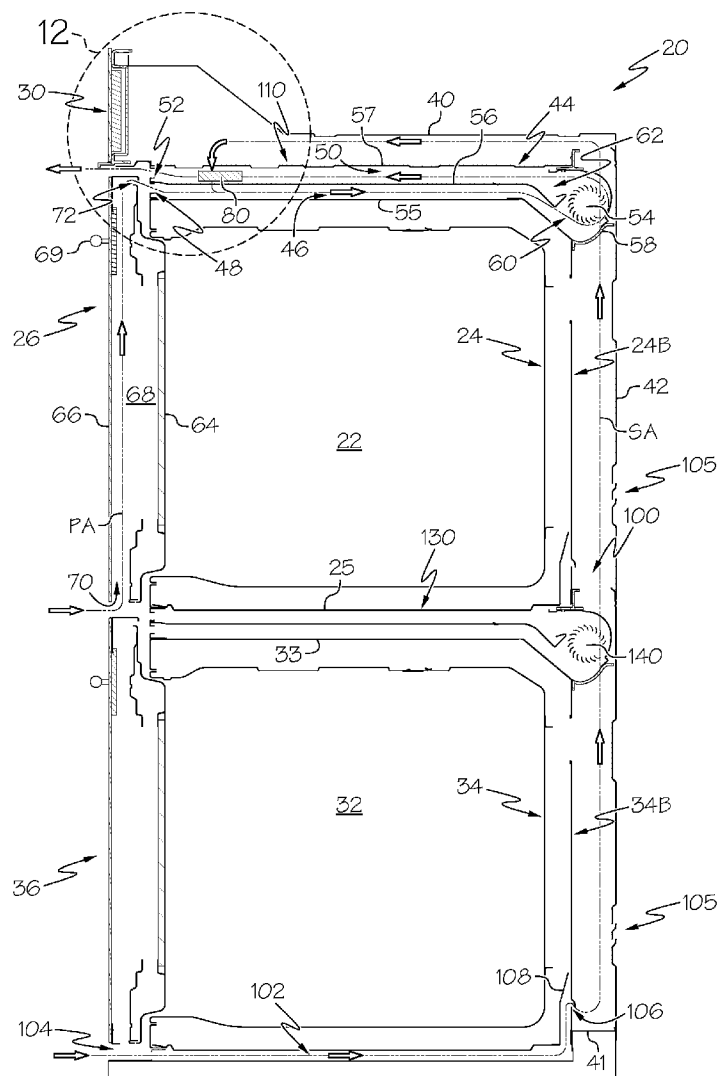




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(19) **United States**(12) **Patent Application Publication**
Brant et al.(10) **Pub. No.: US 2015/0241069 A1**(43) **Pub. Date: Aug. 27, 2015**(54) **WALL OVEN COOLING SYSTEM**(52) **U.S. Cl.**CPC **F24C 15/006** (2013.01)(71) Applicant: **Electrolux Home Products, Inc.**,
Charlotte, NC (US)(72) Inventors: **Ronald Gene Brant**, Greenbrier, TN
(US); **Aaron Todd Holmes**, White
House, TN (US)(73) Assignee: **Electrolux Home Products, Inc.**,
Charlotte, NC (US)(21) Appl. No.: **14/191,763**(22) Filed: **Feb. 27, 2014****Publication Classification**(51) **Int. Cl.**
F24C 15/00 (2006.01)(57) **ABSTRACT**

A cooking oven includes a first heatable oven chamber, a second heatable oven chamber below the first oven chamber. A cooling plenum is located above the first oven chamber including a suction portion to supply cool air and an exhaust portion to discharge heated air. A cooling fan produces a primary cooling airflow through the cooling plenum. An electronic device is located at least partially within the cooling plenum and in flow communication with the heated air. A bypass element is located within the cooling plenum that at least partially surrounds the electronic device to divert the heated air away from the electronic device. In one example, the cooling fan produces a secondary cooling airflow through a vertical channel at the rear of the cooking oven. In another example, a second cooling plenum is located above the second oven chamber.



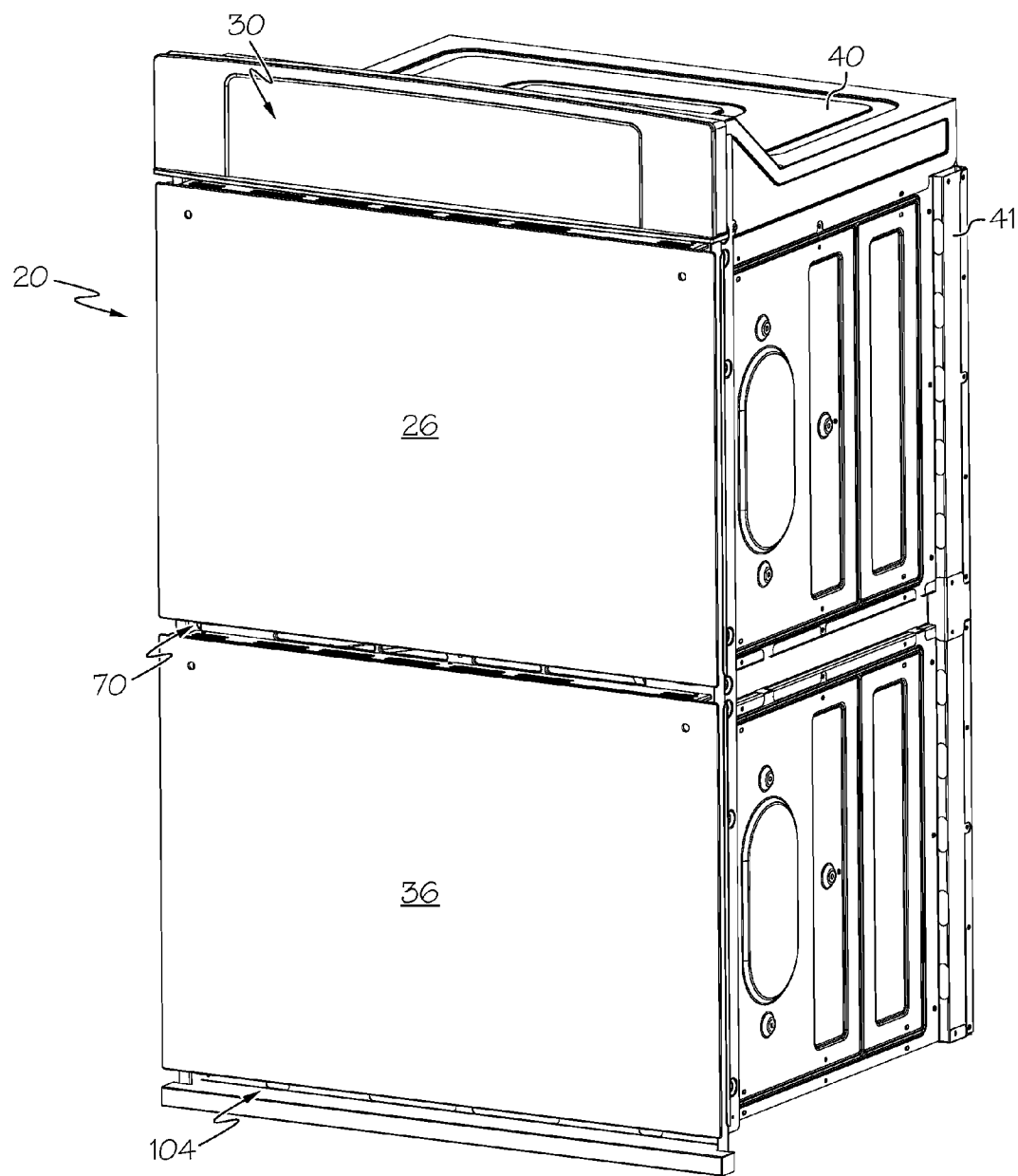


FIG. 1

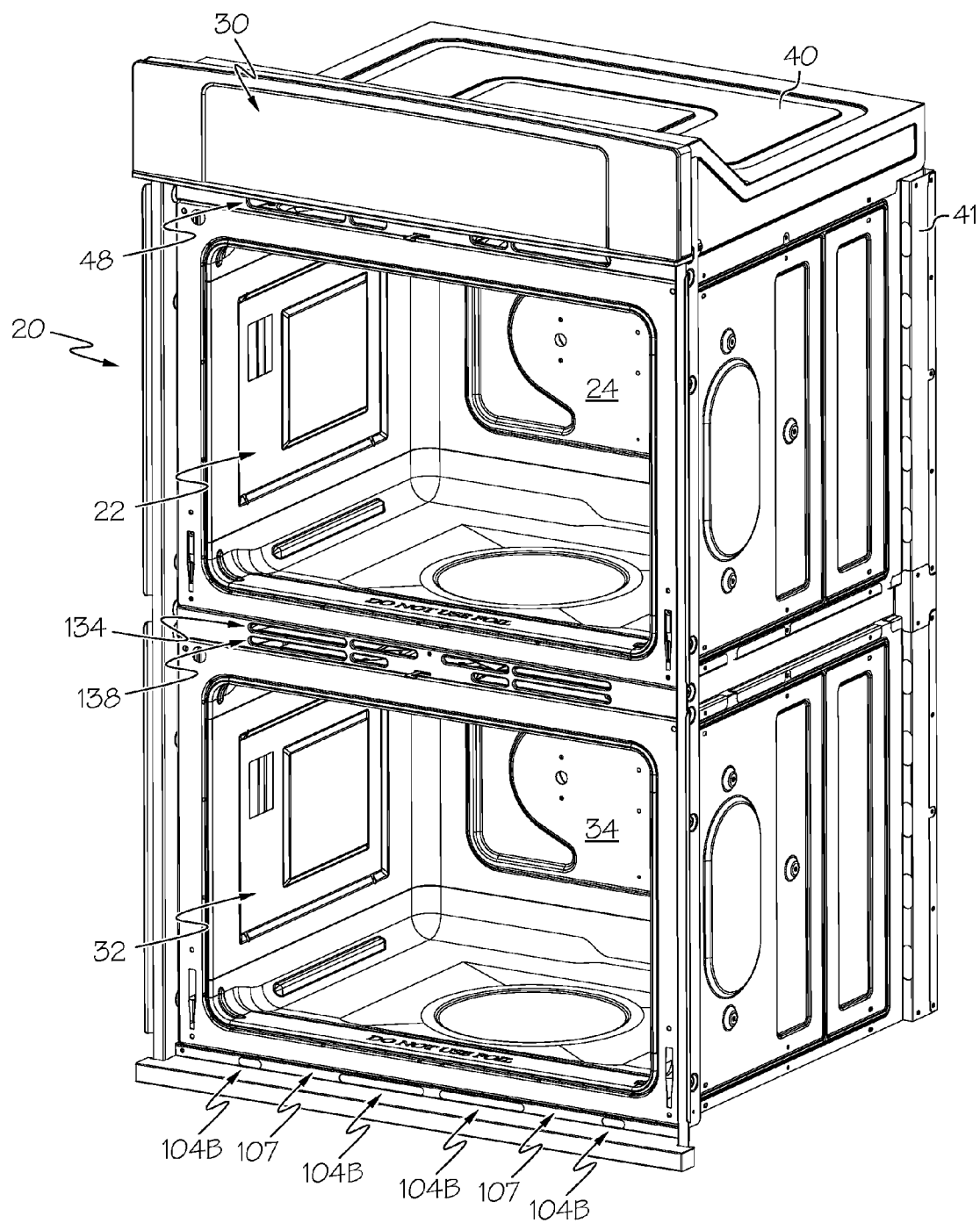


FIG. 2

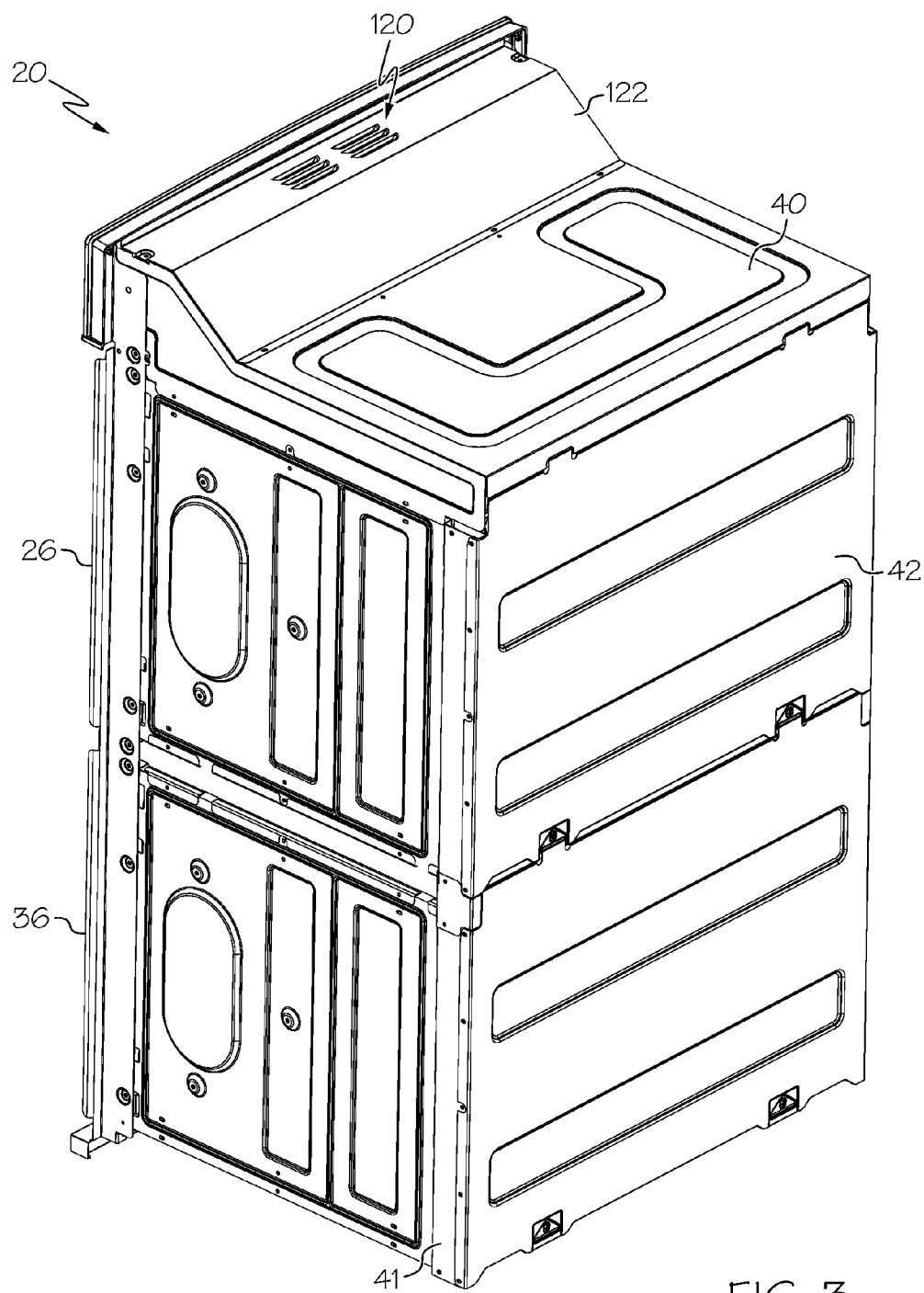


FIG. 3

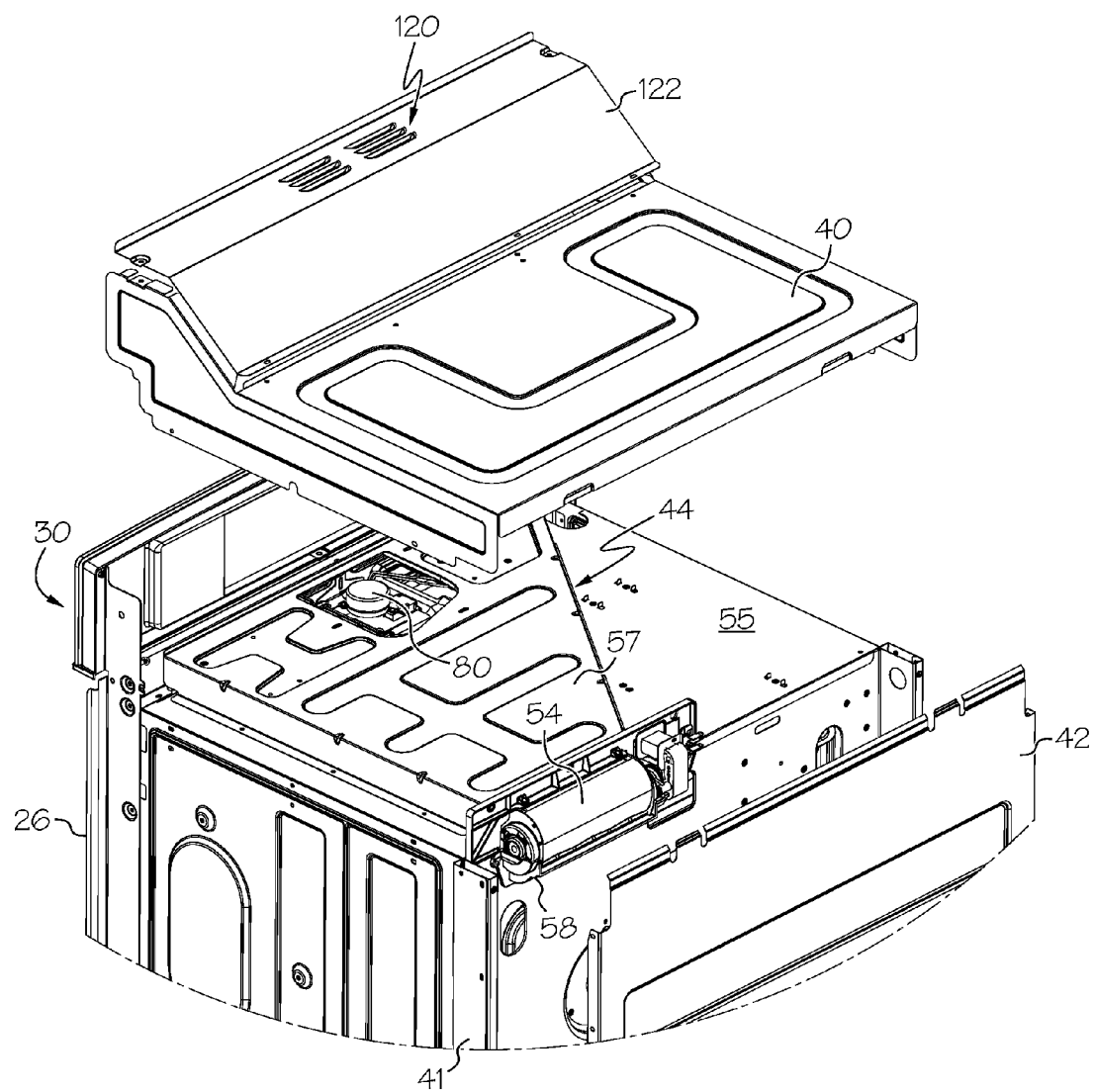
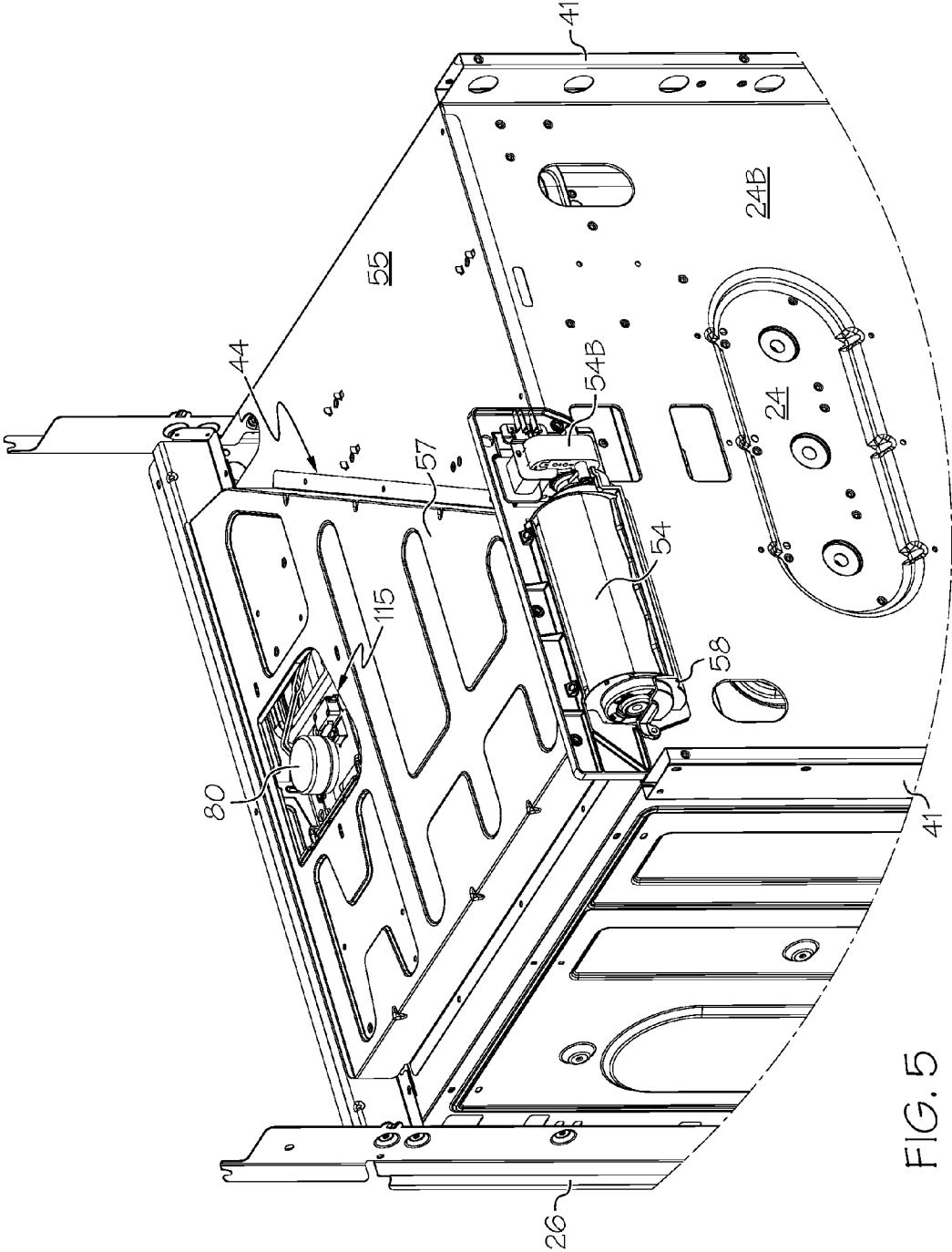


FIG. 4



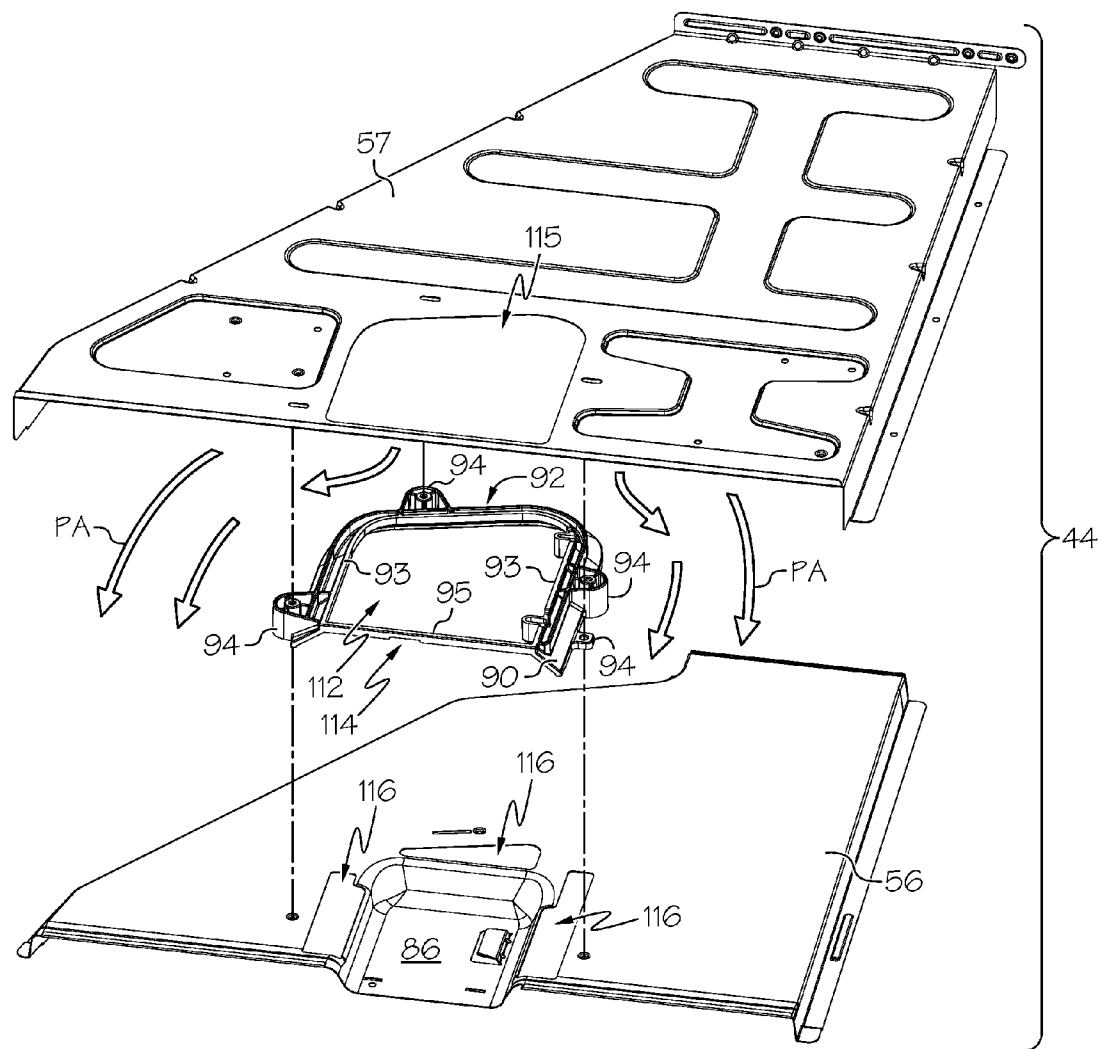


FIG. 6

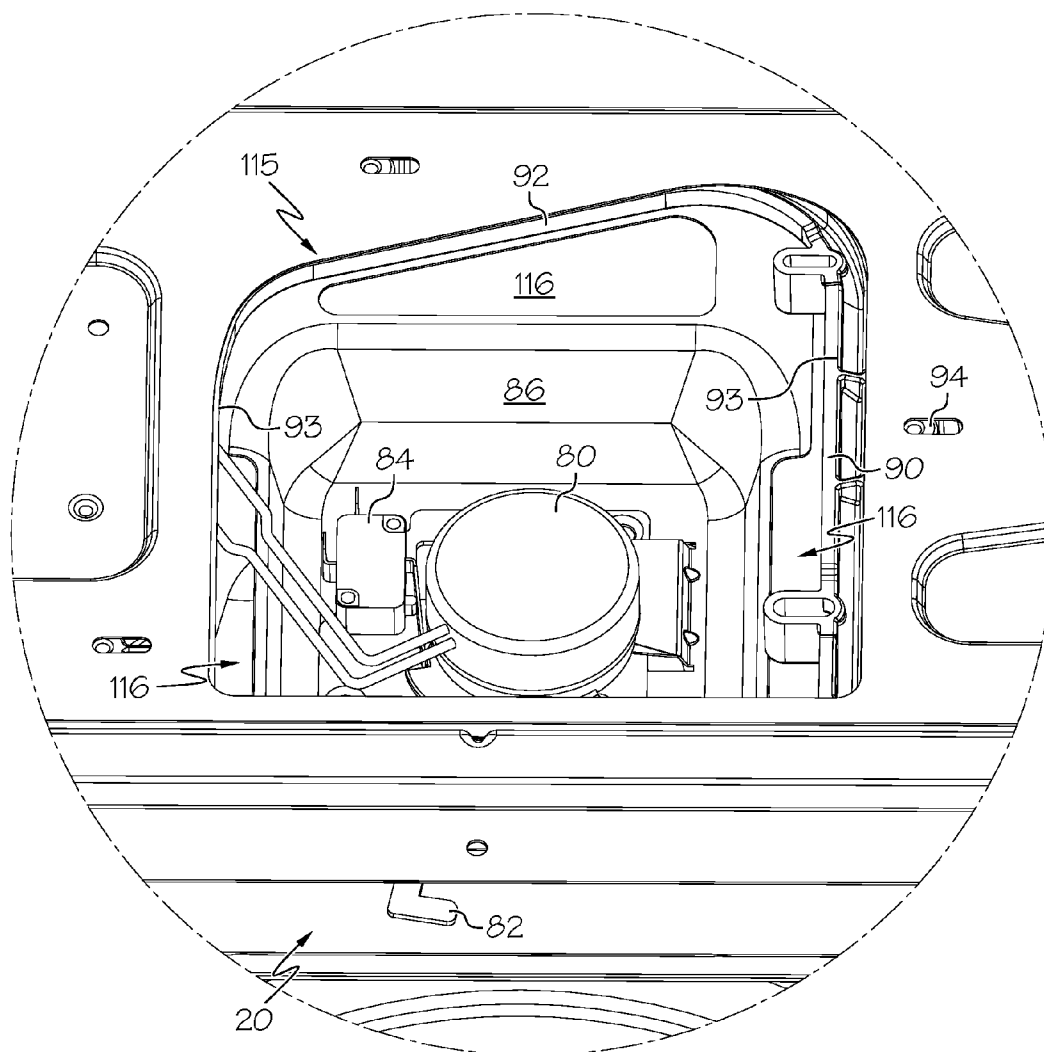


FIG. 7

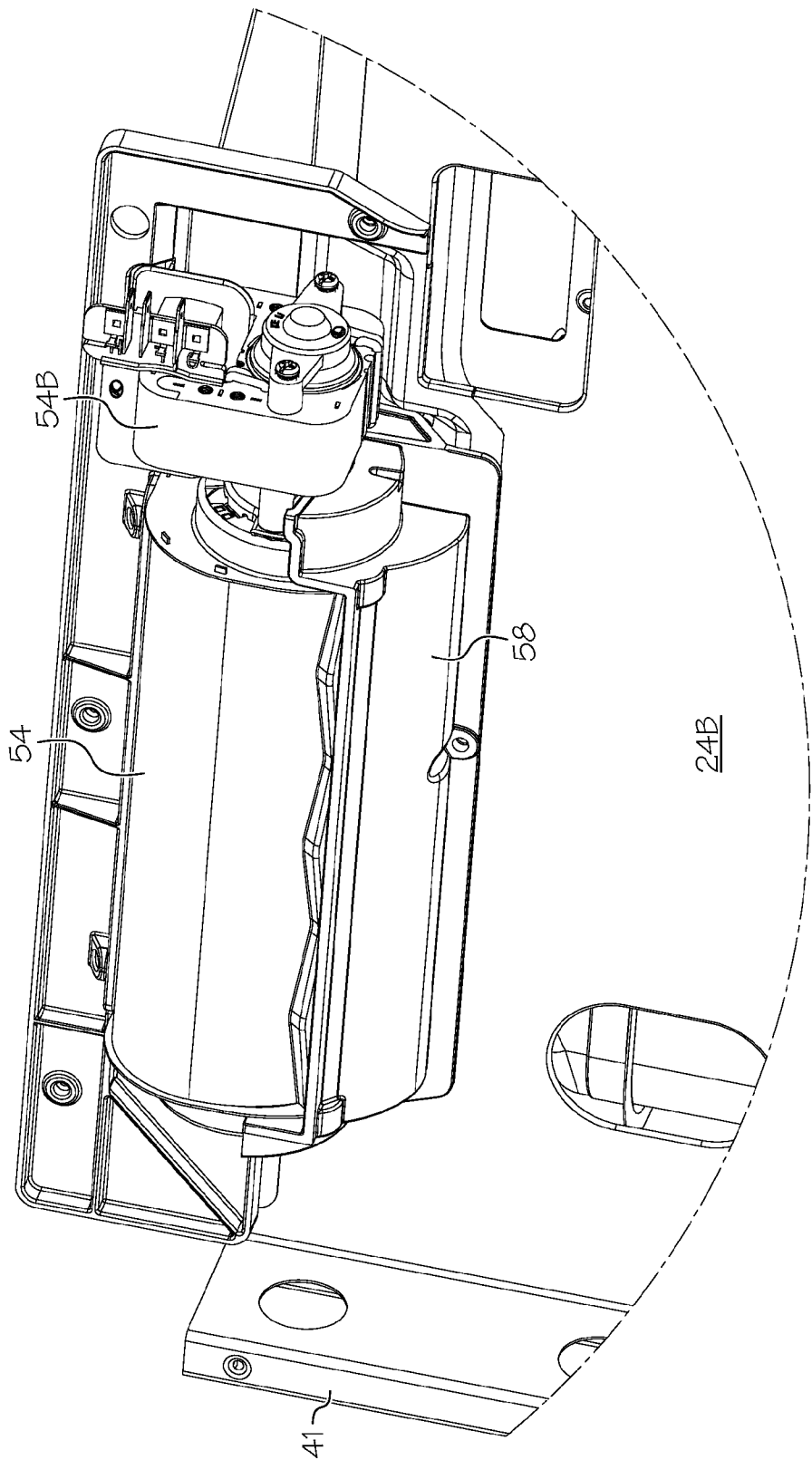


FIG. 8

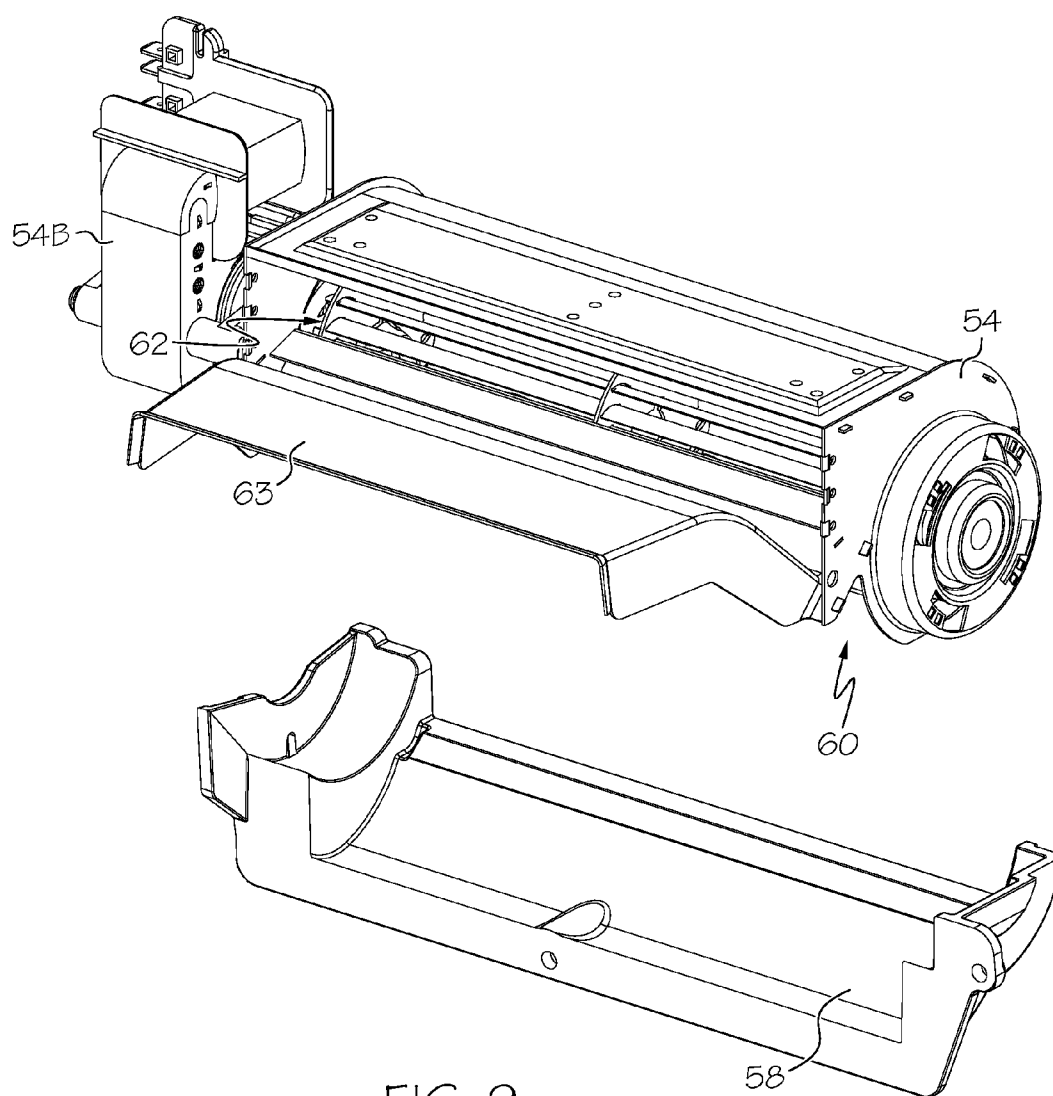
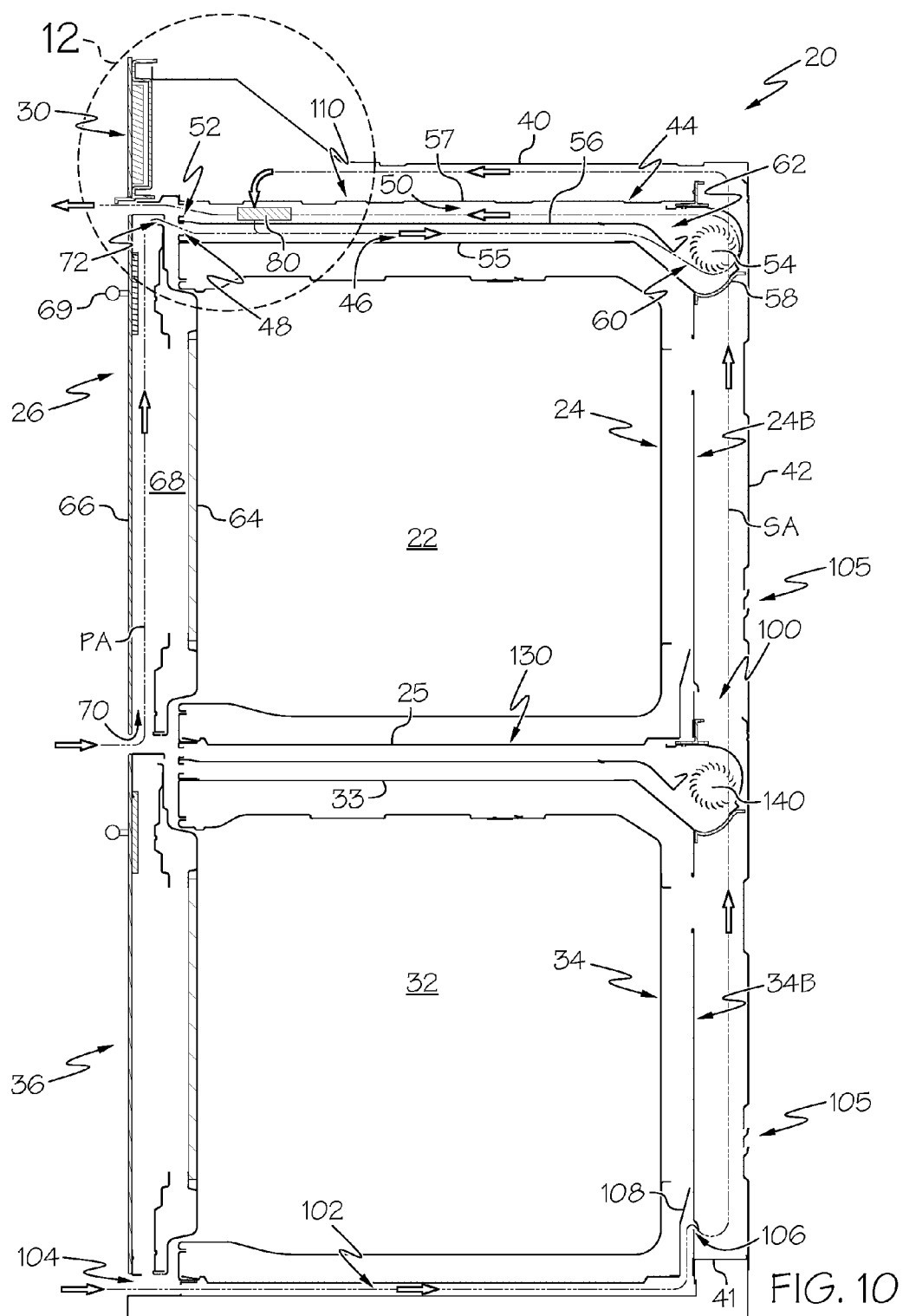


FIG. 9



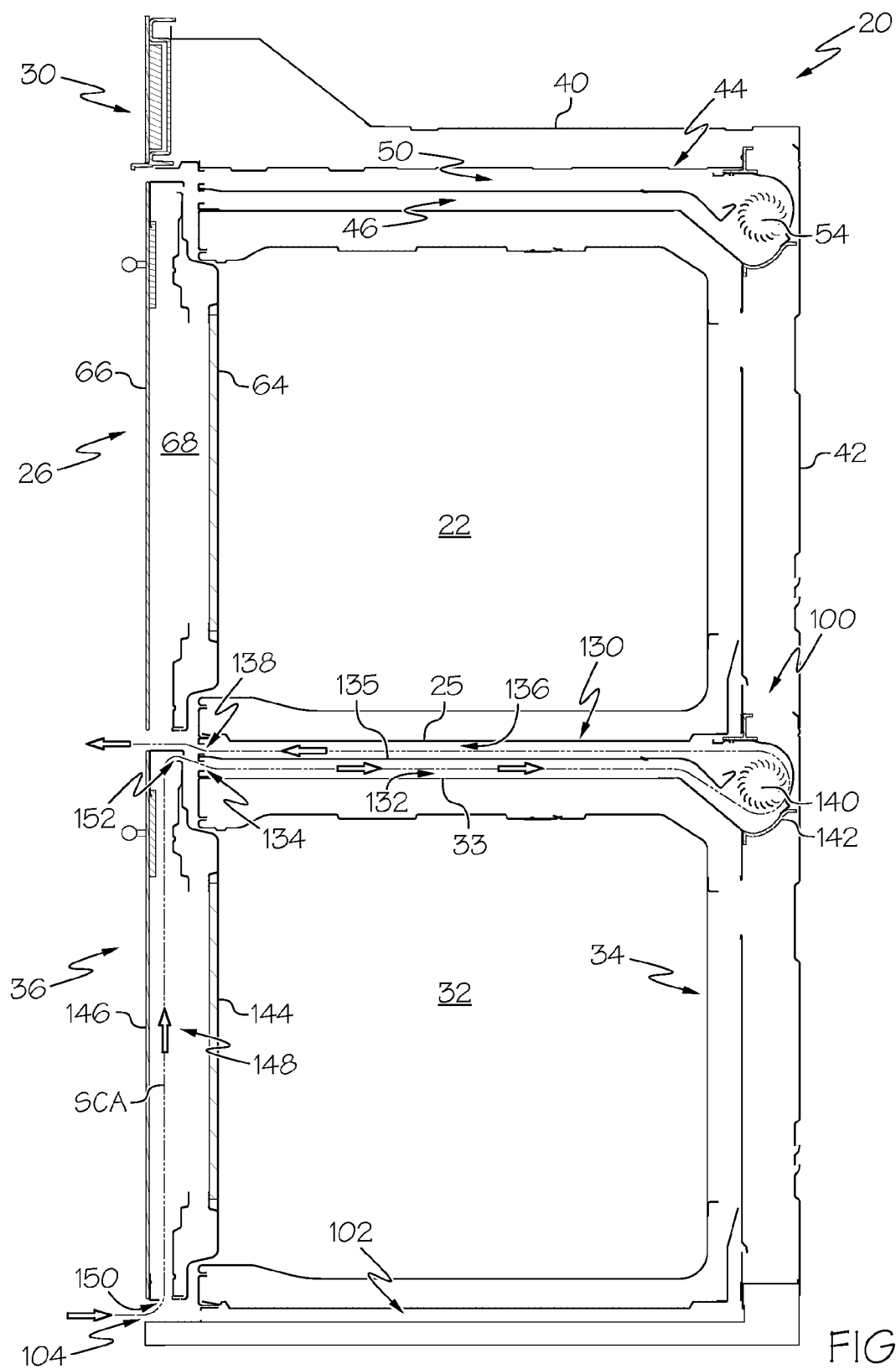


FIG. 11

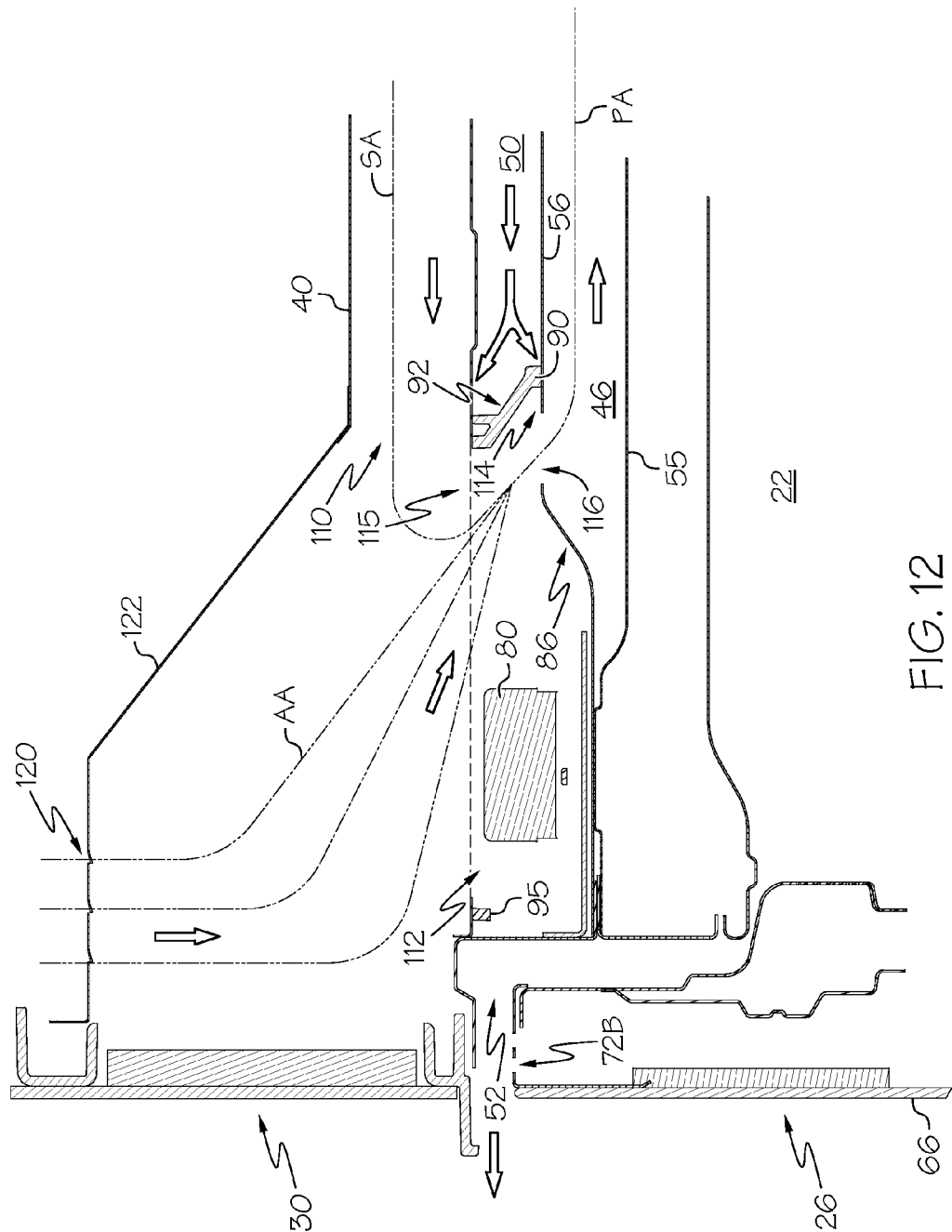


FIG. 12

WALL OVEN COOLING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not applicable.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a cooking oven with a heatable oven chamber, and more particularly, to a cooling system for the cooking oven.

BACKGROUND OF THE INVENTION

[0003] Known oven designs include single ovens, double ovens, and combination ovens that have a conventional oven and a microwave oven. The ovens can be used for baking, roasting, and broiling food items in an oven chamber. The oven chamber can further be cleaned using a high temperature pyrolysis operation. However, in a standalone configuration or especially in a wall-mount configuration, a cooling system is used to maintain the exterior of the cooking oven at a relatively lower temperature while the oven chamber is heated to the desired higher temperature.

BRIEF SUMMARY OF THE INVENTION

[0004] The following presents a simplified summary of the invention in order to provide a basic understanding of some example aspects of the invention. This summary is not an extensive overview of the invention. Moreover, this summary is not intended to identify critical elements of the invention nor delineate the scope of the invention. The sole purpose of the summary is to present some concepts of the invention in simplified form as a prelude to the more detailed description that is presented later.

[0005] In accordance with one aspect of the present invention, a cooking oven comprises a first heatable oven chamber defined in part by a first rear wall and a second heatable oven chamber defined in part by a second rear wall and disposed at an elevation vertically below the first oven chamber. A housing encloses both of the first and second oven chambers, and the housing comprises a top panel and a rear panel. A cooling plenum is located above the first oven chamber and below the top panel of the housing, comprising a suction portion with a suction inlet configured to supply cool air from an outside area and an exhaust portion with an exhaust outlet configured to discharge heated air to said outside area. A cooling fan produces a primary cooling airflow through the cooling plenum. An electronic device is located at least partially within the cooling plenum and in flow communication with the heated air, and a bypass element is located within the cooling plenum that at least partially surrounds the electronic device to divert the heated air away from the electronic device.

[0006] In accordance with another aspect of the present invention, a cooking oven comprises a first heatable oven chamber defined in part by a first rear wall, and a first door pivotally mounted to the first oven chamber to selectively close the first oven chamber from an outside area. A second heatable oven chamber is defined in part by a second rear wall and disposed at an elevation vertically below the first oven chamber, and a second door is pivotally mounted to the second oven chamber to selectively close the second oven chamber from the outside area. A housing encloses both of the first and second oven chambers, the housing comprising a top panel and a rear panel. A first cooling plenum is located above

the first oven chamber comprising a suction portion with a suction inlet configured to supply cool air from said outside area and an exhaust portion with an exhaust outlet configured to discharge heated air to said outside area. A first cooling fan produces a primary cooling airflow through the first cooling plenum. A second cooling plenum is located above the second oven chamber and below the first oven chamber, the first and second cooling plenums being independent. A second cooling fan produces a second oven cooling airflow through the second cooling plenum. An electronic device is located at least partially within the cooling plenum and in flow communication with the heated air, and a bypass element is located within the cooling plenum that at least partially surrounds the electronic device to divert the heated air away from the electronic device.

[0007] In accordance with another aspect of the present invention, a cooking oven comprises a first heatable oven chamber defined in part by a first rear wall, and a second heatable oven chamber defined in part by a second rear wall and disposed at an elevation vertically below the first oven chamber. A housing encloses both of the first and second oven chambers, the housing comprising a top panel and a rear panel. A first cooling plenum is located above the first oven chamber comprising a suction portion with a suction inlet configured to supply cool air from said outside area and an exhaust portion with an exhaust outlet configured to discharge heated air to said outside area. The suction portion and the exhaust portion are arranged in a vertically stacked arrangement separated by a common wall. A vertical channel is located between the rear panel of the housing and the first rear wall of the first oven chamber. A first cooling fan produces a primary cooling airflow through the first cooling plenum along a first airflow path, and a secondary cooling airflow through the vertical channel. An electronic device is located at least partially within the exhaust portion of the cooling plenum and in flow communication with the heated air. A bypass element is located within the exhaust portion of the cooling plenum that at least partially surrounds the electronic device to divert substantially all of the heated air away from the electronic device. The bypass element comprises an open top in flow communication with the vertical channel and an open bottom in flow communication with a hole extending through the common wall, such that the secondary cooling airflow flows through the bypass element and into the inlet portion along a second airflow path that is arranged at an angle relative to the first airflow path.

[0008] It is to be understood that both the foregoing general description and the following detailed description present example and explanatory embodiments of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention and are incorporated into and constitute a part of this specification. The drawings illustrate various example embodiments of the invention, and together with the description, serve to explain the principles and operations of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing and other aspects of the present invention will become apparent to those skilled in the art to which the present invention relates upon reading the following description with reference to the accompanying drawings, in which:

[0010] FIG. 1 illustrates a front perspective view of an example cooking oven;

[0011] FIG. 2 is similar to FIG. 1, but shows the cooking oven with the doors removed;

[0012] FIG. 3 illustrates a rear perspective view of the cooking oven;

[0013] FIG. 4 illustrates a rear perspective detail view of an example housing of the cooking oven, with a top panel and rear panel partially removed;

[0014] FIG. 5 is similar to FIG. 4, but shows the top panel and rear panel completely removed;

[0015] FIG. 6 illustrates a front perspective exploded view of an example cooling plenum;

[0016] FIG. 7 illustrates a top perspective detail view of an example electronic device located at least partially within the cooling plenum;

[0017] FIG. 8 illustrates a rear perspective detail view of an example cooling fan coupled to the cooling plenum;

[0018] FIG. 9 illustrates a front perspective exploded view of the cooling fan;

[0019] FIG. 10 illustrates a sectional view of the cooking oven showing one example cooling operation;

[0020] FIG. 11 illustrates a sectional view of the cooking oven showing another example cooling operation; and

[0021] FIG. 12 illustrates a partial sectional view of the cooking oven showing an auxiliary cooling airflow.

DESCRIPTION OF EXAMPLE EMBODIMENTS

[0022] Example embodiments that incorporate one or more aspects of the present invention are described and illustrated in the drawings. These illustrated examples are not intended to be a limitation on the present invention. For example, one or more aspects of the present invention can be utilized in other embodiments and even other types of devices. Moreover, certain terminology is used herein for convenience only and is not to be taken as a limitation on the present invention. Still further, in the drawings, the same reference numerals are employed for designating the same elements.

[0023] Turning to the shown example of FIGS. 1-2, a front perspective view of a cooking appliance, such as a cooking oven 20, is illustrated in accordance with the instant application. The cooking oven 20 can include a wall-mounted oven, or could also include a freestanding oven. The cooking oven 20 includes at least a first heatable oven chamber 22 defined in part by a first rear wall 24 (and possibly a double rear wall 24B) and having an open front. A first door 26 is pivotally mounted to the first oven chamber 22, opposite to the first rear wall 24, and is used to selectively close the front of the first oven chamber 22 from an outside area external to the cooking oven 20. The first door 26 can be tilted around a horizontal pivot in its lower section between a horizontal position in which the front opening is open to admit product for cooking, and a vertical position in which the front opening is closed. The first door 26 includes a handle used to facilitate opening and closing of the first door 26. It is understood that, as used herein, the terms first, second, primary, secondary, auxiliary, etc. are used for convenience and are not intended to create any limitations upon the instant application.

[0024] Optionally, the cooking oven 20 can include a second cooking device, such as a second heatable oven chamber 32 defined in part by a second rear wall 34 (and possibly a double rear wall 34B) and disposed at an elevation vertically below the first oven chamber 22. A second door 36 (similar to the first door 26, including a handle) is pivotally mounted to

the second oven chamber 32, opposite to the rear wall 34, and is used to selectively close the second oven chamber 32 from the outside area. The cooking oven 20 also includes an electronic control panel 30 that is used to control operation of the first and second oven chambers 22, 32.

[0025] Each of the first and second oven chambers 22, 32 can include one or more heating elements (not shown) used to heat the oven chambers to various temperatures suitable for cooking, baking, broiling, or pyrolysis (i.e., a self-clean operation). The heating elements can include a main heat source typically located towards a bottom of the oven chamber, a broil heat source typically located towards a top of the oven chamber, and/or a convection heat source with a fan typically located on the rear wall. The heating elements can be either gas or electric.

[0026] A housing encloses both of the first and second oven chambers 22, 32 that provides the cooking oven 20 as a unitary item for ease of installation. The housing comprises at least a top panel 40 and a rear panel 42. Optionally, the housing can include a pair of opposed side panels and/or a bottom panel. Any of the panels of the housing may be monolithic, or may be formed of multiple panels. As shown in FIG. 4, at least the top panel 40 and rear panel 42 can be removable to expose various components of the cooking oven 20. The top panel 40 encloses an open area above the first oven chamber 22, while the rear panel 42 encloses an open area behind the rear wall of the oven chambers 22, 32. Turning briefly to FIGS. 5 and 10, the rear panel 42 can be spaced apart from the rear wall 24, or possibly a double rear wall 24B, by a pair of spacer walls 41. Each spacer wall 41 can be secured to the rear wall 24 (or double rear wall 24B) of the first oven chamber 22, and the rear panel 42 can be removably coupled to the spacer walls 41.

[0027] During a heating operation, either or both of the first and second oven chambers 22, 32 will raise the temperature of the cooking oven 20 above ambient temperature, often in the range of 150-550 degrees Fahrenheit (65-285 Celsius) and oven higher for a self-clean operation. Moreover, especially in a wall-mounted configuration, the heat generated by the cooking oven 20 should be dissipated beyond the housing to the outside area. Thus, the cooking oven 20 further includes a cooling plenum 44 located above the first oven chamber 22 and below the top panel 40 of the housing. It is beneficial to locate the cooling plenum 44 above the first oven chamber 22 because the heat that naturally rises upwards can be cooled by the air flowing through the cooling plenum 44. The cooling plenum 44 includes a suction portion 46 with a suction inlet 48 that is configured to supply cool air from the outside area, and an exhaust portion 50 with an exhaust outlet 52 configured to discharge heated air back to the outside area. A cooling fan 54 is used to produce a primary cooling airflow through the cooling plenum 44. More specifically, the primary cooling airflow draws cool air from the outside area can flow into the suction portion 46, where it is heated by operation of the first and second oven chambers 22, 32. The heated air can then flow into the exhaust portion 50, where it is discharged out of the housing to the outside area.

[0028] In one example, the suction portion 46 and the exhaust portion 50 of the first cooling plenum 44 are arranged in a vertically stacked arrangement. The suction portion 46 and the exhaust portion 50 can both provide about the same cross-sectional flow area, although either can be different depending upon the desired airflow performance. Because heat rises, the exhaust portion 50 is preferably located above

the suction portion 46, although these can be reversed. The exhaust portion 50 and suction portion 46 can be formed as separate structures, or can be partially combined to reduce space usage. For example, the exhaust portion 50 and the suction portion 46 can be separated by a common wall 56. Turning briefly to FIGS. 5-6 and 10, the suction portion 46 can be defined between a bottom plenum wall 55 and the common wall 56. The bottom plenum wall 55 can be a discrete wall, or could even be provided by the top-most wall of the first oven chamber 22. The exhaust portion 50 can be defined between the common wall 56 and a top plenum wall 57.

[0029] Additionally, the suction inlet 48 of the suction portion 46, and the exhaust outlet 52 of the exhaust portion 50, can both be arranged at a front side of the cooking oven 20 for communication with the outside area. This configuration can be beneficial in a wall-mount oven configuration, since typically the front of the oven is the only portion exposed to the outside area. The cooling fan 54 can be arranged at a rear of the cooking oven 20, and is preferably located interposed between the suction portion 46 and the exhaust portion 50. For example, an inlet 60 of the cooling fan 54 can be coupled to the suction portion 46, while the outlet 62 of the cooling fan 54 can be coupled to the exhaust portion 50 to provide flow communication through the cooling plenum 44. Additionally, one or more baffles 63 can be used with either of the fan inlet or outlet to interface with the cooling plenum 44 to make the fan 54 a front inlet and/or outlet configuration.

[0030] Turning to FIGS. 8-10, the cooling fan 54 is preferably an electrically-operated cooling fan of various types, driven by an electric motor 54B, such as a cross-flow fan (as shown), axial fan, or centrifugal fan. When using a cross-flow fan with a large inlet 60, an air diverter 58 can be used to at least partially close or restrict the inlet 60 of the cooling fan 54. In the instant design, the air diverter 58 is provided in an at least partially covering relationship over the inlet 60 of the first cooling fan 54 such that the inlet 60 of the first cooling fan 54 is substantially limited to the suction portion 46 of the first cooling plenum 44. That is, although a portion of the air drawn into the cooling fan 54 may come from an alternate source, the air diverter 58 is used to close a majority of the inlet 60 of the cooling fan 54 such that a majority of the airflow taken into the cooling fan 54 is provided by the suction portion 46. Preferably, the air diverter 58 includes a curved wall to gradually redirect the airflow through the cooling plenum 44 so as to reduce negative pressure or other airflow hindrances. Thus, operation of the cooling fan 54 with the air diverter 58 produces the primary cooling airflow such that cooling air is drawn into the suction inlet 48 of the suction portion 46, flows along the length of the suction portion 46 (and along the top of the first oven chamber 22), is diverted into the inlet 60 of the cooling fan 54, is exhausted via the fan outlet 62 back towards and into the exhaust portion 50, and ultimately flows out of the exhaust outlet 52 into the outside area.

[0031] Because the suction inlet 48 and the exhaust outlet 52 can both be arranged at a front side of the cooking oven 20 for communication with the outside area, the front side of the cooking oven 20 can provide suitable structure to enable air ingress and egress. In one example, air ingress can be provided via the first oven door 26, which can provide the dual benefit of concealing the air ingress structure to provide a more pleasing appearance of the oven, while also providing active cooling of the first oven door 26. For example, the first

oven door 26 can include an inner pane 64 facing the first oven chamber 22, an outer pane 66 facing the outside area, and a door cavity 68 provided between the inner and outer panes 64, 66. Although only two panes are described and shown, it is understood that the oven door 26 can include three or more panes and multiple cavities therebetween. Preferably, at least a portion of the inner and outer panes 64, 66 are formed of a light transmissible material, such as glass or other material suitable to withstand oven temperatures, so that a user can view the oven chamber 22 through the oven door 26. Preferably, at least the outer pane 66 is substantially formed of glass to provide an “all-glass” frontal appearance to the cooking oven 20. Additionally, at least one door handle 69 is provided at the front of the oven door to selectively open and close the oven door 26, and may be secured to the outer pane 66.

[0032] The door cavity 68 provides an open space within the oven door 26 between the inner and outer panes 64, 66 that may be partially or completely open. The door cavity further includes a cavity inlet 70 about a bottom of the first oven door 26, and a cavity outlet 72 about a top of the first oven door 26. Both of the cavity inlet 70 and cavity outlet 72 are directly or indirectly in fluid communication with the door cavity 68. Turning briefly back to FIG. 2, it is contemplated that any or all of the cavity inlet 70, cavity outlet 72, suction inlet 48, and/or exhaust outlet 52 can be a single continuous opening, or can include a plurality of adjacent openings (as shown) which can provide additional structural support via support columns arranged between the adjacent openings. The number and arrangement of the adjacent openings can vary.

[0033] Preferably, the cavity inlet 70 is arranged underneath the oven door 26, such as along a bottom edge thereof, so as to be hidden from view. In one example shown in FIG. 10, the cavity outlet 72 is adjacent the suction inlet 48 of the cooling plenum 44. The cavity outlet 72 is arranged on the rear inner surface of the oven door 26 so as to be generally in fluid alignment with the suction inlet 48 of the suction portion 46 of the cooling plenum 44. Still, the cavity outlet 72 could also be arranged on the top surface of the oven door 26, such as shown in FIG. 12. As such, cooling airflow exhausted by the cavity outlet 72 can flow relatively unimpeded into the suction inlet 48. In one example, shown in FIG. 10, the cooling fan 54 causes the primary cooling airflow PA from the outside area that is at a location below the first oven door 26 to enter the cavity inlet 70, flow through the door cavity 68, exit the cavity outlet 72, and then flow into the cooling plenum 44. Additionally, the cavity outlet 72 can be arranged away from the exhaust outlet 52 of the cooling plenum 44, and/or one or more baffles could be used, to limit cross-flow of the incoming cooling air and exhausted heated air.

[0034] Often, various elements of the cooking oven 20 are located according to necessity or convenience, although the placement may not be ideal because of heat when the cooking oven is operating. In one example, the cooking oven 20 includes an electronic device 80 (or electromechanical device) located at least partially within the cooling plenum 44 and in flow communication with the heated air. As shown in FIGS. 6, 7, 10 and 12, the electronic device 80 can be located within the exhaust portion 50 of the cooling plenum 44, such that the electronic device 80 is exposed to the heated portion of the cooling air before the cooling air is exhausted back to the outside area. The electronic device 80 can be located within a depression 86 formed into the upper surface of the common wall 56 that separates the suction portion 46 from the exhaust portion 50 of the cooling plenum 44.

[0035] Various electronic and/or electromechanical devices are contemplated, such as a motor door lock used to electronically lock the first oven door 26 in the closed position via a latch arm 82 or the like. The motor door lock can be used, for example, during high temperature cooking or pyrolysis operation (i.e., self-cleaning operation) to maintain the oven door in a closed and locked position until the internal temperature of the oven cavity 22 decreases below a predetermined temperature (e.g., below 500 degrees Fahrenheit (F), below 400 degrees F., below 300 degrees F., etc.). Operation of the motor door lock can be automatically controlled via the control system of the oven, semi-automatically controlled, or could even be manually controlled. Various other similar or different electronic devices 80 may be located at least partially within the cooling plenum 44, such as switches 84, controls, control systems, sensors, wiring, etc. However, many of these electronic devices 80 are sensitive to temperature, and may have difficulty operating or have a reduced lifespan when subjected to the heated air passing through the cooling plenum 44.

[0036] To counteract this, a bypass element 90 can be located within the cooling plenum 44 that at least partially surrounds, such as completely surrounds, the electronic device 80 to divert the heated air around and away from the electronic device 80. For example, as shown in the exploded view of FIG. 6, the bypass element 90 can be located between the top plenum wall 57 and the common wall 56 and can at least partially surround the depression 86 containing the electronic device 80. The bypass element 90 can be retained variously, such as by a sandwich or clamped construction between the walls 56, 57 and/or by one or more mechanical fastener, adhesive, welding, etc. In addition or alternatively, the bypass element 90 can be secured via one or more screws, bolts, or other mechanical fastener, etc. For example, the bypass element 90 can include one or more bosses 94 configured to receive the screws, bolts, etc. from either of the walls 56, 57. The screws, bolts, or other mechanical fasteners can be threaded or otherwise secured directly to the bosses 94, or they could also pass-through the bosses 94 for securing to one of the walls 56, 57 or other oven structure.

[0037] The bypass element 90 includes at least one wall 92, such as a rear wall, that is positioned as a barrier between the heated airflow and the electronic device 80. For example, as shown in FIGS. 6 and 12, the wall 92 is positioned to intercept and divert the heated airflow around and away from the electronic device 80 and towards other areas of the exhaust portion 50 of the cooling plenum. The bypass element 90 can further include additional walls, such as one or more side walls 93 and/or a front wall 95. For example, the rear wall 92 and pair of side walls 93 can form a U-shape that substantially surrounds the electronic device 80. It is understood that the number, shape, and location of the other walls can be based upon the actual airflow properties and/or the desired amount of airflow diversion. Additionally, the front wall 95 may be provided substantially for structural support of the bypass element 90 (e.g., support between the side walls 93), and may or may not include air diversion structure. The design of each wall 92, 93, 95 can have various shapes and sizes that can divert the heated airflow, and preferably substantially all of the heated airflow, away from the electronic device 80. Preferably, at least the walls 92, 93 extend substantially completely between the common wall 56 and the top plenum wall 57 such that substantially none of the heated airflow enters the depression 86 containing the electronic device 80. Preferably,

some or all of the walls 92, 93 can provide smooth curved air diversion structure, directional structure, and/or flares that reduce disruption to the air flowing around the bypass element 90 to increase efficiency of the cooling system. In addition or alternatively, one or more gaskets, seals, etc. can be used between the bypass element 90 and the walls 56, 57. Further, the overall size of the bypass element 90 should preferably be larger than the electronic device 80 so as to provide an insulating air gap space between the electronic device 80 and the walls 92, 93, 95 to inhibit heat transfer from the bypass element 90 to the electronic device 80.

[0038] Additionally, the bypass element 90 can be configured to permit an active cooling airflow to pass therethrough to cool the electronic device 80. For example, although the bypass element 90 can direct substantially all of the heated airflow from contacting the electronic device 80, continuous operation of the oven 20 during a lengthy cooking cycle will cause the bypass element 90 to heat up over time. This may still cause some heat transfer from the bypass element 90 to the electronic device 80. To counteract this, at least a portion of a secondary cooling airflow can be directed through the bypass element 90 to actively cool the electronic device 80.

[0039] In order to provide a secondary cooling airflow SA, as shown in FIG. 10, the cooking oven 20 can further include a vertical channel 100 located between the rear panel 42 of the housing and the first rear wall 24 of the first oven chamber 22. Preferably, the vertical channel 100 extends substantially the full length of the cooking oven 20, although it is contemplated that it could extend along shorter distances. The vertical channel 100 opens towards the bottom, and a forward-pointing horizontal intake channel 102 provides incoming cooling air from the outside area via a lower channel inlet 104. An opening 106 can extend through the double rear wall 34B to provide communication between the horizontal intake channel 102 and the vertical channel 100. A deflector 108 may be provided above the opening 106 and between the second rear wall 34 and the double rear wall 34B to inhibit cooking-related byproducts from contaminating the secondary cooling airflow SA. Additionally, it is contemplated that at least a portion of the cooling air may be provided by one or more inlets 105 provided in the rear panel 42.

[0040] The first cooling fan 54 produces the secondary cooling airflow SA through the vertical channel 100, and directs it into a space 110 located above the first cooling plenum 44 and below the top panel 40 of the housing. The first cooling fan 54 can directly produce the secondary cooling airflow SA, such as by having a portion of the fan inlet 60 in communication with the vertical channel 100 to draw in cooling air from the lower channel inlet 104. In one example, part of the air diverter 58 may be open to the vertical channel 100 to draw in the cooling air.

[0041] In addition or alternatively, air movement through the first cooling plenum 44 (produced by the first cooling fan 54) may create a suction that draws in the cooling air through the vertical channel 100. For example, the space 110 located above the first cooling plenum 44 may be in limited fluid communication with the suction portion 46 of the first cooling plenum 44. The primary cooling airflow PA flowing through the suction portion 46 can create a negative-pressure suction (e.g., by the Venturi effect created by high velocity airflow through the cooling plenum 44) that draws the secondary cooling airflow SA to flow into the space 110 from the vertical channel 100.

[0042] In one example, the limited fluid communication between the space 110 and the first cooling plenum 44 can be facilitated via the bypass element 90. The bypass element 90 can include an open top 112 in flow communication with the space 110 located above the cooling plenum 44 via a hole 115 extends through the top plenum wall 57. The bypass element 90 further includes an open bottom 114 in flow communication with the suction portion 46 of the first cooling plenum 44, such that the secondary cooling airflow SA is in flow contact with the electronic device 80. At least one hole 116 extends through a wall of the cooling plenum 44, such as through the common wall 56 that separates the suction portion 46 and exhaust portion 50. The hole 116 is in flow communication with the open bottom 114 of the bypass element 90. Preferably, a plurality of holes 116 are provided through the common wall 56 to provide a cross-sectional area that permits a desired amount of the secondary cooling airflow SA to flow through the bypass element 90 and electronic device 80, and into the suction portion 46 of the first cooling plenum 44. Additionally, plurality of holes 116 can permit the secondary cooling airflow SA to flow more evenly about the electronic device 80. The number, position, and sizes of the holes 116 can be adjusted to provide the desired amount of secondary cooling airflow SA to flow through the bypass element 90. Preferably, the holes 116 are located above the depression 86 in which the electronic device 80 is mounted. This enables the depression 86 to provide a relatively larger supporting surface for mounting the electronic device 80, while also increasing the cooling effectiveness by maintaining the electronic device 80 in a recessed “bowl”-shaped depression such that the secondary cooling airflow SA can circulate within the “bowl” and about the electronic device 80 before flowing back through the holes 116 and into the first cooling plenum 44.

[0043] The secondary cooling airflow SA flowing through the bypass element 90 can serve the dual purpose of directly reducing the temperature of the electronic device 80, while also providing an insulating barrier against the heated exhaust air flowing through the exhaust portion 50 and that is deflected by the bypass element 90. Using this design, the secondary cooling airflow SA flows through the bypass element 90 and into the suction portion 46 of the first cooling plenum 44 along a second airflow path that is arranged at an angle relative to the first airflow path (e.g., the primary cooling airflow PA). In other words, as shown in FIG. 12, the bypass element 90 can deflect substantially all of the heated airflow moving in one direction (e.g., moving through the exhaust portion 50) from contacting the electronic device 80, while also permitting the secondary cooling airflow SA moving along another direction to contact the electronic device 80.

[0044] In addition or alternatively, cooling airflow for the electronic device 80 can be provided from other sources. In one example shown in FIG. 12, an auxiliary inlet 120 can extend through the top panel 40 of the housing, and the first cooling fan 54 can cause an auxiliary cooling airflow AA to pass through the auxiliary inlet 120 and into the space 110 located above the cooling plenum 44. The auxiliary inlet 120 can include one or even a plurality of holes through the top panel 40 to provide the auxiliary cooling airflow AA. The auxiliary inlet 120 can be located variously on the top panel 40, and multiple inlets can be arranged together or spaced apart. In one example, the auxiliary inlet 120 can be located at a raised portion 122 of the top panel 40 and behind the electronic control panel 30 such that the auxiliary cooling

airflow AA can provide cooling to the electronic control panel 30 and/or other electronic components of the cooking device 20. The auxiliary cooling airflow AA can be provided directly by the first cooling fan 54, or may be provided by the same negative-pressure suction (e.g., by the Venturi effect) that draws the secondary cooling airflow SA to flow into the space 110. Additionally, the auxiliary cooling airflow AA flows through the open top 112 of the bypass element 90 such that the auxiliary cooling airflow AA merges with the secondary cooling airflow SA to flow together through the bypass element 90 and back into the suction portion 46 of the first cooling plenum 44.

[0045] Turning now to FIG. 11, the cooking oven 20 can include the second cooking device with the second heatable oven chamber 32. The second oven chamber 32 can be located adjacent to the first oven chamber 22, such as disposed below the first oven chamber 22. The first and second cooling plenums 44, 130 are independent. In order to provide additional cooling capacity, a second cooling plenum 130 can be located above the second oven chamber 32 and below the first oven chamber 22. The second cooling plenum 130 can be sandwiched between the bottom wall 25 (or bottom double-wall) of the first oven chamber 22 and the top wall 33 (or top double-wall) of the second oven chamber 32. In fact, portions of the second cooling plenum 130 can be defined by the walls 25, 33 of the first and second oven chambers 22, 32, or can even be formed by additional walls.

[0046] The second cooling plenum 130 can be similar to the first cooling plenum 44, and can include a suction portion 132 with a suction inlet 134 configured to supply cool air from the outside area, in communication with an exhaust portion 136 with an exhaust outlet 138 configured to discharge heated air back to the outside area. The suction portion 132 and the exhaust portion 136 of the second cooling plenum 130 are arranged in a vertically stacked arrangement and can both provide about the same cross-sectional flow area. Because heat rises, the exhaust portion 136 is preferably located above the suction portion 132, although these can be reversed. The exhaust portion 136 and suction portion 132 can be formed as separate structures, or can be partially combined to reduce space usage, such as being separated by a common wall 135. Additionally, the suction inlet 134 of the suction portion 132, and the exhaust outlet 138 of the exhaust portion 136, can both be arranged at a front side of the cooking oven 20 for communication with the outside area.

[0047] A second cooling fan 140 produces a second oven cooling airflow SCA through the second cooling plenum 130. Preferably, the second cooling fan 140 is similar to the first cooling fan 54, and is an electrically-operated cooling fan of various types, driven by an electric motor, such as a cross-flow fan (as shown), axial fan, or centrifugal fan. When using a cross-flow fan with a large inlet, an air diverter 142 can be used to at least partially close or restrict the inlet of the cooling fan 140 such that a majority of the airflow taken into the cooling fan 140 is provided by the suction portion 132 and is subsequently discharged into the exhaust portion 136.

[0048] In one example, air ingress can be provided via the second oven door 36, which can provide the dual benefit of concealing the air ingress structure to provide a more pleasing appearance of the oven, while also providing active cooling of the second oven door 36. For example, the second oven door 36 can include an inner pane 144 facing the second oven chamber 32, an outer pane 146 facing the outside area, and a door cavity 148 provided between the inner and outer panes

144, 146. Although only two panes are described and shown, it is understood that the second oven door **36** can include three or more panes and multiple cavities therebetween. Preferably, at least a portion of the inner and outer panes **144, 146** are formed of a light transmissible material, such as glass or other material suitable to withstand oven temperatures, so that a user can view the second oven chamber **32** through the second oven door **36**. The door cavity **148** provides an open space within the second oven door **36** between the inner and outer panes **144, 146** that may be partially or completely open. The door cavity **148** further includes a cavity inlet **150** about a bottom of the second oven door **36**. Preferably, to save space, the cavity inlet **150** draws in cooling air about the same area as the channel inlet **104** that feeds cooling air to the horizontal intake channel **102** and vertical channel **100**.

[0049] Additionally, the size, shape, and/or position of the lower channel inlet **104** can be adjusted to control the amount of cooling air that is introduced into each of the horizontal intake channel **102** and the door cavity **148**. Generally, the incoming cooling airflow will move along the path of least resistance, and the lower channel inlet **104** tends to be less restrictive as compared to the second door cavity inlet **150**. To control the airflow, the size, shape, and/or position of openings **104B** into the lower channel inlet **104** can control how much air is directed through each of the horizontal intake channel **102** and cavity inlet **150**. This control is affected by increasing or decreasing the opening size, number, shape, and/or location of openings into the lower channel inlet **104** to balance how much air flows through the door versus how much air flows through the horizontal intake channel **102**. In one example, as shown in FIGS. **2** and **10**, the openings **104B** into the lower channel inlet **104** can be arranged as four inlet holes of different sizes and positions. Thus, locations along the lateral front of the oven that have an opening **104B** into the lower channel inlet **104** will tend to introduce the cooling air into the horizontal intake channel **102** and not the cavity inlet **150**. As shown in FIG. **2**, relatively more air will be introduced into the intake channel **102** towards the lateral center of the oven with relatively larger openings **104B** as compared to the smaller openings **104B** shown towards the outer edges. Conversely, blockage locations **107** along the lateral front of the oven where the lower channel inlet **104** is blocked will tend to redirect the cooling air into the cavity inlet **150** instead of the horizontal intake channel **102**. Thus, relatively more cooling airflow will enter the cavity inlet **150** and flow into the door cavity **148** about those regions adjacent the blockage locations **107**. Selective adjustment of the size, shape, and/or position of openings into the lower channel inlet **104**, as well as the blockages **107**, can permit corresponding adjustment of the amount and location of airflow into the cavity inlet **150**. As a result, different portions of each oven door can be selectively cooled more or less depending upon the cooling needs of a particular door design. It is contemplated that the openings **104B** into the lower channel inlet **104** can be integrally formed into the front of the oven, or alternatively can be provided as openings in a plate(s) or the like that can be attached over the lower channel inlet **104**. It is further contemplated that the cavity inlet **150** can similarly include various openings and blockages to achieve a similar effect to control airflow into the door cavity **148**.

[0050] The door cavity **148** also includes a cavity outlet **152** about a top of the second oven door **36**. Both of the cavity inlet **150** and cavity outlet **152** are directly or indirectly in fluid communication with the door cavity **148**. Moreover, it is

appreciated that any or all of the cavity inlet **150**, cavity outlet **152**, suction inlet **134**, and/or exhaust outlet **138** can be a single continuous opening, or can include a plurality of adjacent openings (as shown in FIG. **2**) which can provide additional structural support via support columns arranged between the adjacent openings. The number and arrangement of the adjacent openings can vary.

[0051] Preferably, the cavity inlet **152** is arranged underneath the second oven door **36**, such as along a bottom edge thereof, so as to be hidden from view. The cavity outlet **152** is adjacent the suction inlet **134** of the second cooling plenum **130**. The cavity outlet **152** can be arranged on the rear inner surface of the second oven door **36** so as to be generally in fluid alignment with the suction inlet **134** of the suction portion **132** of the second cooling plenum **130**. As such, cooling airflow exhausted by the cavity outlet **152** can flow relatively unimpeded into the suction inlet **134**. In one example, shown in FIG. **11**, the cooling fan **140** causes the second oven cooling airflow SCA from the outside area that is at a location below the second oven door **36** to enter the cavity inlet **150**, flow through the second door cavity **148**, exit the cavity outlet **152**, and then flow into the second cooling plenum **130**. Additionally, the cavity outlet **152** is preferably arranged away from the exhaust outlet **138** of the second cooling plenum **130** so as to limit cross-flow of the incoming cooling air and exhausted heated air.

[0052] Taking both of FIGS. **10-11** together, it can be seen that selective operation of either or both cooling fans **54, 140** can produce variable cooling capacities for the cooking oven **20**. Although shown separately, it is understood that any of the cooling airflows shown in FIGS. **10-11** can be used together. Manual control can be provided to enable the user to choose which fans are operating. Preferably, the on-board control system can automatically or semi-automatically operate the cooling fans **54, 140** based upon various factors, such as which oven chamber(s) are being heated, the temperature of either or both oven chamber(s), and/or the cooking or cleaning cycle being performed. Moreover, the cooling fans **54, 140** can be operated at various speeds, such as a high speed and a low speed, or even various other numbers of speeds. Additionally, although described as "low speed" and "high speed," it is further contemplated that either cooling fan **54, 140** could be duty-cycled on and off to achieve increased or reduced effective cooling amounts.

[0053] In various examples, the first cooling fan **54** can be energized at a low speed when the first oven chamber **22** is used for a food-cooking operation using the main heat source, or at a high speed when the first oven chamber **22** is used for a food-broiling operation using the broil heat source. Similarly, the second cooling fan **140** can be energized at a low speed when the second oven chamber **32** is used for a food-cooking operation using its main heat source, or at a high speed when the second oven chamber **32** is used for a food-broiling operation using its broil heat source. Because heat rises, the first cooling fan **54** may also be used at a low speed when the second oven chamber **32** is used for a food-broiling operation. If both of the first and second oven chambers **22, 32** are being simultaneously operated in food-cooking operations using their respective main heat sources, both cooling fans **54, 140** can be operated in a low speed.

[0054] If the first oven chamber **22** is being cleaned using a high temperature pyrolysis operation, the first cooling fan **54** can be operated at a high speed while the second cooling fan **140** can be operated at a low speed. Because heat rises, if the

second oven chamber **32** is being cleaned using a high temperature pyrolysis operation, then both of the cooling fans **54**, **140** can be operated at a high speed. It is understood that although some fan operation examples are described above, other combinations are contemplated. Also, the fans **54**, **140** can each be operated at various different speeds by the oven control system to achieve a desired effective cooling target. For example, any of the above could be programmed as a default fan operation schedule that could be supplemented with increased cooling if high temperatures are sensed by one or more temperature sensors placed about the cooking oven **20** that exceed a particular threshold value. For example, if the first oven chamber **22** is used for a relatively high-temperature and/or long duration food-cooking operation, the first cooling fan **54** may start at a low speed, but may be temporarily increased to a higher speed if a temperature sensor indicates a need for increased cooling. The cooling fan **54** can be later reduced in speed after a predetermined time and/or after the sensed temperature drops below a particular threshold value. [0055] The invention has been described with reference to the example embodiments described above. Modifications and alterations will occur to others upon a reading and understanding of this specification. Examples embodiments incorporating one or more aspects of the invention are intended to include all such modifications and alterations insofar as they come within the scope of the appended claims.

1. A cooking oven, comprising:

- a first heatable oven chamber defined in part by a first rear wall;
- a housing enclosing the first oven chamber, the housing comprising a top panel and a rear panel;
- a cooling plenum located above the first oven chamber and below the top panel of the housing, comprising a suction portion with a suction inlet configured to supply cool air from an outside area and an exhaust portion with an exhaust outlet configured to discharge heated air to said outside area;
- a cooling fan that produces a primary cooling airflow through the cooling plenum;
- an electronic device located at least partially within the cooling plenum and in flow communication with the heated air; and
- a bypass element located within the cooling plenum that at least partially surrounds the electronic device to divert the heated air away from the electronic device.

2. The cooking oven of claim 1, further comprising a vertical channel located between the rear panel of the housing and the first rear wall of the first oven chamber.

3. The cooking oven of claim 2, wherein the cooling fan produces a secondary cooling airflow through the vertical channel that is directed into a space located above the cooling plenum and below the top panel of the housing.

4. The cooking oven of claim 3, wherein the bypass element is located within the exhaust portion and encircles the electronic device such that substantially all of the heated air is diverted away from the electronic device.

5. The cooking oven of claim 4, wherein the bypass element comprises an open top in flow communication with said space located above the cooling plenum, and an open bottom in flow communication with the suction portion, such that the secondary cooling airflow is in flow contact with the electronic device.

6. The cooking oven of claim 5, wherein at least one hole extends through a wall of the cooling plenum and is in flow

communication with the open bottom of the bypass element, such that the secondary cooling airflow flows through the bypass element and into the suction portion.

7. The cooking oven of claim 3, further comprising an auxiliary inlet extending through the top panel of the housing, wherein the cooling fan causes an auxiliary cooling airflow through the auxiliary inlet and into said space located above the cooling plenum and below the top panel of the housing.

8. The cooking oven of claim 1, wherein the cooling fan is a cross-flow fan.

9. The cooking oven of claim 1, further comprising a first door pivotally mounted to the first oven chamber to selectively close the first oven chamber from said outside area, wherein the first door comprises an inner pane facing the first oven chamber, an outer pane facing the outside area, and a door cavity provided between the inner and outer panes, wherein the door cavity further comprises a cavity inlet about a bottom of the first door and a cavity outlet about a top of the first door.

10. The cooking oven of claim 9, wherein the cavity outlet is adjacent the suction inlet of the cooling plenum, such that the cooling fan causes the primary cooling airflow from the outside area that is at a location below the first door to enter the cavity inlet, flow through the door cavity, exit the cavity outlet, and then flow into the cooling plenum.

11. The cooking oven of claim 9, further comprising a second heatable oven chamber defined in part by a second rear wall and disposed at an elevation vertically below the first oven chamber, and a second door pivotally mounted to the second oven chamber to selectively close the second oven chamber from the outside area, a second cooling plenum located above the second oven chamber and below the first oven chamber; and a second cooling fan that produces a second oven cooling airflow through the second cooling plenum.

12. The cooking oven of claim 11, wherein the second door comprises an inner pane facing the second oven chamber, an outer pane facing the outside area, and a second door cavity provided between the inner and outer panes, wherein the second cooling fan causes the second oven cooling airflow from the outside area that is at a location below the second door to flow through the second door cavity and then flow into the second cooling plenum.

13. A cooking oven, comprising:

- a first heatable oven chamber defined in part by a first rear wall;
- a first door pivotally mounted to the first oven chamber to selectively close the first oven chamber from an outside area;
- a second heatable oven chamber defined in part by a second rear wall and disposed at an elevation vertically below the first oven chamber;
- a second door pivotally mounted to the second oven chamber to selectively close the second oven chamber from the outside area;
- a housing enclosing the first oven chamber, the housing comprising a top panel and a rear panel;
- a first cooling plenum located above the first oven chamber comprising a suction portion with a suction inlet configured to supply cool air from said outside area and an exhaust portion with an exhaust outlet configured to discharge heated air to said outside area;
- a first cooling fan that produces a primary cooling airflow through the first cooling plenum;

a second cooling plenum located above the second oven chamber and below the first oven chamber, the first and second cooling plenums being independent;
 a second cooling fan that produces a second oven cooling airflow through the second cooling plenum;
 an electronic device located at least partially within the cooling plenum and in flow communication with the heated air; and
 a bypass element located within the cooling plenum that at least partially surrounds the electronic device to divert the heated air away from the electronic device.

14. The cooking oven of claim **13**, further comprising a vertical channel located between the rear panel of the housing and the first rear wall of the first oven chamber, and wherein the cooling fan produces a secondary cooling airflow through the vertical channel that is directed into a space located above the cooling plenum and below the top panel of the housing.

15. The cooking oven of claim **13**, further comprising an auxiliary inlet extending through the top panel of the housing, wherein the cooling fan causes an auxiliary cooling airflow through the auxiliary inlet and into a space located above the cooling plenum and below the top panel of the housing.

16. The cooking oven of claim **13**, wherein the suction portion and the exhaust portion of the first cooling plenum are arranged in a vertically stacked arrangement separated by a common wall, and wherein the suction inlet and the exhaust outlet are both arranged at a front of the cooking oven for communication with said outside area, and wherein the first cooling fan is arranged at a rear of the cooking oven.

17. The cooking oven of claim **16**, wherein an inlet of the first cooling fan is coupled to the suction portion and an outlet of the first cooling fan is coupled to the exhaust portion to provide flow communication through the first cooling plenum.

18. The cooking oven of claim **17**, further comprising an air diverter in an at least partially covering relationship over the inlet of the first cooling fan such that the inlet of the first cooling fan is substantially limited to the suction portion of the first cooling plenum.

19. A cooking oven, comprising:

a first heatable oven chamber defined in part by a first rear wall;
 a second heatable oven chamber defined in part by a second rear wall and disposed at an elevation vertically below the first oven chamber;
 a housing enclosing the first oven chamber, the housing comprising a top panel and a rear panel;

a first cooling plenum located above the first oven chamber comprising a suction portion with a suction inlet configured to supply cool air from an outside area and an exhaust portion with an exhaust outlet configured to discharge heated air to said outside area, wherein the suction portion and the exhaust portion are arranged in a vertically stacked arrangement separated by a common wall;

a vertical channel located between the rear panel of the housing and the first rear wall of the first oven chamber;
 a first cooling fan that produces a primary cooling airflow through the first cooling plenum along a first airflow path, and a secondary cooling airflow through the vertical channel;

an electronic device located at least partially within the exhaust portion of the cooling plenum and in flow communication with the heated air; and

a bypass element located within the exhaust portion of the cooling plenum that at least partially surrounds the electronic device to divert substantially all of the heated air away from the electronic device,

wherein the bypass element comprises an open top in flow communication with the vertical channel and an open bottom in flow communication with a hole extending through the common wall, such that the secondary cooling airflow flows through the bypass element and into the suction portion along a second airflow path that is arranged at an angle relative to the first airflow path.

20. The cooking oven of claim **19**, further comprising an auxiliary inlet extending through the top panel of the housing, wherein the first cooling fan causes an auxiliary cooling airflow through the auxiliary inlet that merges with the secondary cooling airflow to flow through the bypass element.

21. The cooking oven of claim **19**, wherein a first door comprises an inner pane facing the first oven chamber, an outer pane facing the outside area, and a door cavity provided between the inner and outer panes, wherein the first cooling fan causes the primary cooling airflow from the outside area that is at a location below the first door to flow through the door cavity and then flow into the first cooling plenum.

22. The cooking oven of claim **19**, further comprising a second door pivotally mounted to the second oven chamber to selectively close the second oven chamber from the outside area, a second cooling plenum located above the second oven chamber and below the first oven chamber; and a second cooling fan that produces a second oven cooling airflow through the second cooling plenum.

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