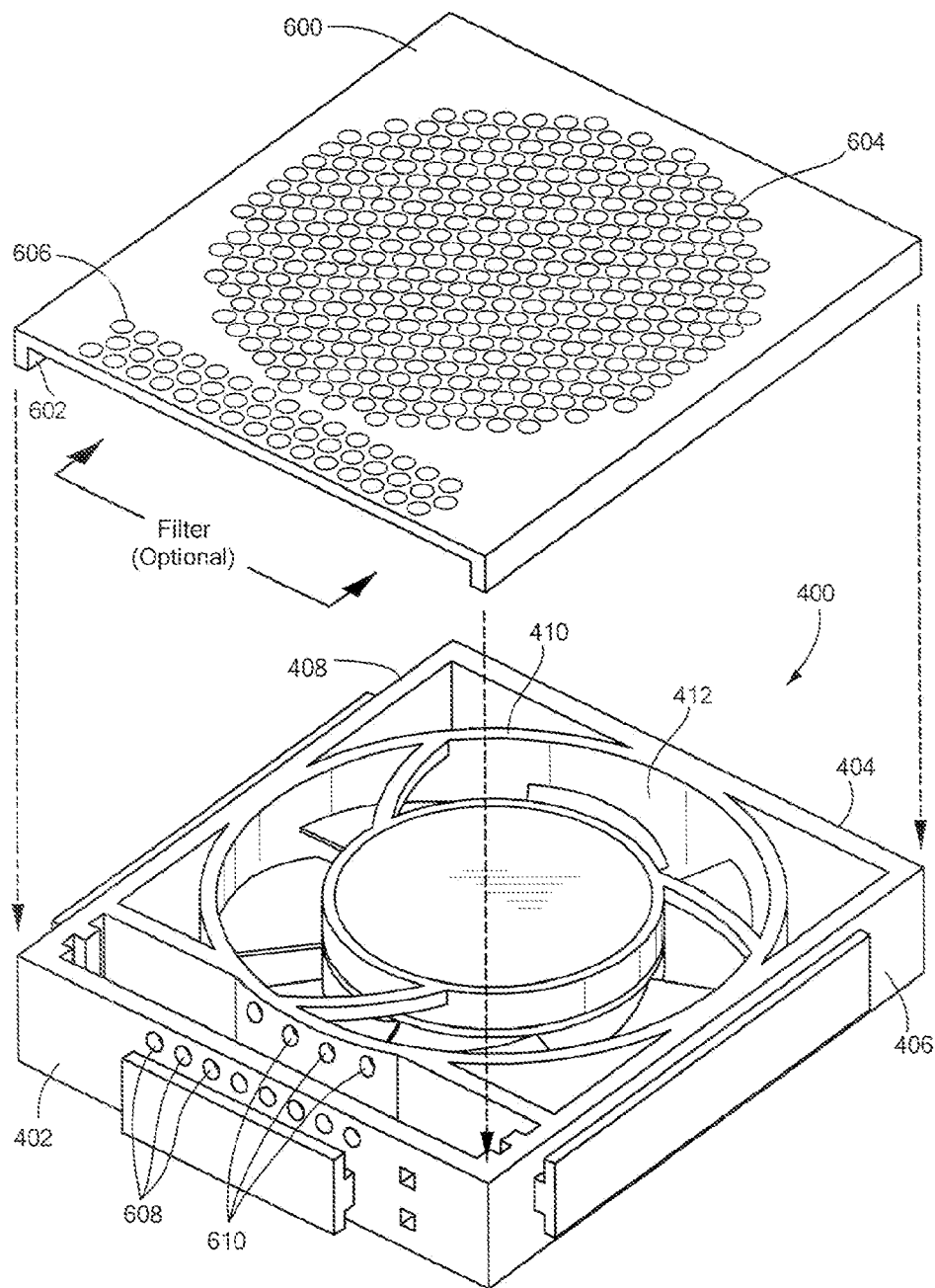


FIG. 6

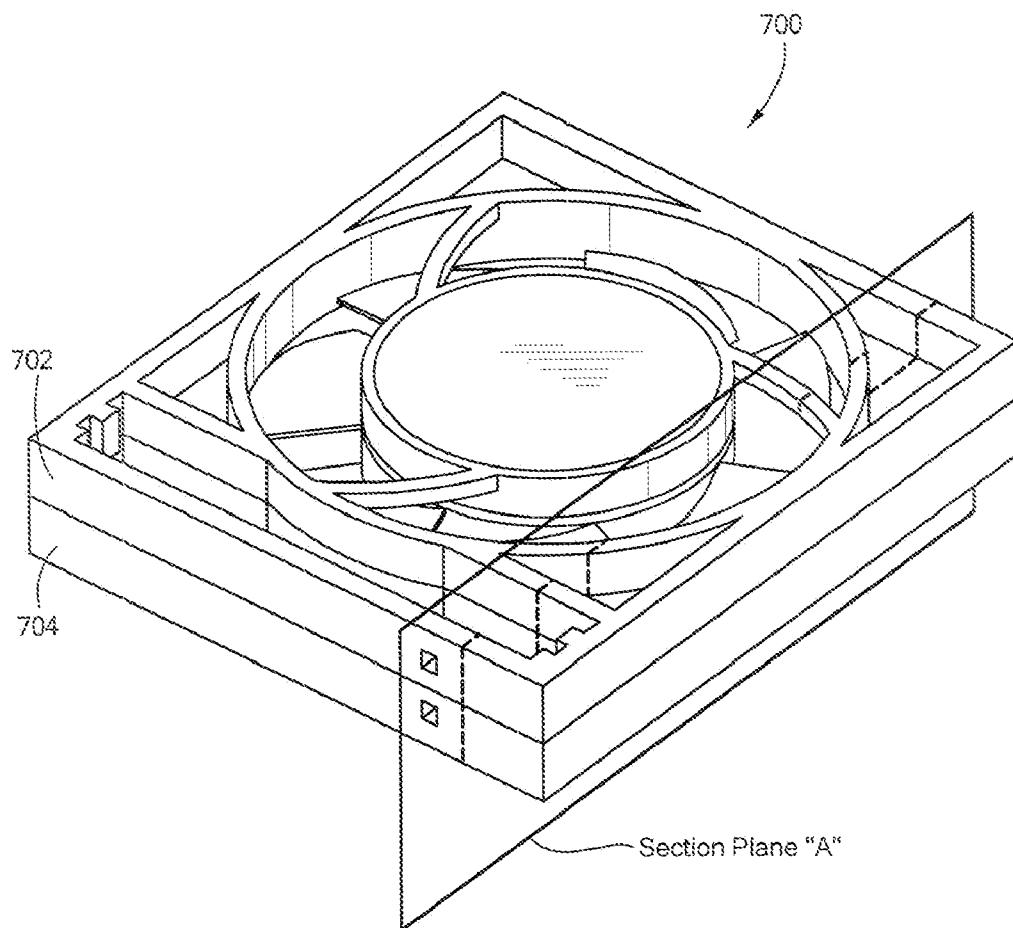


FIG. 7

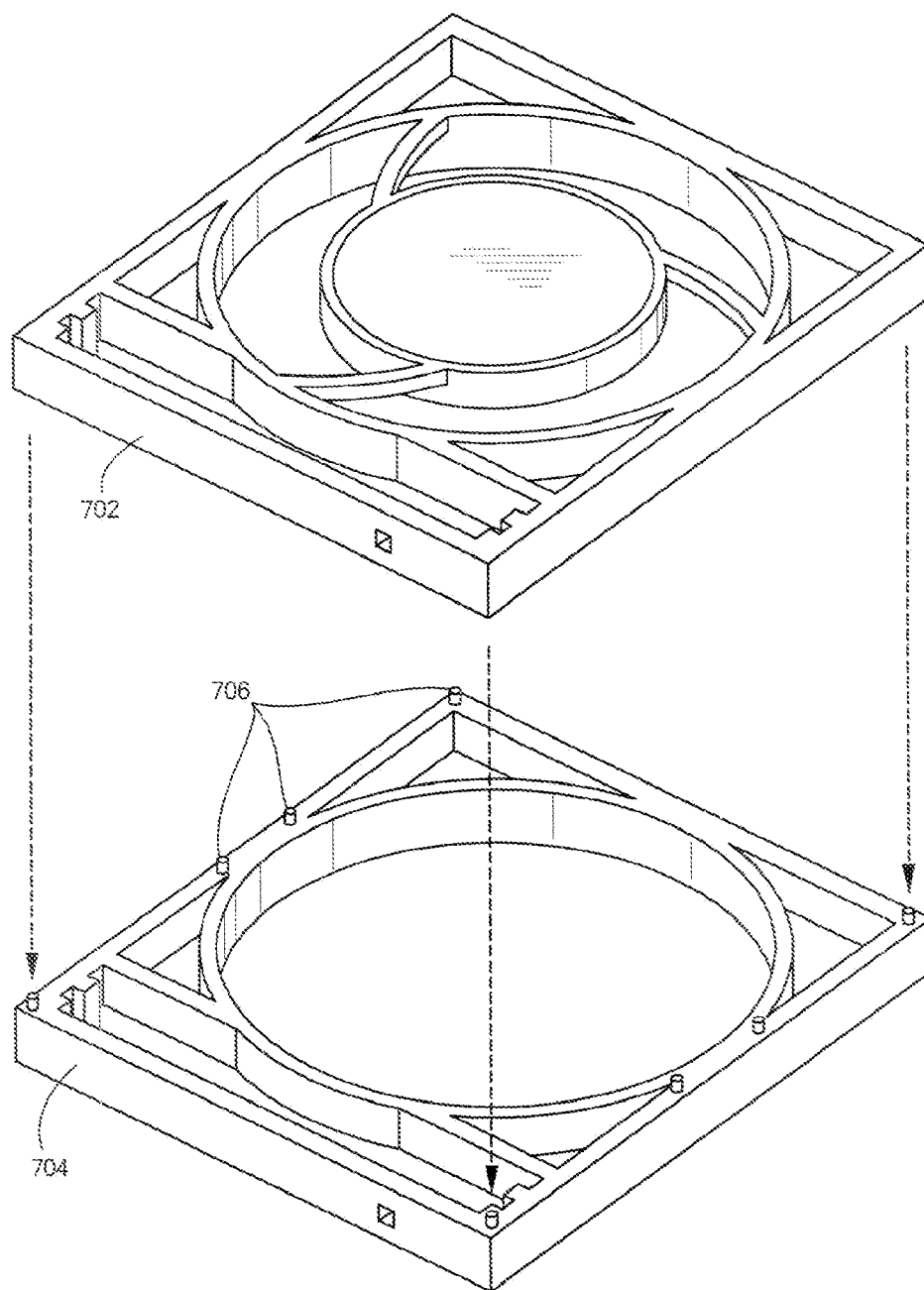
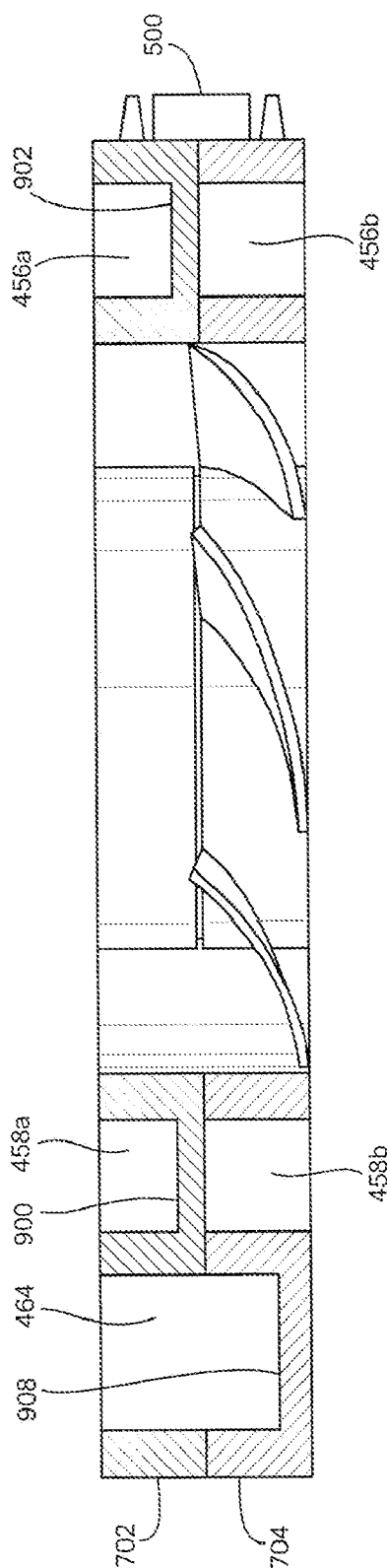
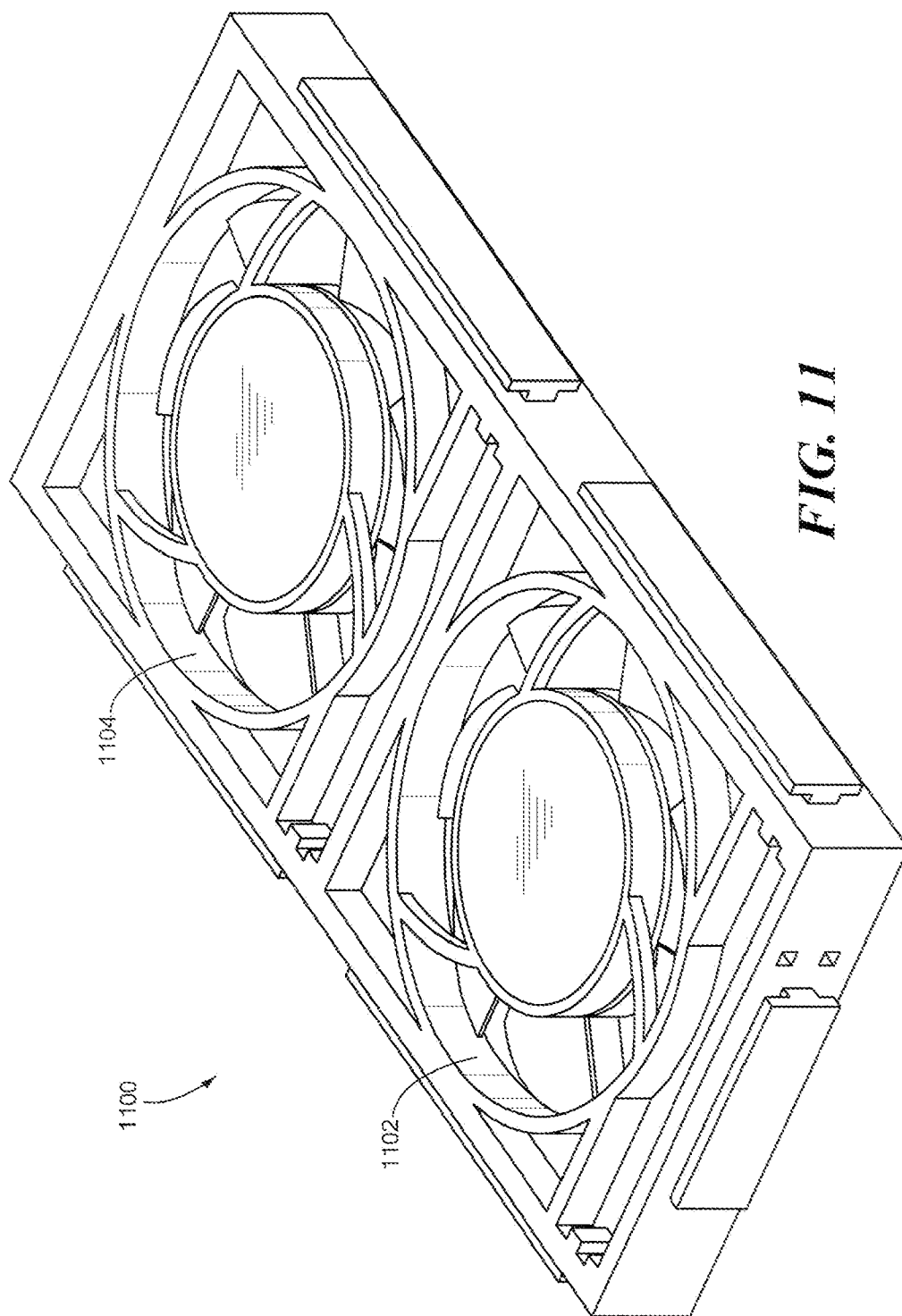


FIG. 8



(Section A)

FIG. 10



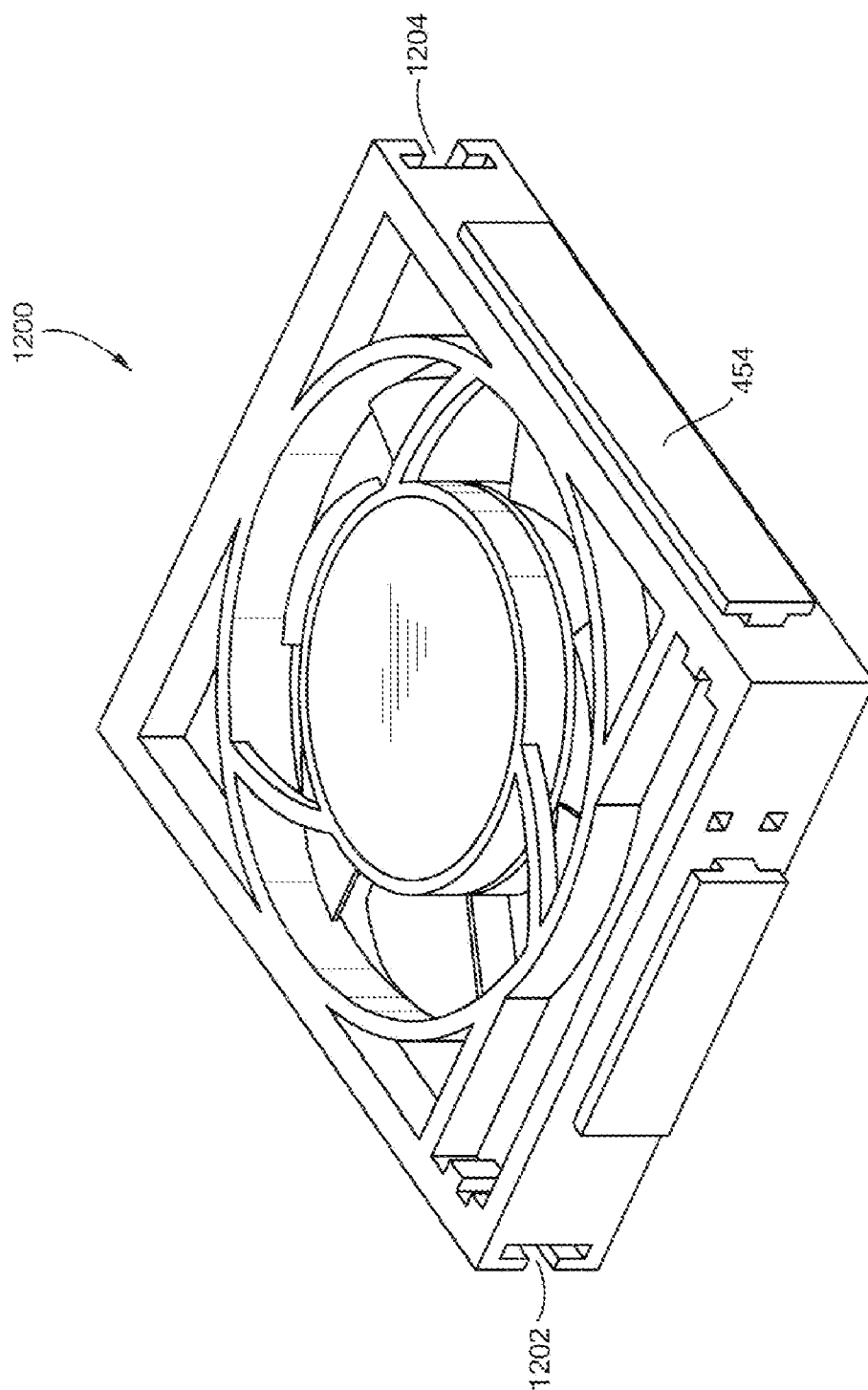


FIG. 12

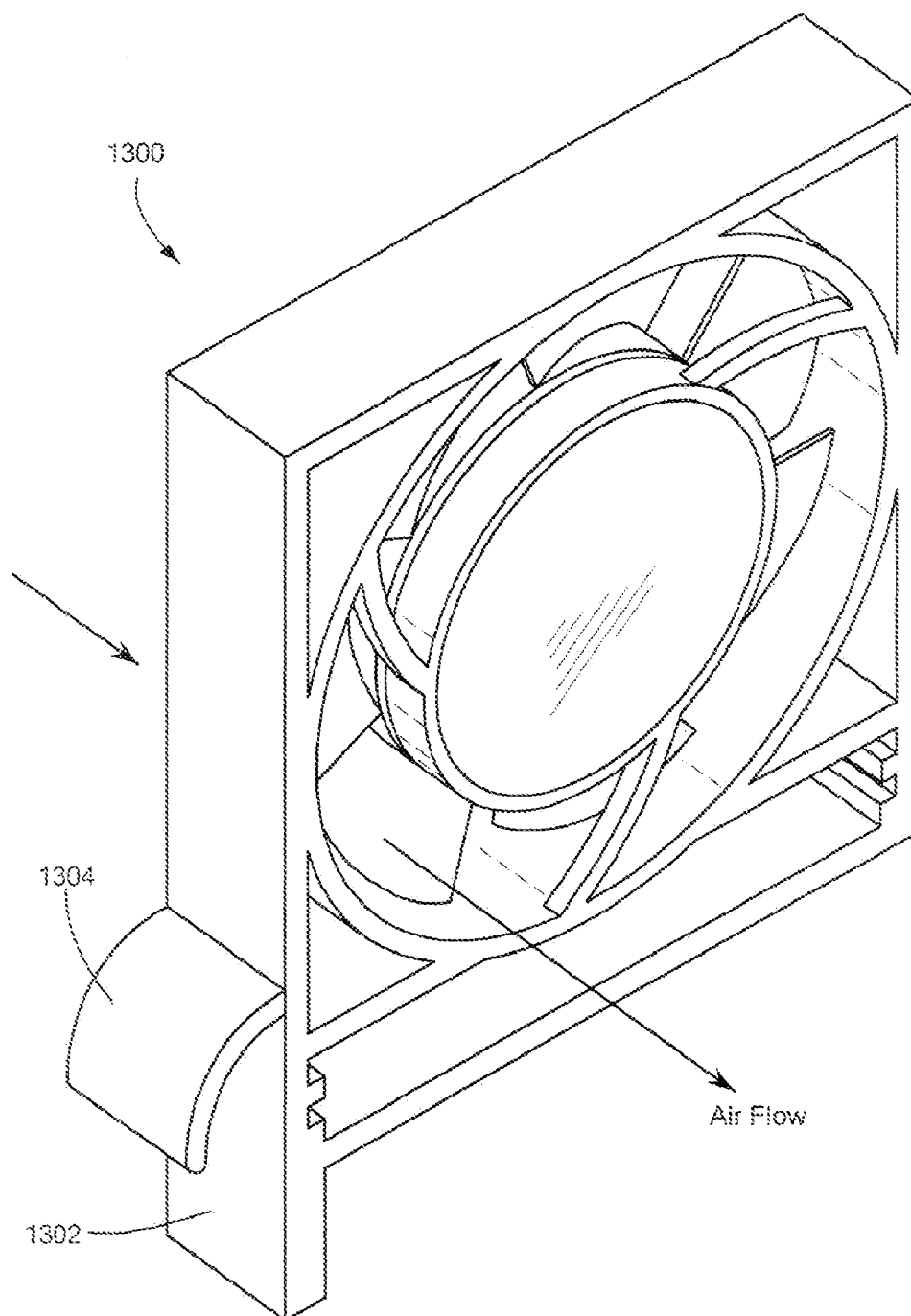


FIG. 13

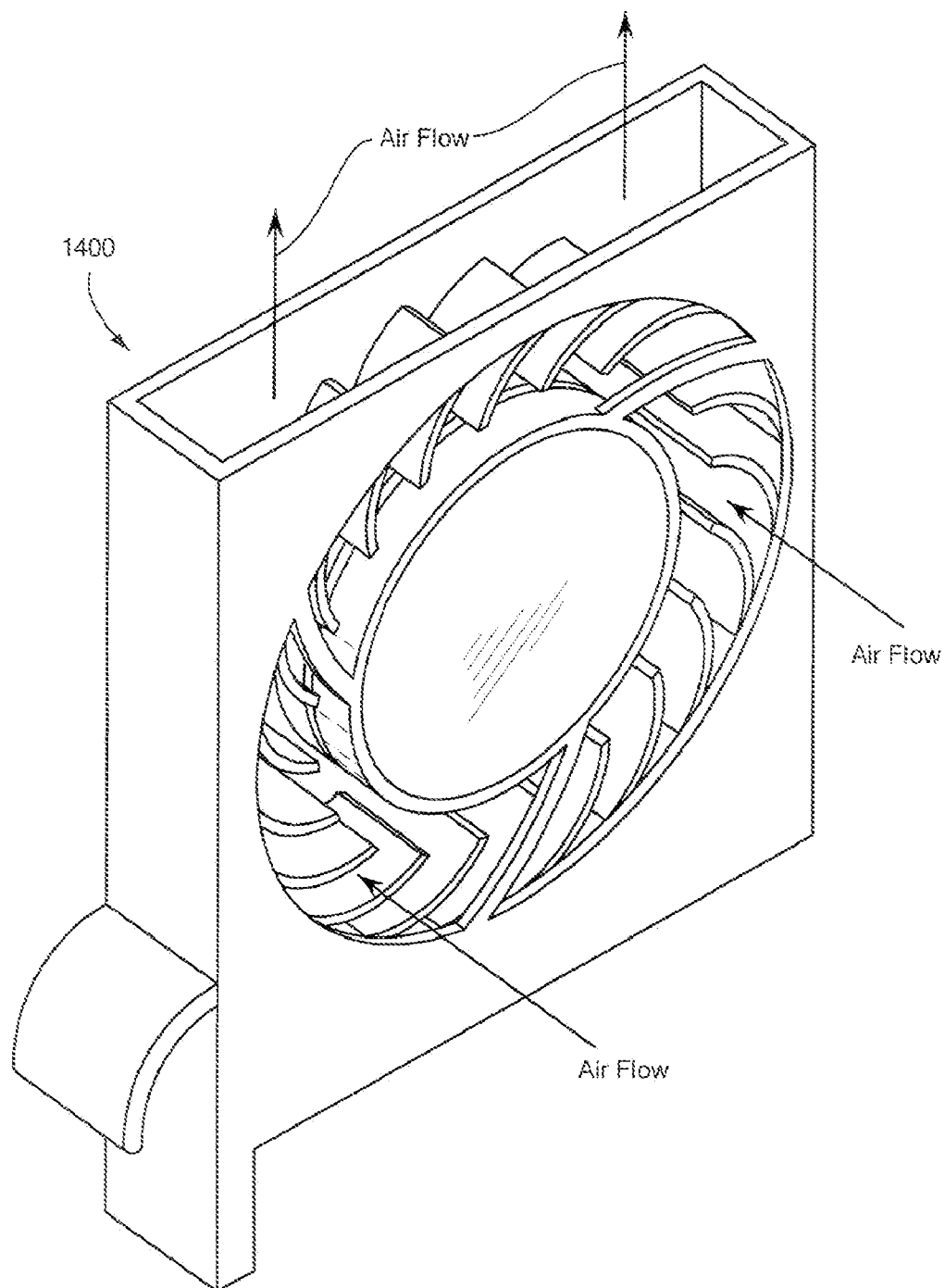


FIG. 14

FAN TRAY ASSEMBLY SHAPED VENTURI

BACKGROUND ART

[0001] The present invention relates to equipment cooling fans and, more particularly, to cooling fan trays.

[0002] Electronic and other devices, such as telecommunications equipment, audiovisual equipment and rack-mounted computer equipment (such as “blade” systems), generate heat that must be dissipated to avoid damage to the devices. Fans are commonly used to force cooling air through the devices. To facilitate replacing a failed or failing fan, the fans are typically mounted in removable trays. FIGS. 1 and 2 illustrate a typical prior-art single-fan tray, and FIG. 3 illustrates a typical prior-art multi-fan tray.

[0003] Conventional fan trays are constructed of sheet metal. Conventional fan trays are, however, time-consuming and expensive to manufacture. The sheet metal must be stamped, bent, welded, degreased, polished, etc., and the individual fan units must be installed in the fan trays.

SUMMARY OF THE INVENTION

[0004] An embodiment of the present invention provides a fan tray component. The fan tray component includes a front wall, a back wall, and two side walls. Each of the side walls is connected to the front wall and to the back wall. The front wall, the back wall and the two side walls define a volume. The fan tray component also includes a first inner wall that is at least partially disposed within the volume. The first inner wall defines a Venturi. The fan tray component also includes a first motor housing. The front wall, the back wall, the two side walls, the first inner wall and the first motor housing are formed as a single casting.

[0005] The first inner wall may be connected by at least one first structural member to at least one of the front wall, the back wall, one of the two side walls and/or the other of the two side walls. The fan tray may also include at least one second structural member that connects the first motor housing to the first inner wall. The at least one second structural member may suspend the first motor housing within the Venturi. The at least one first structural member, the at least one second structural member and the front wall are formed as a single casting.

[0006] The fan tray component may also include an electrical connector mounted to the back wall. The electrical connector may include at least four terminals. The electrical connector can be a blind-mating connector.

[0007] The fan tray component may include an electric motor disposed within the first motor housing and electrically connected to the electrical connector. A rotor may be attached to the electric motor, such that when the electric motor operates, the electric motor rotates the rotor.

[0008] The fan tray component may also include a circuit board that has electrical components electrically connected to the electrical connector and to the electric motor. The electrical components control a rotational speed of the electric motor. At least one of the electrical components may be operative to receive signals, via the electrical connector, to control the rotational speed of the electric motor. The signals may conform to an inter-integrated circuit (I2C) protocol or to a controller area network (CAN) protocol.

[0009] The fan tray component may also include a handle adjacent the front wall. The handle and the front wall may be

formed as a single casting. Alternatively, the handle may be attached to the front wall by at least one fastener.

[0010] The fan tray component may also include a latch mechanism. The latch mechanism may be adjacent the back wall. Alternatively, the latch mechanism may be adjacent one of the two side walls.

[0011] The fan tray component may also include a grill adjacent one end of first inner wall. The fan tray component may also include a filter receiving element.

[0012] The back wall may be parallel to the front wall. The two side walls may be perpendicular to the front wall and to the back wall. Alternatively, the walls may be oriented differently, such as at angles other than 90° to each other.

[0013] The fan tray component may include a mounting bracket adjacent one of the side walls and extending along at least part of the length of the side wall, such as along a line between the front wall and the back wall. The mounting bracket may have a first predefined cross-sectional profile, such as when the cross-section is taken perpendicular to the length of the side wall. The other side wall of the fan tray component may define a mounting bracket receiver that extends along at least part of the length of the side wall, such as along a line between the front wall and the back wall. The mounting bracket receiver may have a second predefined cross-sectional profile, such as when the cross-section is taken perpendicular to the length of the side wall. The first cross-sectional profile (of the mounting bracket) may be complementary to the second cross-sectional profile (of the mounting bracket receiver).

[0014] The back wall of the fan tray component may define a mounting bracket receiver that has a first predefined cross-sectional profile.

[0015] The fan tray component may also include a mounting bracket adjacent the front wall and that has a predefined cross-sectional profile.

[0016] The fan tray may have a second inner wall at least partially disposed within the volume. The second inner wall may define a second Venturi. The second inner wall may be connected by at least one third structural element to the front wall, the back wall, one of the two side walls, the other of the two side walls, the first inner wall or combination thereof.

[0017] The fan tray may include a second motor housing. The fan tray may also include at least one fourth structural element that connects the second motor housing to the second inner wall. The first inner wall and the second inner wall are formed as a single casting.

[0018] Another embodiment of the present invention provides a fan tray component that includes a first component joined to a second component. The first component includes a first front wall, a first back wall and two first side walls. Each first side wall is connected to the first front wall and to the first back wall. The first front wall, the first back wall and the two first side walls define a volume. The first component also includes an inner wall that is at least partially disposed within the volume. The inner wall defines a Venturi. The first component also includes a motor housing that is at least partially disposed within the Venturi. The first front wall, the first back wall, the first two side walls, the first inner wall and the motor housing are formed as a single casting. The first component defines at least one void.

[0019] The second component includes a second front wall, a second back wall and two second side walls. Each second side wall is connected to the second front wall and to the second back wall. The second front wall, the second back wall

and the two second side walls are formed as a single casting. The first component and/or the second component further also includes at least one block located to prevent air from flowing through the at least one void.

[0020] Yet another embodiment of the present invention provides a modular fan tray component that includes a front wall, a back wall and two side walls. Each side wall is connected to the front wall and to the back wall. The front wall, the back wall and the two side walls define a volume. The fan tray component also includes a first inner wall at least partially disposed within the volume. The first inner wall defines a Venturi. The fan tray component also includes a fan that is at least partially disposed within the Venturi. The fan tray component also includes a first mounting bracket adjacent one of the two side walls. The first mounting bracket has a first predefined cross-sectional profile. The other of the two side walls defines a first mounting bracket receiver that has a second predefined cross-sectional profile.

[0021] The first cross-sectional profile may be complementary to the second cross-sectional profile.

[0022] The back wall may define a second mounting bracket receiver that has a third predefined cross-sectional profile.

[0023] The other of the two side walls may have a length that extends from the front wall to the back wall, and the first mounting bracket receiver may extend along at least part of the length of the other of the two side walls. The back wall may have a length extending from one of the two side walls to the other of the two side walls, and the second mounting bracket receiver may extend along at least part of the length of the back wall.

[0024] The modular fan tray component may also include a second mounting bracket adjacent the front wall. The second mounting bracket may have a fourth predefined cross-sectional profile.

[0025] The third cross-sectional profile may be complementary to the fourth cross-sectional profile.

[0026] Another embodiment of the present invention provides a dummy modular fan tray component that includes a front wall, a back wall and two side walls. Each side wall is connected to the front wall and to the back wall. The front wall, the back wall and the two side walls define an area. The dummy modular fan tray also includes a partition that blocks air flow through the area. The dummy modular fan tray also includes a first mounting bracket adjacent one of the two side walls. The first mounting bracket has a predefined cross-sectional profile. The other of the two side walls defines a first mounting bracket receiver that has a predefined cross-sectional profile.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The invention will be more fully understood by referring to the following Detailed Description of Specific Embodiments in conjunction with the Drawings, of which:

[0028] FIG. 1 is a perspective front view of a prior-art, single-fan fan tray;

[0029] FIG. 2 is a perspective rear view of the prior-art fan tray of FIG. 1;

[0030] FIG. 3 is a perspective front view of a prior-art, multi-fan fan tray;

[0031] FIG. 4 is a perspective front view of a fan tray according to one embodiment of the present invention;

[0032] FIG. 5 is a perspective rear view of the fan tray of FIG. 4;

[0033] FIG. 6 is a perspective front view of a fan tray according to another embodiment of the present invention;

[0034] FIG. 7 is a perspective front view of a fan tray according to yet another embodiment of the present invention;

[0035] FIG. 8 is a perspective exploded front view of the fan tray of FIG. 7;

[0036] FIG. 9 is a perspective cut-away front view of the fan tray of FIG. 7;

[0037] FIG. 10 is a cross-sectional view of a portion of the fan tray of FIG. 7;

[0038] FIG. 11 is a perspective front view of a multi-fan fan tray according to an embodiment of the present invention;

[0039] FIG. 12 is a perspective front view of a modular fan tray according to an embodiment of the present invention;

[0040] FIG. 13 is a perspective side view of a vertically-oriented fan tray according to an embodiment of the present invention; and

[0041] FIG. 14 is a perspective side view of a vertically-oriented fan tray according to another embodiment of the present invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0042] In accordance with one embodiment of the present invention, a fan trays assembly is made of one or a small number of cast or injection molded (collectively "cast") components. Each component can be cast of plastic, metal or another material. For example, in one embodiment, one of the components of the fan tray includes a front wall, a back wall, two side walls, an inner wall defining a Venturi and a motor housing suspended within the Venturi by a structural member. The walls, the motor housing and the structural member are all formed as a single casting. Casting these pieces together reduces the complexity and cost of manufacturing the fan trays.

[0043] FIGS. 1 and 2 show front and back views, respectively, of a conventional (i.e., prior art) single-fan tray 100. The tray 100 includes a metal chassis 102, which is fabricated from sheet metal. The sheet metal is typically stamped, bent, welded or riveted or screwed together, degreased and polished. A discrete fan unit 104 is housed in the chassis 102. The fan unit 104 is a generic device, i.e., it is capable of being mounted in a number of different contexts. For this reason, the fan unit 104 includes its own structural frame, which defines a Venturi.

[0044] The fan unit 104 is attached to the metal chassis 102, such as by sheet metal screws (not shown). Optionally, a grill or other cover 114 is attached to the chassis 102. The fan tray 100 also includes a handle 116 that facilitates installing/removing the fan tray 100 into/from a device that the fan tray 100 is to cool. Optionally, the fan tray 100 includes side rails 118 (one of which is not visible in FIG. 1) that cooperate with receiving rails in the device that the fan tray 100 is to cool. Each receiving rail typically defines an appropriately shaped opening, into which the corresponding side rail 118 slides.

[0045] As shown in FIG. 2, an electrical connector 200 is attached to a back wall of the chassis 102. Power is provided to the fan tray 100 via the connector 200. The chassis 102 also houses a printed circuit board 106 that is connected to the connector 200 and to the fan unit 104 via wires (not shown). The circuit board 106 includes electronic components, which control operation of the fan unit 104. Optionally, control signals are sent and/or received via the connector 200. For

example, the fan tray **100** can receive signals to control the speed of the rotor **202** of the fan unit **104** or to report status of the fan tray **100**. The fan tray **100** also typically includes a latch **204** on a back of the fan tray or, alternatively, on the side(s) (not shown) of the fan tray **100**.

[0046] Returning to FIG. 1, optionally, the printed circuit board **106** controls indicators, such as a power indicator **108** and a fault indicator **110**, that are visible on a front panel **112** of the fan tray **100**.

[0047] FIG. 3 shows a conventional multi-fan tray **300**. Construction of the multi-fan tray **300** is similar to the single-fan tray **100**, except the multi-fan tray **300** includes a plurality of individual fan units, each separately attached to the chassis. As noted, conventional fan trays are expensive and time-consuming to manufacture, because of the number of steps required. In addition, the individual fan units used in conventional fan trays add unnecessary material, weight and cost to the fan trays. These and other disadvantages of the prior art are avoided by fan trays constructed according to the present disclosure.

[0048] FIG. 4 is a front view of one embodiment of a fan tray **400**, according to the present invention. The fan tray **400** includes a front wall **402**, a back wall **404** and two side walls **406** and **408**. The walls **402-408** are cast as a single unit and can be made of plastic (such as liquid crystal polymer), metal (such as steel or aluminum) or any other suitable material.

[0049] The fan tray **400** also includes a curved inner wall **410** that defines a Venturi **412**. The inner wall **410** is cast at the same time, and of the same material, as the walls **402-408**. Thus, the walls **402-408** and the inner wall **410** form a single, integrated unit. In the embodiment shown in FIG. 4, the inner wall **410** is circular; however, in other embodiments, the inner wall **410** can have other shapes.

[0050] In the embodiment shown in FIG. 4, the inner wall **410** is attached to the side walls **406** and **408** by structural members **414** and **416**. In addition, the inner wall **410** joins the side wall **408** in a region **418**. Similarly, the inner wall **410** joins the other side wall **406** and the back wall **404** in similar regions **420** and **422**, respectively. The regions **418-422** are also referred to herein as "structural members." The structural members **414-422** are cast at the same time, and of the same material, as the inner wall **410** and the other cast portions of the fan tray **400**. Thus, the structural members **414-422**, the inner wall **410** and the other cast portions of the fan tray **400** form a single, integrated unit. In other embodiments, other numbers of structural members can be used. In addition, in other embodiments, the structural member(s) can connect the inner wall **410** to any one or more of the walls **402-408**.

[0051] The fan tray **400** also includes a motor housing **424**. Three additional structural members **426**, **428** and **430** connect the motor housing **424** to the inner wall **410**, thus suspending the motor housing **424** within the Venturi **412**. The motor housing **424** and the structural members **426-430** are cast at the same time, and of the same material, as the inner wall **410** and the other cast portions of the fan tray **400**. Thus, motor housing **424**, the structural members **426-430**, the inner wall **410** and the other cast portions of the fan tray **400** form a single, integrated unit. Other numbers of structural members can be used to connect the motor housing **424** to the inner wall **410** and suspend the motor housing **424** within the Venturi **412**.

[0052] An electric motor (not visible) is disposed within the motor housing **424** and coupled to a rotor **432** having one or more blades. Thus, when the electric motor operates, the rotor

rotates, and the blades force air through the fan tray **400**. Fabricating a fan tray **400** with an integrated motor housing **424** obviates the need for a discrete fan unit with its own structural frame, as is used in the prior art. The walls **402-408**, the inner wall **410** and the structural members **414-422** all structurally reinforced each other. Thus, the fan tray **400** can be stronger, lighter in weight and/or contain less material than a prior art fan tray that includes a discrete fan unit.

[0053] The side walls **406** and **408** define channels **434** and **436**, into which a printed circuit board **438** can be received, as indicated by arrows **440** and **442**. Optionally, the front wall **402** defines openings **444** and **446**, and the printed circuit board **438** includes indicators **448** and **450** that register with the openings **444** and **446** when the printed circuit board **438** is inserted into the channels **434** and **436**. The printed circuit board **438** includes electrical components that are connected to the electric motor via wires (not visible). The wires can, for example, pass through the structural members **414** or **416** and **426**. The electrical components supply power to, and therefore can control the rotational speed of, the electric motor, as is well known in the art.

[0054] FIG. 5 is a rear view of the fan tray **400**. A multi-terminal electrical connector **500** is mounted to the back wall **404**. The electrical connector **500** is connected via wires (not shown) to the electric motor and/or the printed circuit board **438** (omitted from FIG. 4 for clarity). The electrical connector **500** is preferably a "blind-mate" connector, which is well-known in the art. A blind-mate connector can, but need not, include a mating guide (such as a flange, a funnel or a guide-post) that helps align the electrical connector **500** with a corresponding connector in the device that is to be cooled by the fan tray **400** when the fan tray is inserted into the device. The electrical connector **500** can, but need not, be of the "floating" type, i.e., the x and y coordinates of the electrical connector **500** need not be rigidly fixed, with respect to the back wall **404** of the fan tray **400**.

[0055] Optionally, the fan tray **400** can communicate with control circuitry in the device that the fan tray **400** is to cool. For example, the circuit board **438** can include components that communicate with the control circuitry according to a protocol, such as the well-known inter-integrated circuit (I2C) protocol. In this case, the electrical connector **500** includes a number of pins that carry messages according to the protocol. In some embodiments, the electrical connector **500** includes a pin for each of: I2C data, I2C clock, power and ground. Any other suitable protocol, such as Controller Area Network (CAN), Bluetooth or RS232, can be used. In each of these cases, the electrical connector **500** may have a suitable number of pins.

[0056] Returning to FIG. 4, the fan tray **400** optionally includes a handle **452**. The handle **452** can be molded along with the front wall **402**, i.e., the handle **452** and the front wall **402** can be formed as a single casting. Alternatively, the handle **452** can be separate from the front wall **402**. In this case, the handle **452** is attached to the front wall **402**, such as by at least one fastener. This fastener can be a screw, a rivet, a boss projecting from the front wall **402** onto which the handle **452** is pressed (or vice versa), an adhesive or any other appropriate fastener.

[0057] Optionally, the fan tray **400** includes one or more side rails (mounting brackets), one of which is visible at **454**, for mounting the fan tray **400** in a device that is to be cooled. The mounting brackets **454** are adjacent the side walls **406** and **408**, respectively, and extend along at least part of the

length of the side walls **406** and **408**, i.e., along a line from the front wall **402** to the back wall **404**. Each mounting bracket **454** has a predefined cross-sectional profile. An alternative profile is shown at **454a**. Other portfolios can, of course, be used. In addition, the mounting brackets **454** need not be aligned along a line extending from the front wall **402** to the back wall **404**; instead, the mounting brackets **454** can be aligned along any convenient line. Each mounting bracket **454** can slide into a complementary-shaped opening in the device that the fan tray **400** is to cool. For example, the mounting bracket **454** can have a male profile, and the device can have a complementary female profile.

[0058] The side rails **454** can be molded along with the side walls **406-408**, i.e., each side rail **454** and the corresponding side wall **406** or **408** are formed as a single casting. Alternatively, the side rails **454** can be separate from the side walls **406-408**. In this case, the side rails **454** are attached to the side walls **406** and **408**, respectively, such as by at least one fastener, as described above with respect to the handle **452**.

[0059] As shown in FIG. 5, a latch **502** is attached to the back wall **404** of the fan tray **400**. The latch **502** secures the fan tray **400**, after the fan tray **400** has been inserted into the device that it is to cool. The latch **502** can be any suitable type, such as a detent-type latch, which can be overcome by applying a sufficient pulling force on the handle **452**. Alternatively, a manual or remotely-controlled release latch can be used. In this case, the fan tray **400** can include a release lever (not shown) on the front wall **402**, on the handle **452** or in another suitable location. In other embodiments, the latch can be attached to one or both side walls **406** and/or **408** or to other portions of the fan tray **400** instead of or in addition to the back wall **404**.

[0060] Optionally, a grill and/or filter can be attached to the fan tray **400**, as shown in FIG. 6. A grill **600** can be attached to the top and/or bottom of the fan tray **400**. Optionally, the grill **600** includes a stepped portion **602** that accepts a filter element (not shown). In one embodiment, the grill **600** is perforated to form an air-flow area **604** approximately the same size and shape as the Venturi **412** defined by the inner wall **410**. The grill **600** is configured such that, when the grill **600** is attached to the fan tray **400**, the airflow area **604** registers with the Venturi **412**. Alternatively, the grill **600** can be partially or entirely made of a screen or mesh material.

[0061] The grill **600** can be made of plastic, metal or any other suitable material, and the grill **600** can be attached to the fan tray **400** by any suitable mechanism. For example, if the grill **600** is plastic, the grill **600** can be ultrasonically welded to the edges of the walls **402-408** of the fan tray **400**. Alternatively, the grill **600** can be fastened to the edges of the walls **402-408** by self-tapping screws.

[0062] Optionally, the grill **600** includes a second air-flow area **606** to provide ventilation for the circuit board **438**. Alternatively or optionally, the front wall **402** and/or the inner wall **410** include one or more holes **608** and **610**, respectively, to force cooling air over the circuit board **438** (not shown).

[0063] Returning again to FIG. 4, the walls **402-408**, the inner wall **410** and the structural members **414-416** define hollow sections ("voids") **456**, **458**, **460**, **462** and **464**. Other configurations of the inner wall **410** and/or other numbers or other configurations of the structural members may define other numbers and/or shapes of voids. Preferably, the voids **460-464** do not extend all the way from the top to the bottom of the fan tray **400**. That is, the fan tray **400** includes blocks that prevent air from flowing through the voids **460-464**.

[0064] The circuit board **438** occupies at least part of the void **464**. It may be desirable for air to flow through the void **464** to cool the circuit board **438**. In that case, the void **464** can be unblocked or only partially blocked. In either case, the walls **402-408** define a rectangular area above and below the fan tray **400**. Air is drawn into one of these rectangular areas (an intake area) and exhausted through the other of the two rectangular areas (an exhaust area) by the rotating blades attached to the rotor **432**. The inner wall **410** defines a Venturi **412** having a cross-sectional area that is smaller than the intake area or the exhaust area.

[0065] This difference in cross-sectional areas is provided largely by the above-mentioned blocks. To facilitate fabricating a fan tray that includes such blocks, the fan tray can be cast as two separate components. FIG. 7 shows one embodiment of a fan tray **700** that is cast as two separate components **702** and **704**. FIG. 8 shows the two components **702** and **704** before they are joined together. The two components **702** and **704** can be joined together by any suitable mechanism, such as an adhesive, ultrasonic welding or pins **706** on one of the two components **702** or **704** that press fit into corresponding holes (not visible) in the other of the two components.

[0066] FIG. 9 similarly shows the two components **702** and **704** before they are joined together. Each of the voids **456-464** extends at least partly through the top component **702** of the fan tray **700**. Some of the voids **456-464** may extend all the way through the top component **702**. As shown in the top part of FIG. 9, the top part of the void **464** (labeled **464a** in FIG. 9) extends all the way through the top component **702**. On the other hand, as shown in a top part of FIG. 9, the top part of the void **458** (labeled **458a** in FIG. 9) does not extend all the way through the top portion **702**, because the top portion **702** includes a floor **900** at the bottom of the void **458a**. Similarly, the top portion **702** includes floors **902**, **904** and **906** to prevent air from flowing through the voids **456-462**.

[0067] The top portion **702** does not include a floor to prevent air from flowing through the void portion **464a**. The bottom portion **704** includes a floor **908** to prevent air from flowing all the way through the void **464**. However, because the floors **900-906** prevent air from flowing through the respective void portions **456a-462a** of the top portion **702**, the bottom portion **704** need not include floors for void portions **456b-462b**. This is also visible in a cross-section A (shown in FIG. 10) of the two components **702** and **704**. (A corresponding section plane A is shown in FIG. 7.)

[0068] Although a fan tray **700** made up of two components **702** and **704** is described, in other embodiments, the fan tray **700** can be made up of other numbers of components. For example, the fan tray **400** shown in FIGS. 4, 5 and 6 can be cast as a single component. On the other hand, a fan tray can also be made of more than two components.

[0069] Thus far, a fan tray **400** or **700** that includes a single fan has been described. However, in other embodiments of the present invention, a fan tray can include more than one fan. For example, as shown in FIG. 11, a fan tray **1100** includes two fans **1102** and **1104**. Other embodiments can include other numbers of fans, and the fans can be arranged in any pattern. Most other aspects of the multi-fan fan tray **1100** are similar to the fan trays **400** and **700** described above.

[0070] Modular fan tray units can also be constructed, according to another embodiment of the present invention. For example, as shown in FIG. 12, a fan tray **1200** includes a side rail **454** on one side, as described above. However, on the other side, the fan tray **1200** defines a complementary-shaped

opening (also referred to as a side rail receiver or a mounting bracket receiver) **1202**, into which the side rail **454** of another fan tray (not shown) can be slid, thus forming a multi-fan tray. Preferably, the side rail **454** and the opening **1202** interlock when the side rail **454** is slid into the opening **1202**; however, interlocking rails and openings are not necessary.

[0071] Optionally, the rear wall of the fan tray **1200** also includes a similar opening (also referred to as a front rail receiver or a mounting bracket receiver) **1204**. In this case, another fan tray (not shown) that includes a front rail (instead of a handle) can be joined to the rear of the fan tray **1200**. By this mechanism, a fan tray consisting of any number of desired fans, arranged in any desired pattern, can be easily assembled by an end user or system administrator.

[0072] Although the side rail **454**, the side rail receiver **1202** and the front rail receiver **1204** are shown as being horizontally oriented, i.e., parallel to the plane of the fan tray **1200**, the side rail **454** and the rail receivers **1202-1204** can be oriented along other lines.

[0073] "Dummy" fan trays (not shown) can also be provided. A dummy fan tray has a side and/or a front rail and mounting bracket receiver(s), as described above. However, the dummy fan tray does not include a fan; instead, the dummy fan tray includes a partition to block airflow through an area defined by the front, back and side walls. A combination of real and dummy fan trays can be assembled to meet a current cooling or airflow requirement. Later, if the requirement increases, one or more of the dummy fan trays can be replaced with real fan trays.

[0074] FIG. 13 shows a vertically-oriented fan tray **1300**, according to another embodiment of the present invention. The front wall **1302** includes a handle **1304**, by which the fan tray **1300** can be inserted into, or remove from, a device that the fan tray **1300** is to cool.

[0075] FIG. 14 shows a vertically-oriented fan tray **1400**, according to yet another embodiment of the present invention. In this embodiment, a squirrel cage fan is used to direct air at a right angle to the air intake direction.

[0076] While the invention is described through the above-described exemplary embodiments, it will be understood by those of ordinary skill in the art that modifications to, and variations of, the illustrated embodiments may be made without departing from the inventive concepts disclosed herein. For example, although rectangular fan trays have been described, other embodiments of the inventive fan tray can be made in other shapes. For example, pie-section shaped fan trays (i.e., fan trays with angled side walls) can be used in circular devices. Moreover, while the preferred embodiments are described in connection with various illustrative materials and manufacturing processes, one skilled in the art will recognize that other materials and/or manufacturing processes may be employed. Accordingly, the invention should not be viewed as limited, except by the scope and spirit of the appended claims.

What is claimed is:

1. A fan tray component, comprising:

a front wall;

a back wall;

two side walls, each side wall being connected to the front wall and to the back wall; the front wall, the back wall and the two side walls defining a volume;

a first inner wall at least partially disposed within the volume and defining a Venturi; and

a first motor housing at least partially disposed within the Venturi;

wherein the front wall, the back wall, the two side walls, the first inner wall and the first motor housing are formed as a single casting.

2. A fan tray component as defined in claim 1, further comprising:

at least one first structural member connecting the first inner wall to at least one of the front wall, the back wall, one of the two side walls and the other of the two side walls; and

at least one second structural member connecting the first motor housing to the first inner wall and suspending the first motor housing within the Venturi;

wherein the at least one of first structural member, the at least one second structural member and the front wall are formed as a single casting.

3. A fan tray component as defined in claim 1, further comprising an electrical connector mounted to the back wall.

4. A fan tray component as defined in claim 3, wherein the electrical connector includes at least four terminals.

5. A fan tray component as defined in claim 3, wherein the electrical connector is a blind-mating connector.

6. A fan tray component as defined in claim 3, further comprising:

an electric motor disposed within the first motor housing and electrically connected to the electrical connector; and a rotor attached to the electric motor, such that when the electric motor operates, the electric motor rotates the rotor.

7. A fan tray component as defined in claim 6, further comprising a circuit board having electrical components electrically connected to the electrical connector and to the electric motor and operative to control a rotational speed of the electric motor.

8. A fan tray component as defined in claim 7, wherein at least one of the electrical components is operative to receive signals, via the electrical connector, to control the rotational speed of the electric motor.

9. A fan tray component as defined in claim 8, wherein the signals conform to an inter-integrated circuit (I2C) protocol.

10. A fan tray component as defined in claim 8, wherein the signals conform to a controller area network (CAN) protocol.

11. A fan tray component as defined in claim 1, further comprising a handle adjacent the front wall.

12. A fan tray component as defined in claim 11, wherein the handle and the front wall are formed as a single casting.

13. A fan tray component as defined in claim 11, wherein the handle is attached to the front wall by at least one fastener.

14. A fan tray component as defined in claim 1, further comprising a latch mechanism.

15. A fan tray component as defined in claim 14, wherein the latch mechanism is adjacent the back wall.

16. A fan tray component as defined in claim 14, wherein the latch mechanism is adjacent one of the two side walls.

17. A fan tray component as defined in claim 1, further comprising a grill adjacent one end of first inner wall.

18. A fan tray component as defined in claim 1, further comprising a filter receiving element.

19. A fan tray component as defined in claim 1, wherein the back wall is parallel to the front wall.

20. A fan tray component as defined in claim 1, wherein the two side walls are perpendicular to the front wall and to the back wall.

21. A fan tray component as defined in claim 1, wherein at least one of the two side walls has a length extending from one end thereof to another end thereof; and

further comprising a mounting bracket adjacent the side wall and extending along at least part of the length of the side wall, the mounting bracket having a first predefined cross-sectional profile when the cross-section is taken perpendicular to the length of the side wall.

22. A fan tray component as defined in claim 21, wherein the other of the two side walls:

has a length extending from one end thereof to another end thereof; and

defines a mounting bracket receiver extending along at least part of the length of the side wall, the mounting bracket receiver having a second predefined cross-sectional profile when the cross-section is taken perpendicular to the length of the side wall.

23. A fan tray component as defined in claim 22, wherein the first cross-sectional profile is complementary to the second cross-sectional profile.

24. A fan tray component as defined in claim 21, wherein the back wall defines a mounting bracket receiver having a first predefined cross-sectional profile.

25. A fan tray component as defined in claim 24, further comprising a mounting bracket adjacent the front wall and having a second predefined cross-sectional profile.

26. A fan tray component as defined in claim 1, further comprising:

a second inner wall at least partially disposed within the volume and defining a second Venturi, the second inner wall being connected by at least one third structural element to at least one of the front wall, the back wall, one of the two side walls, the other of the two side walls and the first inner wall;

a second motor housing; and

at least one fourth structural element connecting the second motor housing to the second inner wall;

wherein the first inner wall and the second inner wall are formed as a single casting.

27. A fan tray, comprising:

a first component, comprising:

a first front wall;

a first back wall;

two first side walls, each first side wall being connected to the first front wall and to the first back wall; the first front wall, the first back wall and the two first side walls defining a volume;

an inner wall at least partially disposed within the volume and defining a Venturi; and

a motor housing at least partially disposed within the Venturi;

wherein the first front wall, the first back wall, the first two side walls, the first inner wall and the motor housing are formed as a single casting; and

wherein the first component defines at least one void; and

a second component joined to the first component, the second component comprising:

a second front wall;

a second back wall;

two second side walls, each second side wall being connected to the second front wall and to the second back wall; and

wherein the second front wall, the second back wall and the two second side walls are formed as a single casting;

wherein at least one of the first component and the second component further comprises at least one block located to prevent air from flowing through the at least one void.

28. A modular fan tray component, comprising:

a front wall;

a back wall;

two side walls, each side wall being connected to the front wall and to the back wall; the front wall, the back wall and the two side walls defining a volume;

a first inner wall at least partially disposed within the volume and defining a Venturi;

a fan at least partially disposed within the Venturi; and

a first mounting bracket adjacent one of the two side walls, the first mounting bracket having a first predefined cross-sectional profile;

wherein the other of the two side walls defines a first mounting bracket receiver having a second predefined cross-sectional profile.

29. A modular fan tray component as defined in claim 28, wherein the first cross-sectional profile is complementary to the second cross-sectional profile.

30. A modular fan tray component as defined in claim 25, wherein the back wall defines a second mounting bracket receiver having a third predefined cross-sectional profile.

31. A modular fan tray component as defined in claim 30, wherein:

the other of the two side walls has a length extending from the front wall to the back wall;

the first mounting bracket receiver extends along at least part of the length of the other of the two side walls;

the back wall has a length extending from one of the two side walls to the other of the two side walls; and

the second mounting bracket receiver extends along at least part of the length of the back wall.

32. A modular fan tray component as defined in claim 30, further comprising a second mounting bracket adjacent the front wall, the second mounting bracket having a fourth predefined cross-sectional profile.

33. A modular fan tray component as defined in claim 32, wherein the third cross-sectional profile is complementary to the fourth cross-sectional profile.

34. A dummy modular fan tray component, comprising:

a front wall;

a back wall;

two side walls, each side wall being connected to the front wall and to the back wall; the front wall, the back wall and the two side walls defining an area;

a partition blocking air flow through the area; and

a first mounting bracket adjacent one of the two side walls, the first mounting bracket having a predefined cross-sectional profile;

wherein the other of the two side walls defines a first mounting bracket receiver having a predefined cross-sectional profile.

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