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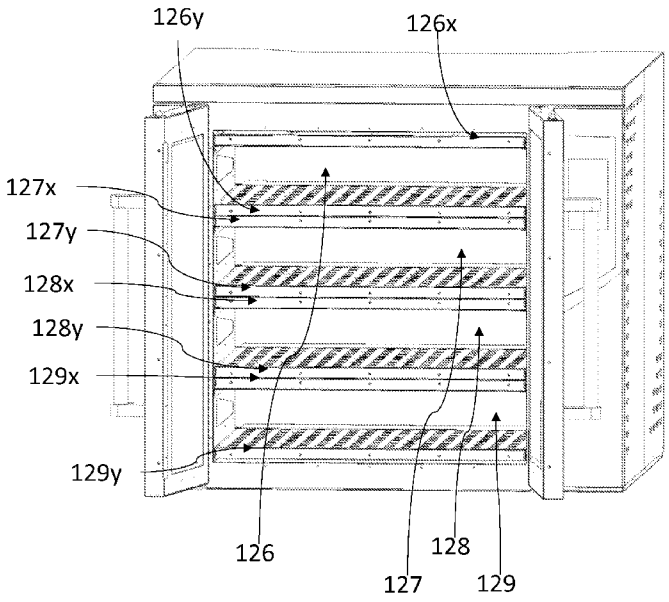

FIGURE 2B

(57) Abstract: A convection oven is disclosed. The convection oven comprises a housing having an oven cavity and an oven door for access to the oven cavity, at least one air blower for generating heated air, one or more air channels for directing the heated air from the air blower toward the oven cavity, and one or more removable air plenums, wherein each removable air plenum is connected to one of the one or more air channels, comprises an air intake edge for receiving the heated air from the air channel, defines the top or the bottom of a cooking chamber within the oven cavity, and comprises a plurality of air vents for directing the heated air into the cooking chamber. The convection oven may further comprise a control panel for separately and independently controlling each of the cooking chambers defined by the removable air plenums.

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CONVECTION OVEN HAVING REMOVABLE AIR PLENUMS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Patent Application No. 14/733,533, filed on June 8, 2015, the contents of which are incorporated by reference herein in their entirety.

FIELD OF INVENTION

[0002] The present invention relates to cooking ovens in general, and in particular to a convection oven having removable air plenums.

BACKGROUND OF THE INVENTION

[0003] An oven generally includes an oven cavity configured to receive food articles for cooking. The oven also includes a heating element, which can be an electric resistance element or a gas burner, for generating heat energy to cook any food items placed within an oven cavity. Some ovens may include a fan for forcing movement of heated air within the oven cavity, and those ovens are commonly referred to as convection ovens.

[0004] Convection ovens have been the workhorse in commercial kitchens for many decades. Commercial convection ovens generally come in two sizes, namely, full-size and half-size. Full-sized commercial convection ovens are designed to fit within the space of an industry standard footprint, which is approximately 40 inches wide by 40 inches deep, made available for full-sized convection ovens in most commercial kitchens. The oven cavity of full-sized commercial ovens are also dimensioned to accept industry standard full-sized cooking trays, which are approximately 26 inches wide by 18 inches deep. The height of the cook cavity is typically about 20 inches, which is capable of being configured to allow for multiple rack heights, such as 11 possible rack heights, to accommodate the height of various foods that can be cooked in a convection oven. For example, only 2 racks may be placed in a

commercial convection oven if 9-inch tall turkeys are being cooked, but 4 to 5 racks may be evenly spaced from top to bottom when that many racks of 2-inch tall lasagna are being cooked. Half-sized commercial convection ovens are similarly configured and dimensioned to fit into industry standard half-sized spaces in commercial kitchens and to receive industry standard half-sized sheet pans.

[0005] When cooking in a typical convection oven, heated air within the oven cavity is circulated by a fan. The fan initiates a flow of heated air by pulling air from the oven cavity through multiple openings on a back wall of the oven cavity. The heated air then exits other openings on the side walls of the oven cavity. The heated air moves through the oven cavity to help distribute heat energy to food articles placed within the oven cavity. An example of the heating system of a typical convection oven can be found in U.S. Patent No. 4,395,233 to Smith et al.

[0006] One problem with the heating system of a conventional convection oven is that it can generate regions of high and low speed air flow in the oven cavity such that the heated air is not uniformly distributed within the oven cavity. As a result, food items placed in the oven cavity may be cooked unevenly. For example, food items placed on different racks at different heights within the convection oven may be cooked at different rates. In addition, food items placed on the same rack may not receive uniform heating either. This unevenness of cooking can result in food waste, as food items located in the higher heat portions of the oven cavity can be unacceptably overdone as compared to the food items located in the lower heat portions. Unevenness of cooking can be partially overcome by rotating cook trays within the oven cavity, as well as utilizing reduced cooking temperatures and blower speeds, but doing so will increase skilled labor requirements as well as cook times.

[0007] Conventional convection ovens have other problems as well. For example, only one cook temperature and heat transfer profile, such as blower speed, can be delivered in a

conventional convection oven at any one time, thereby limiting the types of foods that can be cooked simultaneously. This can be overcome by having multiple convection ovens set at different cook temperatures and heat transfer profiles, but doing so will result in space and energy inefficiency.

[0008] Consequently, it would be desirable to provide an improved convection oven that can eliminate the above-mentioned problems.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention itself, as well as a preferred mode of use, further objects, and advantages thereof, will best be understood by reference to the following detailed description of illustrative and exemplary embodiments when read in conjunction with the accompanying drawings, wherein:

[0010] Figure **1** is an isometric view of a convection oven, in accordance with an exemplary embodiment of the present invention;

[0011] Figure **2A** is a front view of an oven cavity within the convection oven from Figure **1**, in accordance with an exemplary embodiment of the present invention;

[0012] Figure **2B** is an isometric view of the oven cavity from Figure **2A** with multiple cooking chambers formed and defined by removable air plenums placed within the oven cavity;

[0013] Figure **3** is a detailed diagram of a removable air plenum from Figure **2B**;

[0014] Figure **4A** shows a set of blower systems for the convection oven from Figure **1**;

[0015] Figure **4B** is a cross-sectional side view of the convection oven from Figure **1,** depicting the various air paths within the oven cavity; and

[0016] Figure **5** depicts the air paths within the oven cavity when some of the removable air plenums are removed from the oven cavity.

SUMMARY OF THE INVENTION

[0017] It has now been found that the above and related objects of the present invention are obtained in the form of several related aspects, including a convection oven having removable air plenums.

[0018] In accordance with an exemplary embodiment of the present invention, a convection oven has one or more removable air plenums that can be placed within the oven cavity to divide the cavity into separate cooking chambers. Removable air plenums are connectable to and engageable with air channels of the oven. Each removable air plenum includes an air intake edge for receiving heated air from the engaged air channel in the oven and a plurality of air vents for directing the heated air into the corresponding cooking chamber for the purpose of heating any food items located within the cooking chamber. When a removable air plenum is disengaged from the oven air channel and removed from the oven cavity, the air channel is covered by a flap.

[0019] By placing, removing, or re-arranging removable air plenums within the oven cavity, one can arrange to have different number of cooking chambers with variable heights in the convection oven to meet multiple cooking needs simultaneously. The oven may be provided with a control panel that can control each cooking chamber independently.

[0020] The oven may have one or two oven doors for accessing all of the cooking chambers. In other words, the size of the oven door(s) is not dependent on the height of cooking chambers defined by the removable air plenums.

[0021] The oven may also have a sensor for detecting the opening of oven doors during a cook cycle. To compensate for any disruption to the cook cycle due to the opened oven door, the oven's controller may extend the cooking time(s) or re-adjust cooking parameters for the

cooking chamber(s) based on the measured amount of time the oven doors were kept open during their respective cook cycles.

[0022] The present invention also relates to a convection oven comprising a housing having an oven cavity and an oven door for access to the oven cavity, at least one air blower for generating heated air, one or more air channels for directing the heated air from the air blower toward the oven cavity, and one or more removable air plenums, wherein each of the one or more removable air plenums is connected to one of the one or more air channels; comprises an air intake edge for receiving the heated air from the one of the one or more air channels; defines the top or the bottom of a cooking chamber within the oven cavity; and comprises a plurality of air vents for directing the heated air into the cooking chamber.

[0023] In at least one embodiment, at least one of the one or more air channels is coverable by a flap if not connected to one of the one or more removable air plenums.

[0024] In at least one embodiment, at least one of the one or more removable air plenums comprises a tab configured to open the flap when connected to one of the one or more air channels.

[0025] In at least one embodiment, the convection oven further comprises a control panel for separately and independently controlling each of the cooking chambers defined by the one or more removable air plenums.

[0026] In at least one embodiment, the convection oven further comprises a sensor for detecting the oven door being kept opened during a cook cycle.

[0027] In at least one embodiment, the convection oven further comprises a controller for re-adjusting a cooking parameter for at least one of the cooking chambers defined by the one or more removable air plenums based on the amount of time the oven door is kept opened during the cook cycle.

[0028] In at least one embodiment, at least one of the one or more removable air plenums is configured to direct the heated air upward.

[0029] In at least one embodiment, at least one of the one or more removable air plenums is configured to direct the heated air downward.

[0030] In at least one embodiment, at least one of the one or more removable air plenums is configured to support a food rack within the corresponding cooking chamber.

[0031] All features and advantages of the present invention will become apparent in the following detailed written description.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0032] Referring now to the drawings and in particular to Figure **1**, there is depicted an isometric view of a convection oven, in accordance with an exemplary embodiment of the present invention. As shown, a convection oven **10** includes a housing having a top panel **11**, a bottom panel **12**, a rear panel **13** and two side panels **14a**, **14b**.

[0033] A pair of oven doors **15a**, **15b** may form the front panel of the housing and are pivotally connected with side panels **14a**, **14b**, respectively, via hinges. Oven doors **15a** and **15b** may include handles **16a** and **16b**, respectively, for opening and closing the same, and a latch may be provided to keep doors **15a**, **15b** in a closed position. Door sensing switches (not shown) may be placed so as to sense when doors **15a**, **15b** are being opened or closed.

[0034] In alternative embodiments, instead of a pair of oven doors, the oven may include a single oven door which is pivotally connected with one of side panels **14a**, **14b**, top panel **11**, or bottom panel **12** via hinges.

[0035] Convection oven **10** also includes a control panel **18**. For example, control panel **18** may be implemented with touchscreen technology. An operator can enter commands or cooking

parameters, such as cooking temperature, cooking time, fan speed, etc., via control panel **18** to effectuate cooking controls on any food items placed within convection oven **10**.

[0036] With reference now to Figure **2A**, there is depicted a front view of the oven cavity **20** within convection oven **10**, in accordance with an exemplary embodiment of the present invention. As shown, an oven cavity **20** is defined by a top wall **21**, a bottom wall **22**, a rear wall **23**, and side walls **24a**, **24b** along with doors **15a**, **15b** (shown in Figure **2B**). Located on side walls **24a**, **24b** are multiple parallel rails **25** (e.g., four rails shown in Figure **2A**) configured to support one or more removable air plenums, which may also serve as food rack supports, to direct heated air flow.

[0037] Located on rear wall **23** are multiple sets of air channel pairs (e.g., four sets shown in Figure **2A**) for bringing hot air into oven cavity **20**. For example, as shown in Figure **2A**, a first set of air channel pairs includes a top air channel **26x** and a bottom air channel **26y**, a second set of air channel pairs includes a top air channel **27x** and a bottom air channel **27y**, a third set of air channel pairs includes a top air channel **28x** and a bottom air channel **28y**, and a fourth set of air channel pairs includes a top air channel **29x** and a bottom air channel **29y**. Each of the four air channel pairs can separately and independently send heated air into oven cavity **20**.

[0038] In Figure **2B**, oven cavity **20** is shown to be populated with multiple removable air plenums **126x-129x** and **126y-129y**. These removable air plenums divide the oven cavity **20** into and define multiple (e.g., four in this case) cooking chambers **126, 127, 128, 129**.

[0039] In accordance with an exemplary embodiment of the present invention, the multiple removable air plenums **126x-129x** and **126y-129y** may be all substantially identical to each other. In alternative embodiments, each or some of them may be configured differently.

[0040] In accordance with an exemplary embodiment shown in Figures **2A** and **2B**, removable air plenum **126x** may be directly connected to and engaged with top air channel **26x**; removable air plenum **126y** may be directly connected to and engaged with bottom air channel

26y; removable air plenum **127x** may be directly connected to and engaged with top air channel **27x**; removable air plenum **127y** may be directly connected to and engaged with bottom air channel **27y**; removable air plenum **128x** may be directly connected to and engaged with top air channel **28x**; removable air plenum **128y** may be directly connected to and engaged with bottom air channel **28y**; removable air plenum **129x** may be directly connected to and engaged with top air channel **29x**; and removable air plenum **129y** may be directly connected to and engaged with bottom air channel **29y**. Removable air plenums **126x-129x** and **126y-129y** function to direct heated air from the corresponding air channels into the corresponding cooking chambers **126-129** formed within oven cavity **20** for the purpose of heating any food items located within each cooking chamber.

[0041] Referring now to Figure **3**, there is depicted an exemplary embodiment of a removable air plenum **126y**. As shown, removable air plenum **126y** includes an air intake edge **31**, multiple air vents **32** and a tab **33**. Air intake edge **31** is configured to connect to an air channel **26y** to receive heated air from the air channel. The heated air is then directed upward through air vents **32** into cooking chamber **126** within oven cavity **20** (from Figure **2B**). A tab **33** functions to open a flap (not shown) that covers air channel **26y** when removable air plenum **126y** is not connected to or engaged with air channel **26y**.

[0042] With reference now to Figures **4A-4B**, there are depicted diagrams of a set of blower systems and the associated airflow path within convection oven **10** in accordance with an exemplary embodiment of the present invention. As shown, four blower systems **41-44** may be located at the rear of convection oven **10**. Each of blower systems **41-44** may be equipped with its own heater and controlled independently of the other blower systems with respect to both temperature and/or blower speed. As an example, Figure **4A** shows that each of blower systems **41-44** is equipped with two blowers (e.g., **41a** and **41c**) which are driven by a single motor (e.g., **41b**) placed between the two blowers.

[0043] In this exemplary embodiment, blower systems **41-44** may be substantially identical to each other in structure and generate similar airflow path. Hence, only blower system **41** will be further described below in details. In alternative embodiments, each or some of the blower systems may be differently configured.

[0044] As shown in Figure **4B**, blower system **41** sends heated air through diverters **d1** and **d2** that separate the heated air exiting blower system **41** into a top airstream and a bottom airstream. The top airstream from diverter **d1** then travels through top air channel **26x** and enters removable air plenum **126x** where the heated air is channeled and directed to be substantially evenly disbursed in a downward direction into cooking chamber **126**. Similarly, the bottom airstream from diverter **d2** travels through bottom air channel **26y** and enters removable air plenum **126y** where the heated air is channeled and directed to be substantially evenly disbursed in an upward direction into cooking chamber **126**. Once entering cooking chamber **126**, the heated air comes into contact with any food item that is placed on one or more food racks (not shown) within cooking chamber **126**. Afterwards, the air within the cooking chamber **126** may be drawn towards return air opening(s) on one or both sides of cooking chamber **126** and travels back to blower system **41**.

[0045] Convectional oven **10** having a four-cooking chamber configuration (e.g., having four cooking chambers **126, 127, 128, 129**), as shown in Figures **2B** and **4B**, can be easily transformed into, for example, a three-cooking chamber configuration, a two-cooking chamber configuration, or a one-cooking chamber configuration by simply removing some or all of the removable air plenums from oven cavity **20**.

[0046] Referring now to Figure **5**, there is illustrated the airflow of convection oven **10** in a two-cooking chamber configuration after air plenum **126y**, air plenum **127x**, air plenum **128y** and air plenum **129x** have been removed from oven cavity **20**. After the removal of air plenums **126y** and **127x**, flaps **26yc** and **27xc** are activated (e.g., drop down) to cover air channels **26y**

and **27x**, respectively. Similarly, after the removal of air plenums **128y** and **129x**, flaps **28yc** and **29xc** are activated (e.g., drop down) to cover air channels **28y** and **29x**, respectively. Flaps **26yc**, **27xc**, **28yc** and **29xc** may enable more heated air to be delivered through the remaining open air channels while also eliminating air entry from the back of oven cavity **20**, which would introduce cooking unevenness between food located in the back and food located in the front of oven cavity **20**.

[0047] In accordance with an exemplary embodiment of the present invention, each of flaps **26yc**, **27xc**, **28yc** and **29xc** may be automatically engaged when a tab **33** (from Figure **3**) is not in contact with a corresponding air channel. In other words, when no removable air plenum is connected to and engaged with an air channel (e.g., via tab **33**), a flap automatically covers the air channel.

[0048] As described above, oven cavity **20** can be re-configured to have different numbers of cooking chambers with variable heights simply by re-arranging the location and the number of removable air plenums (such as a four-cooking chamber configuration shown in Figures **2B** and **4B** and a two-cooking chamber configuration shown in Figure **5**).

[0049] Whether in a two-cooking chamber configuration or a four-cooking chamber configuration, each of the cooking chambers within oven cavity **20** may be utilized to cook different food items (*e.g.*, food items that require different cook times and/or different cooking temperature). Using a four-cooking chamber configuration as an example, each of the four cooking chambers can be independently managed by a corresponding one of blower systems **41-44**. Specifically, cook times, temperatures, and blower speeds tailored for food items located in each of the four cooking chambers can be separately entered via a control panel, such as control panel **18** in Figure **1**, such that heated air directed to each of the four cooking chambers will be independently supplied from one of blower systems **41-44**.

[0050] For example, biscuits may be placed in a first cooking chamber (e.g., cooking chamber **126**) at 7:30 a.m. to cook for 15 minutes at 350 °F at a medium blower speed. Bacon strips may be placed in a second cooking chamber (e.g., cooking chamber **127**) at 7:35 a.m. to cook for 5 minutes at 425 °F at a high blower speed. Pies may be placed in a third cooking chamber (e.g., cooking chamber **128**) at about the same time as the bacon strips, but will be cooked for a longer time (e.g., 45 minutes) at a lower temperature (e.g., 325 °F) at a low blower speed. And cookies may be placed in a fourth cooking chamber (e.g., cooking chamber **129**) at 7:40 a.m. to cook for 10 minutes at 400 °F at a medium blower speed. In this example, the bacon strips will be done at 7:40 a.m., the biscuits will be done at 7:45 a.m., cookies will be done at 7:50 a.m., and the pies will be done at 8:20 a.m., all using the same convection oven.

[0051] In the above example, oven doors (such as oven doors **15a** and **15b** from Figure **1**) are likely to be opened and closed multiple times while the various food items are in the process of being cooked for a predetermined time. Each time the oven doors are opened, the cooking process already in progress for the various cooking chambers will likely be disrupted. In order to compensate for this disruption, convection oven **10** may include a sensor for detecting opening of oven doors **15a** and **15b** during a cook cycle. The length of time that doors **15a** and **15b** are kept open may then be recorded and the cooking parameters for the various food items placed within different cooking chambers (e.g., cooking chambers **126, 127, 128, 129**) may be re-adjusted based on the amount of time the oven doors are kept open during their respective cook cycles. For example, the cook times for the various food items placed in the various cooking chambers may be extended for an amount of time that is substantially identical or proportional to the amount of time the oven doors are kept open during their respective cook cycles.

[0052] As has been described, the present invention provides an improved convection oven providing a more uniform flow of heated air within the cooking chamber and also providing more flexibility for oven configurability.

[0053] While this invention has been described in conjunction with exemplary embodiments outlined above and illustrated in the drawings, it is evident that many alternatives, modifications and variations in form and detail will be apparent to those skilled in the art. Accordingly, the exemplary embodiments of the invention, as set forth above, are intended to be illustrative, not limiting, and the spirit and scope of the present invention is to be construed broadly and limited only by the appended claims, and not by the foregoing specification.

What is claimed is:

1. A convection oven comprising:

a housing having an oven cavity and an oven door for access to the oven cavity;

at least one air blower for generating heated air;

one or more air channels for directing the heated air from the air blower toward the oven cavity;

one or more removable air plenums, wherein each of the one or more removable air plenums is configured to be removably connected to one of the one or more air channels; comprises an air intake edge for receiving the heated air from the one of the one or more air channels; defines the top or the bottom of a cooking chamber within the oven cavity when the removable air plenum is connected to the air channel; and comprises, on its top or bottom surface, a plurality of air vents for directing the heated air into the cooking chamber; and

one or more flaps, wherein each of the one or more air channels is associated with one of the one or more flaps and is configured to be covered by the associated flap if the air channel is not connected to one of the one or more removable air plenums.

2. The convection oven of Claim 1, wherein each of the one or more removable air plenums comprises a tab configured to open the flap associated with one of the one or more air channels when the removable air plenum is connected to the air channel.

3. The convection oven of Claim 1, further comprising a sensor for detecting the oven door being kept opened during a cook cycle.

4. The convection oven of Claim 3, further comprising a controller for re-adjusting a cooking parameter for at least one of the cooking chambers defined by the one or more

removable air plenums based on the amount of time the oven door is kept opened during the cook cycle.

5. The convection oven of Claim 1, wherein at least one of the one or more removable air plenums is configured to direct the heated air upward.

6. The convection oven of Claim 1, wherein at least one of the one or more removable air plenums is configured to direct the heated air downward.

7. The convection oven of Claim 1, wherein at least one of the one or more removable air plenums is configured to support a food rack within the corresponding cooking chamber.

8. The convection oven of Claim 1, wherein the one or more air channels are located on a rear wall of the oven cavity.

9. The convection oven of Claim 1, further comprising one or more pairs of parallel rails located on left and right side walls of the oven cavity to support the one or more removable air plenums.

10. The convection oven of Claim 1, further comprising return air openings located on both left and right sides of the cooking chamber.

11. A convection oven comprising:

a housing having an oven cavity and an oven door for access to the oven cavity;

at least one air blower for generating heated air;

one or more air channels for directing the heated air from the air blower toward the oven cavity;

one or more removable air plenums, wherein each of the one or more removable air plenums is configured to be removably connected to one of the one or more air channels; comprises an air intake edge for receiving the heated air from the one of the one or more air channels; defines the top or the bottom of a cooking chamber within the oven cavity when the removable air plenum is connected to the air channel; and comprises, on its top or bottom surface, a plurality of air vents for directing the heated air into the cooking chamber; and

a control panel for separately and independently controlling each of the cooking chambers defined by the one or more removable air plenums.

12. The convection oven of Claim 11, further comprising a sensor for detecting the oven door being kept opened during a cook cycle.

13. The convection oven of Claim 12, further comprising a controller for re-adjusting a cooking parameter for at least one of the cooking chambers defined by the one or more removable air plenums based on the amount of time the oven door is kept opened during the cook cycle.

14. The convection oven of Claim 11, wherein at least one of the one or more removable air plenums is configured to direct the heated air upward.

15. The convection oven of Claim 11, wherein at least one of the one or more removable air plenums is configured to direct the heated air downward.

16. The convection oven of Claim 11, wherein at least one of the one or more removable air plenums is configured to support a food rack within the corresponding cooking chamber.

17. The convection oven of Claim 11, wherein the one or more air channels are located on a rear wall of the oven cavity.

18. The convection oven of Claim 11, further comprising one or more pairs of parallel rails located on left and right side walls of the oven cavity to support the one or more removable air plenums.

19. The convection oven of Claim 11, further comprising return air openings located on both left and right sides of the cooking chamber.

20. A convection oven comprising:

a housing having an oven cavity and an oven door for access to the oven cavity;

at least one air blower for generating heated air;

one or more air channels for directing the heated air from the air blower toward the oven cavity; and

one or more removable air plenums, wherein each of the one or more removable air plenums is configured to be removably connected to one of the one or more air channels; comprises an air intake edge for receiving the heated air from the one of the one or more air channels; defines the top or the bottom of a cooking chamber within the oven cavity when the removable air plenum is connected to the air channel; and comprises, on its top or bottom surface, a plurality of air vents for directing the heated air into the cooking chamber,

wherein:

the one or more air channels comprise a top air channel and a bottom air channel;

the one or more removable air plenums comprise an upper removable air plenum removably connected to the top air channel and a lower removable air plenum removably connected to the bottom air channel;

the upper removable air plenum defining the top of the cooking chamber within the oven cavity and comprising a plurality of air vents on its bottom surface to direct the heated air downward into the cooking chamber; and

the lower removable air plenum defining the bottom of the cooking chamber within the oven cavity and comprising a plurality of air vents on its top surface to direct the heated air upward into the cooking chamber.

21. The convection oven of Claim 20, further comprising a diverter to separate the heated air exiting from the air blower into a top airstream directed to the top air channel and a bottom air stream directed to the bottom air channel.

22. The convection oven of Claim 20, further comprising a sensor for detecting the oven door being kept opened during a cook cycle.

23. The convection oven of Claim 22, further comprising a controller for re-adjusting a cooking parameter for at least one of the cooking chambers defined by the one or more removable air plenums based on the amount of time the oven door is kept opened during the cook cycle.

24. The convection oven of Claim 20, wherein the lower removable air plenum is configured to support a food rack within the corresponding cooking chamber.

25. The convection oven of Claim 20, wherein the one or more air channels are located on a rear wall of the oven cavity.

26. The convection oven of Claim 20, further comprising one or more pairs of parallel rails located on left and right side walls of the oven cavity to support the one or more removable air plenums.

27. The convection oven of Claim 20, further comprising return air openings located on both left and right sides of the cooking chamber.

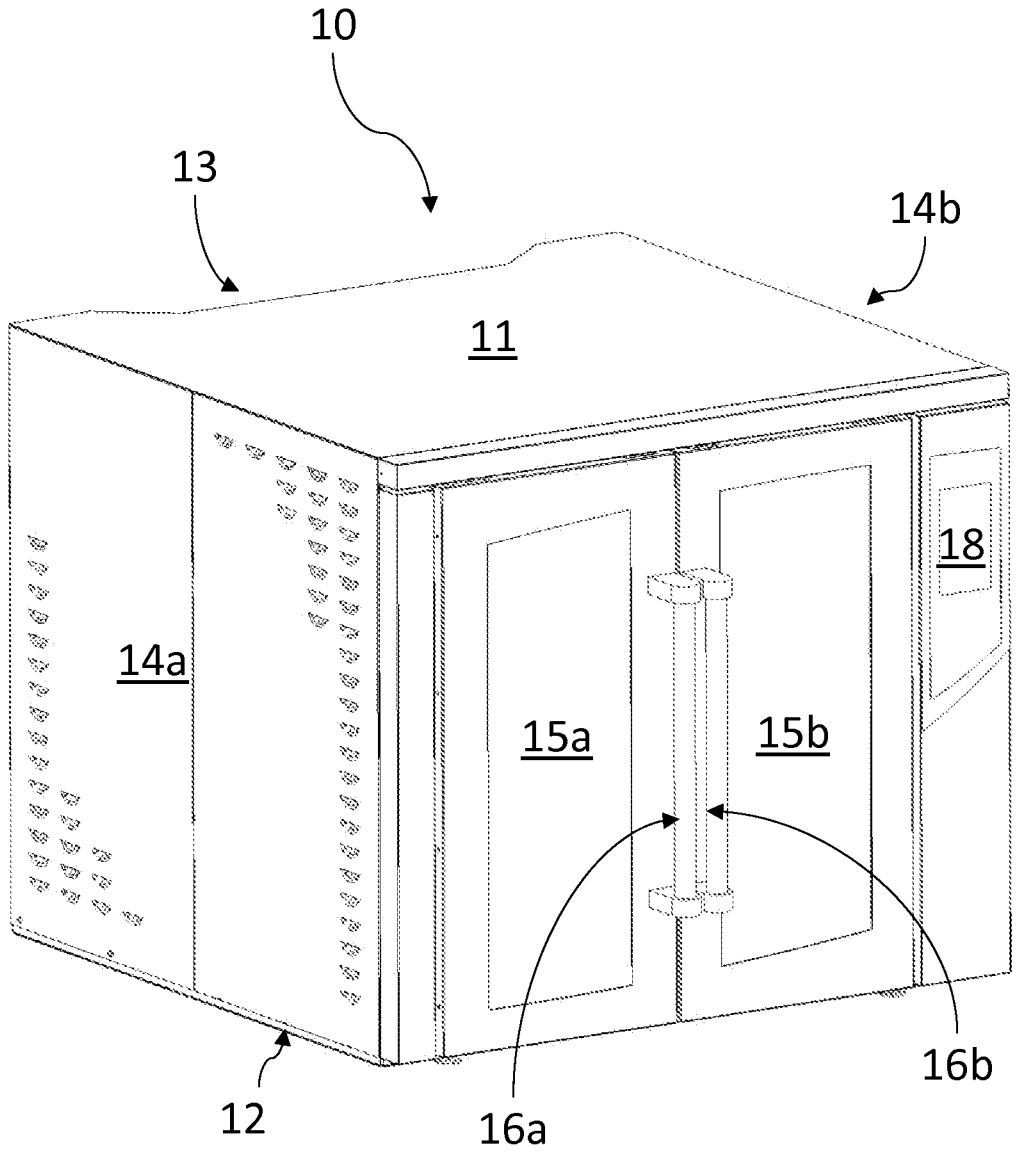

FIGURE 1

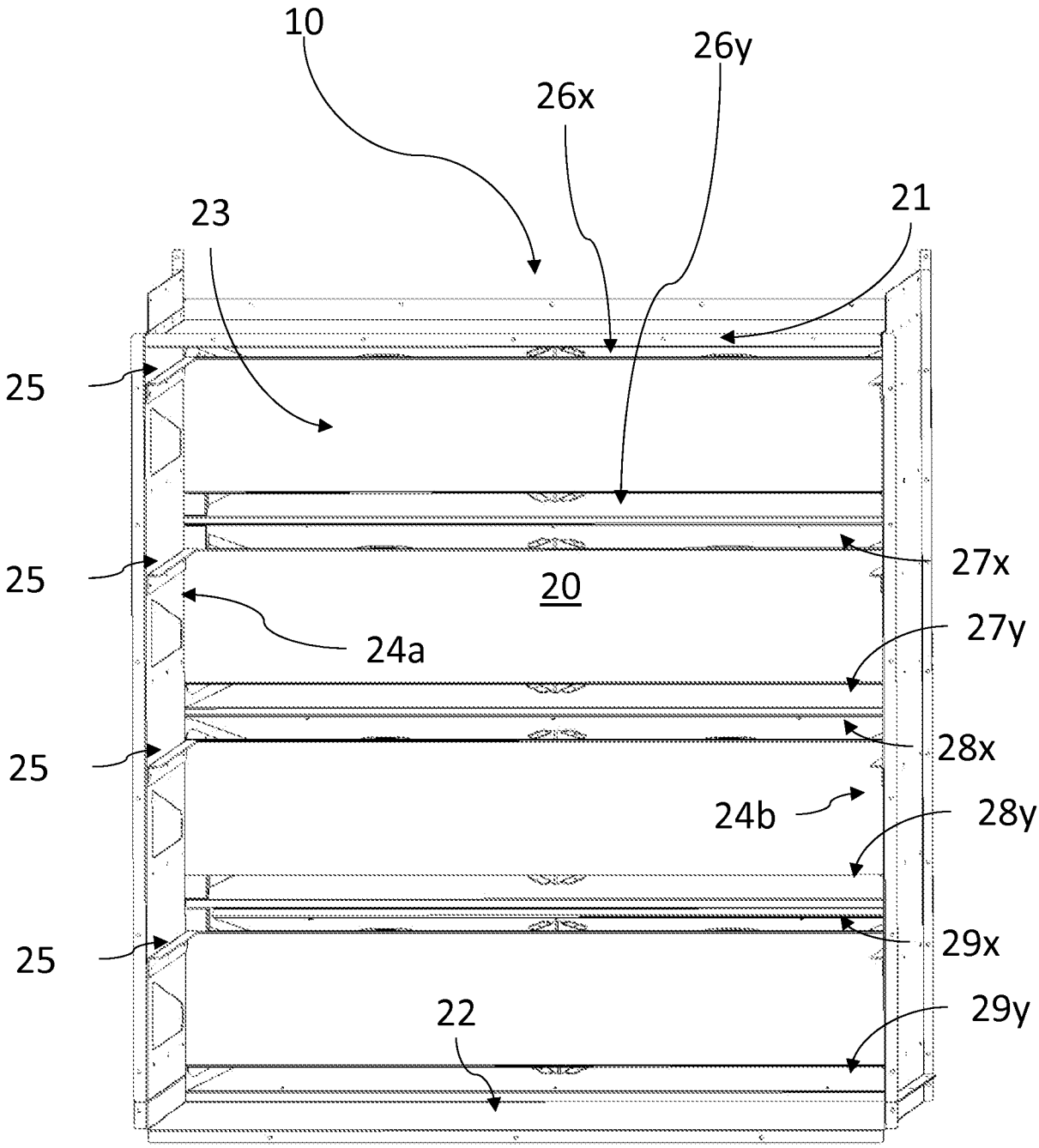

FIGURE 2A

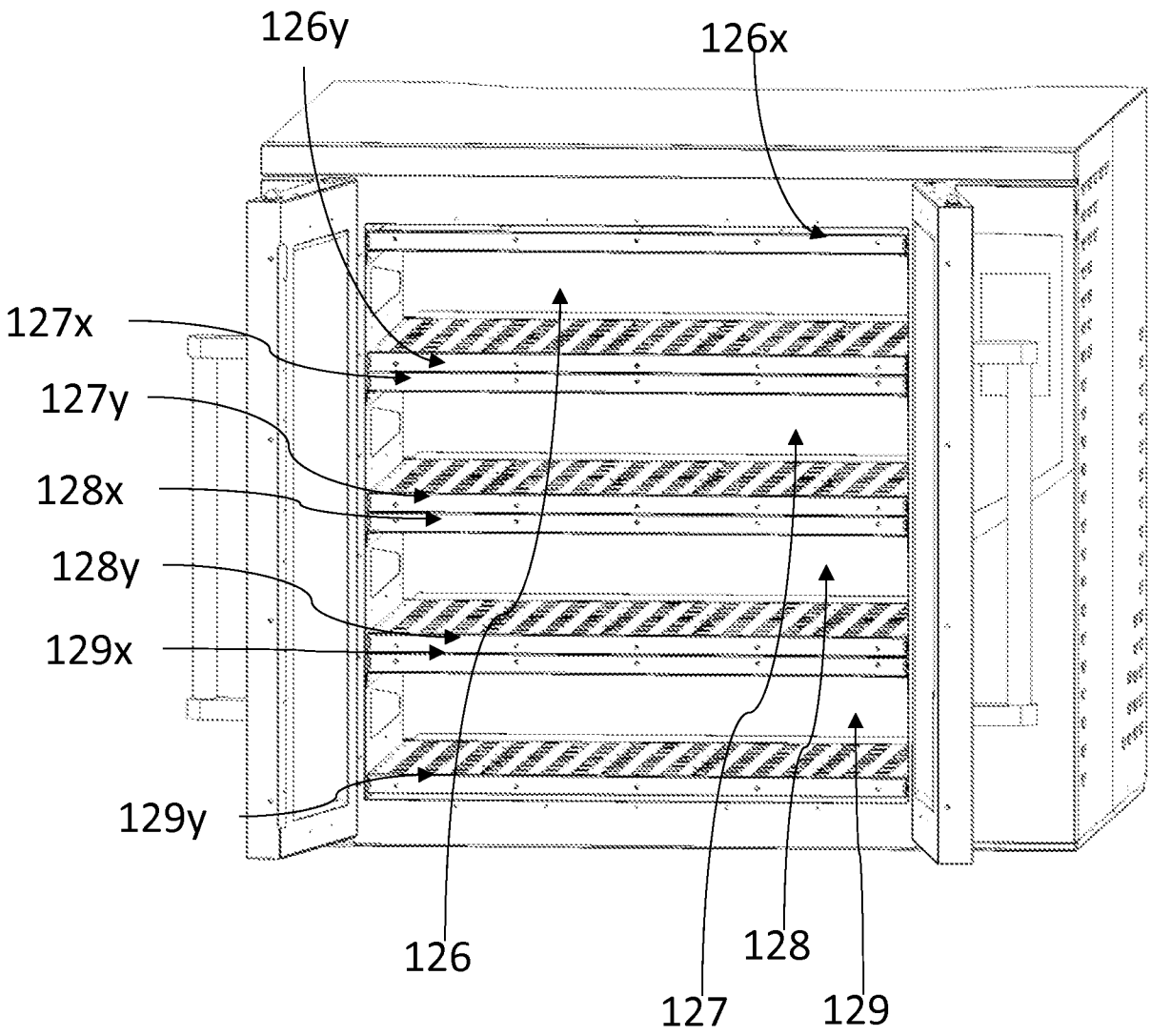

FIGURE 2B

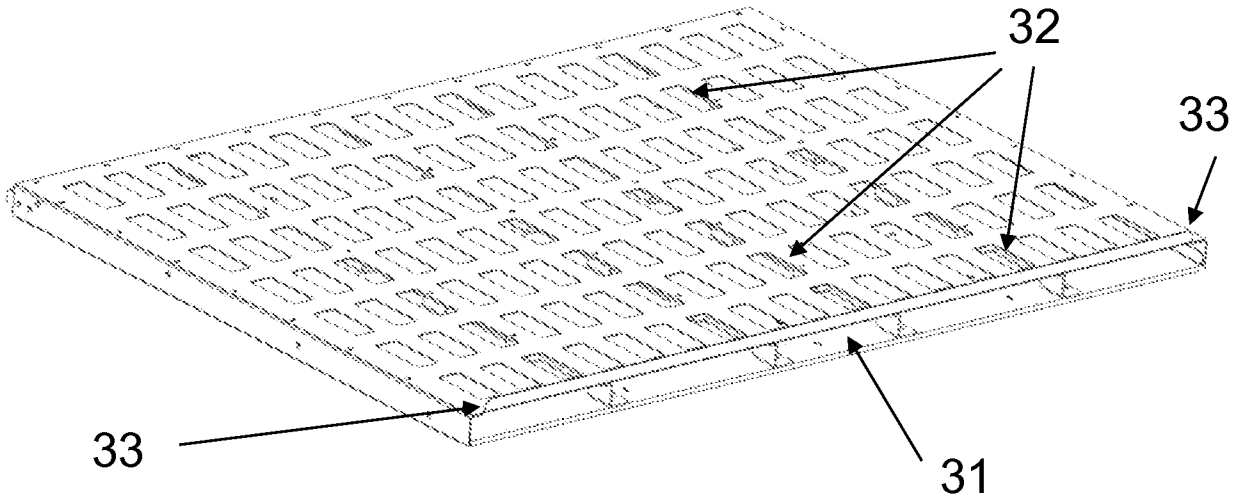

FIGURE 3

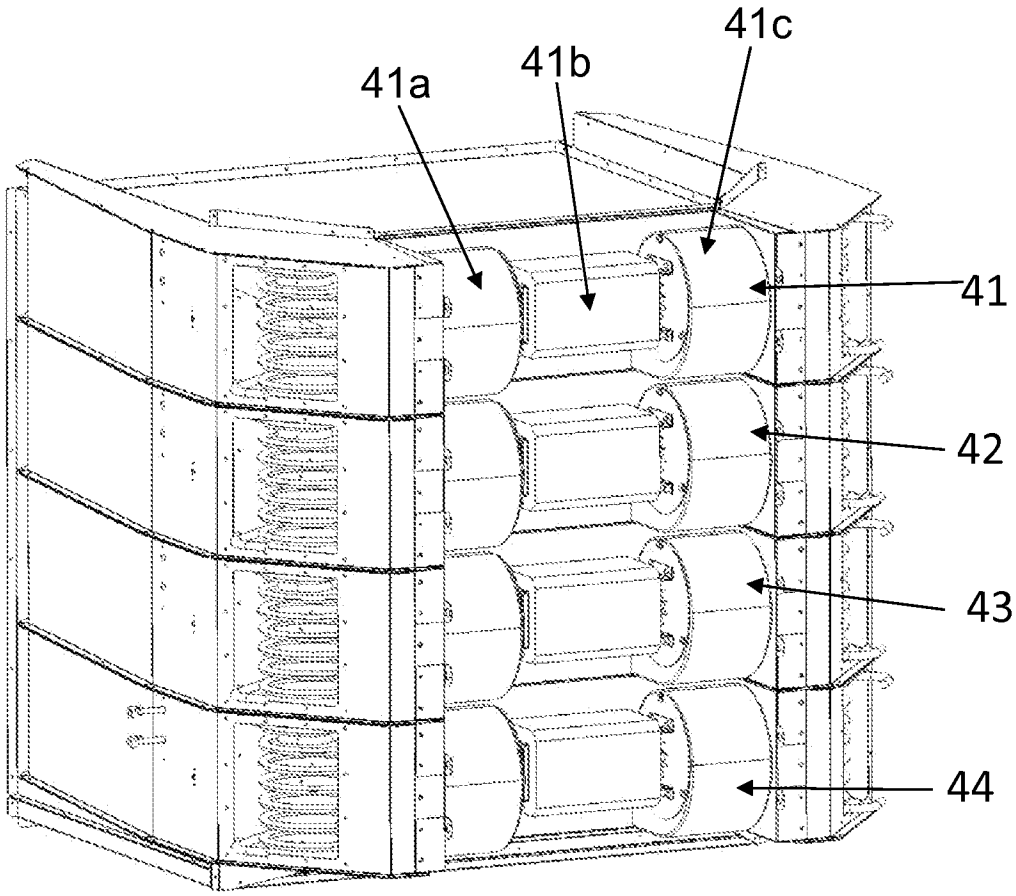

FIGURE 4A

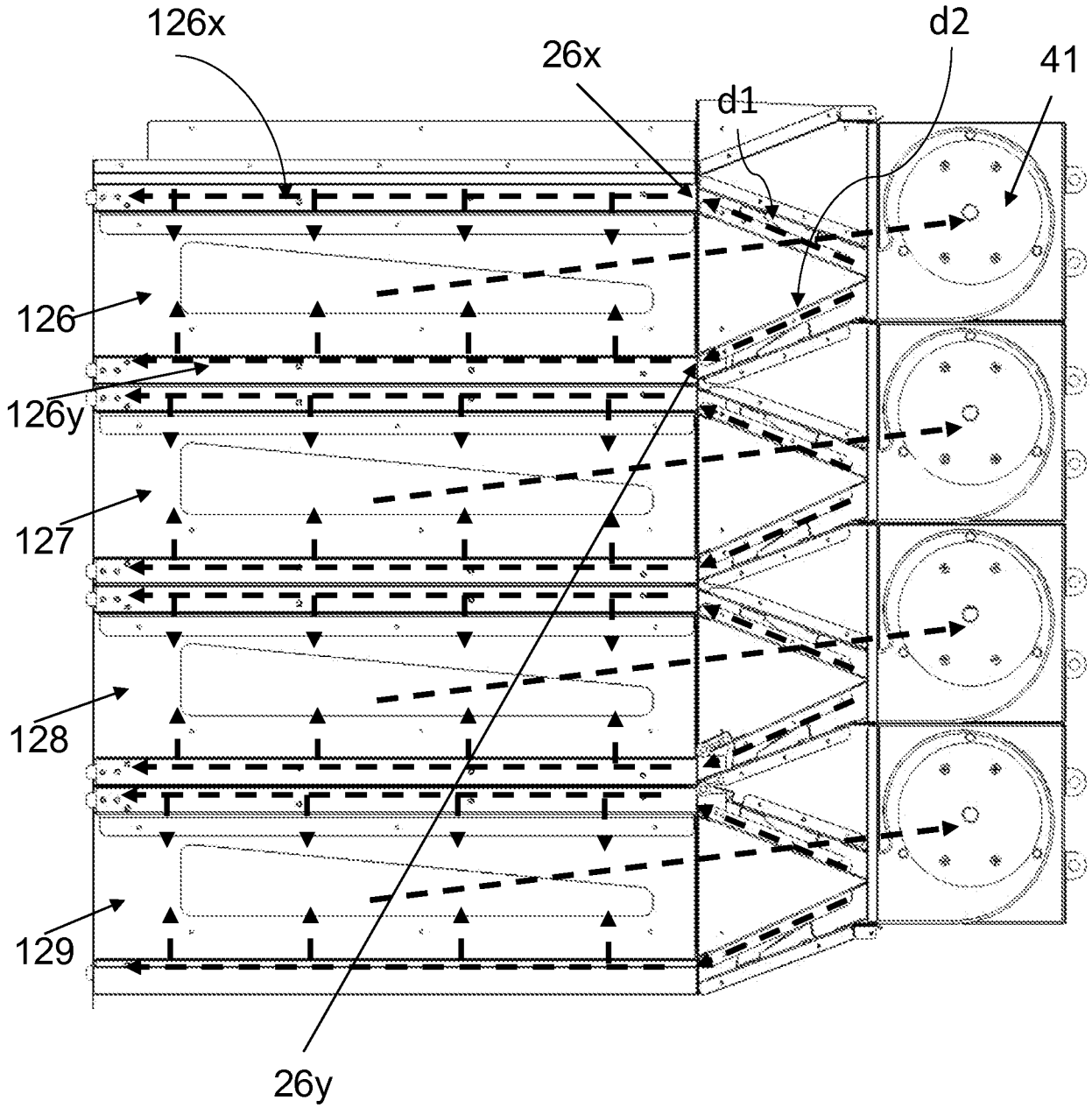

FIGURE 4B

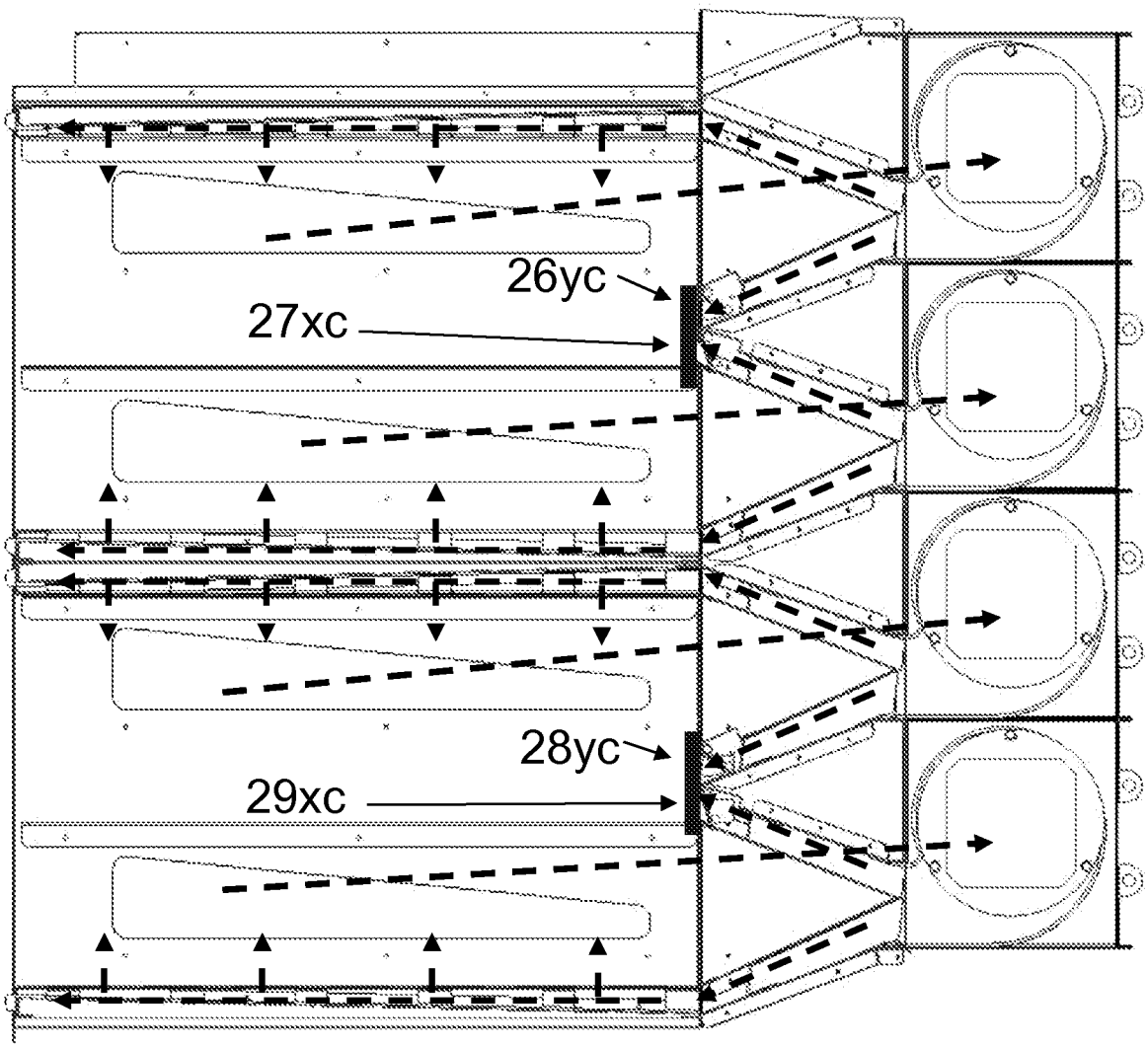

FIGURE 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/030718

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A47J 37/04; A21B 1/26; A21B 1/50; A21B 3/02; A21B 3/04; F27B 9/10 (2016.01)
CPC - A47J 37/049; A21B 1/26; A21B 1/50; A21B 3/02; A21B 3/04; A47J 37/04; F27B 9/10 (2016.05)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED .

Minimum documentation searched (classification system followed by classification symbols)
IPC - A21B 1/26; A21B 1/50; A21B 3/02; A21B 3/04; A47J 37/04; F27B 9/10
CPC - A21B 1/26; A21B 1/50; A21B 3/02; A21B 3/04; A47J 37/04; A47J 37/049; F27B 9/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 99/324, 374, 447; 219/395, 398, 402; 432/128, 133 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar, Google
Search terms used: convection, oven, housing, door, handle, wall, control, panel, controller, side, rear, cooking, chamber, removable, air, plenum, food, rack, channel, blower, flap, heated, tab, edge, intake, edge, cavity, parameter, sensor, upward, downward, vent, parallel, rails,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,951,645 A (LUEBKE et al) 28 August 1990 (28.08.1990) entire document	1-27
A	US 5,228,385 A (FRIEDRICH et al) 20 July 1993 (20.07.1993) entire document	1-27
A	US 2010/0000509 A1 (BABINGTON) 07 January 2010 (07.01.2010) entire document	1-27
A	US 7,196,291 B2 (COTHRAN) 27 March 2007 (27.03.2007) entire document	1-27
A	US 4,307,659 A (MARTIN et al) 29 December 1981 (29.12.1981) entire document	1-27

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 June 2016	27 JUL 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774