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(54) **MULTI-ZONE FOOD HOLDING BIN**

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F24C 15/18	(2006.01)

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CPC ***A47J 36/2483*** (2013.01); ***A47J 36/2488*** (2013.01); ***A47J 39/006*** (2013.01); ***F24C 15/18*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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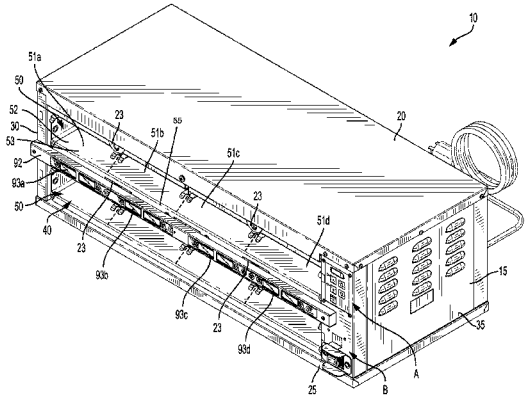
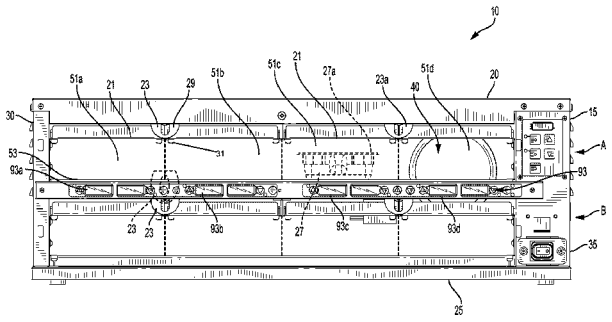
(57) **ABSTRACT**

A multi-zone food holding bin has a continuous food supporting surface with multiple food holding zones. Each food holding zone is independently controllable so that different food temperatures may be maintained in adjacent food holding zones.

34 Claims, 6 Drawing Sheets





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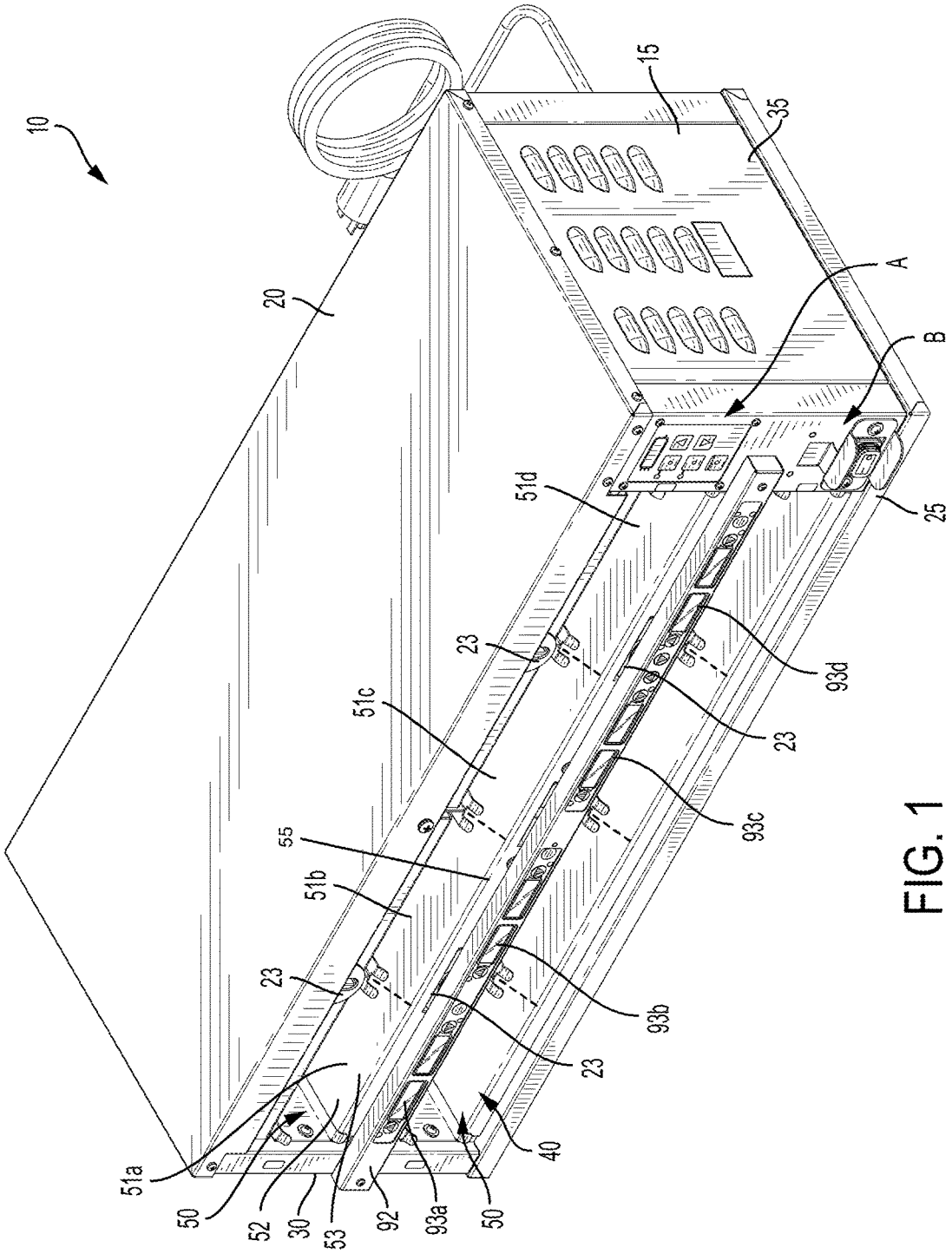
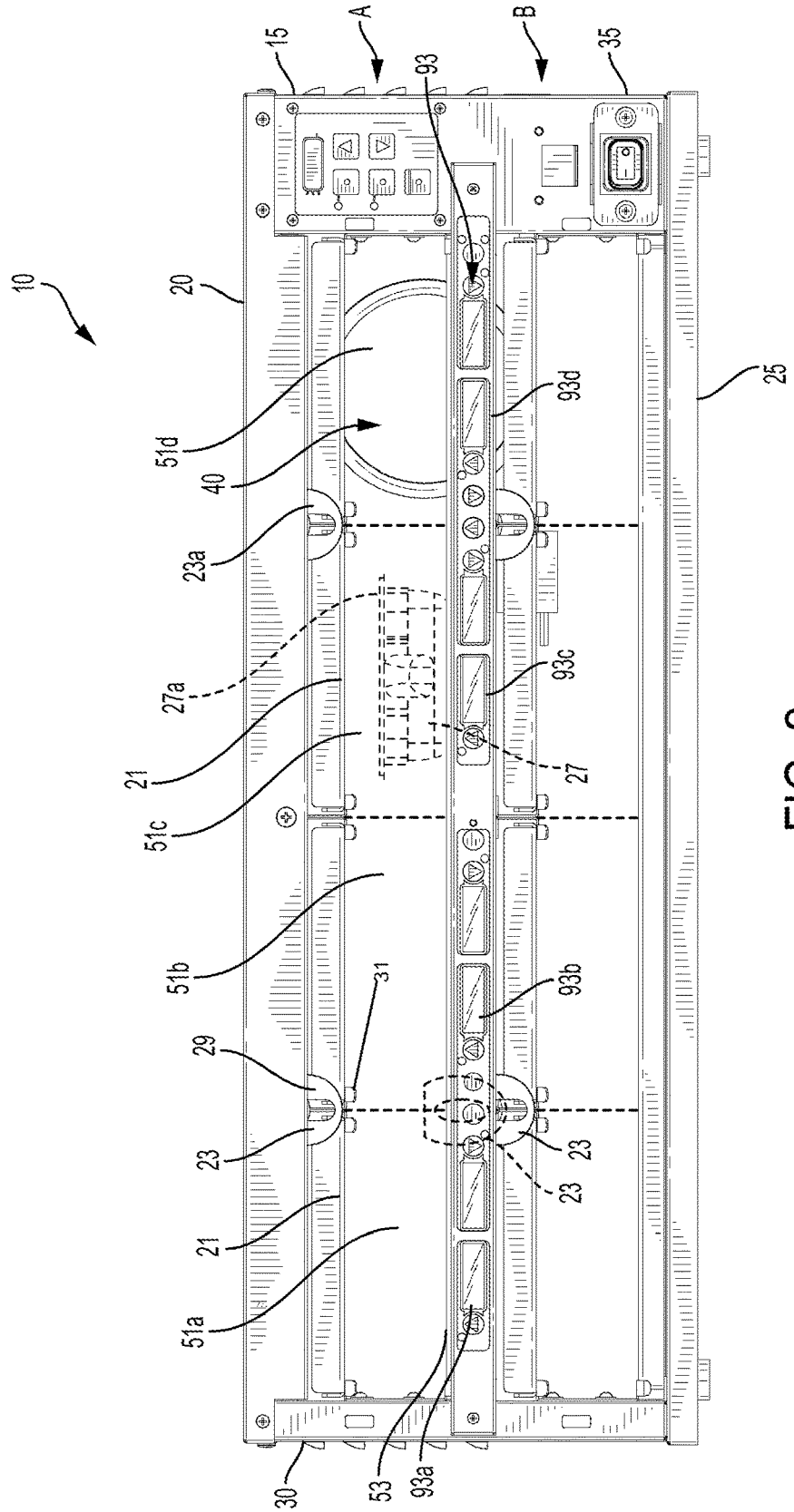

10
15
35
20
A
B
25
51d
23
93d
51c
23
93c
55
51b
23
93b
23
40
51a
50
52
30
53
92
93a
50

FIG. 1


10
15
A
93
B
35
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25
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40
93d
23a
27a
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51b
31
93b
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23
23
23
21
51a
53
93a
30

FIG. 2

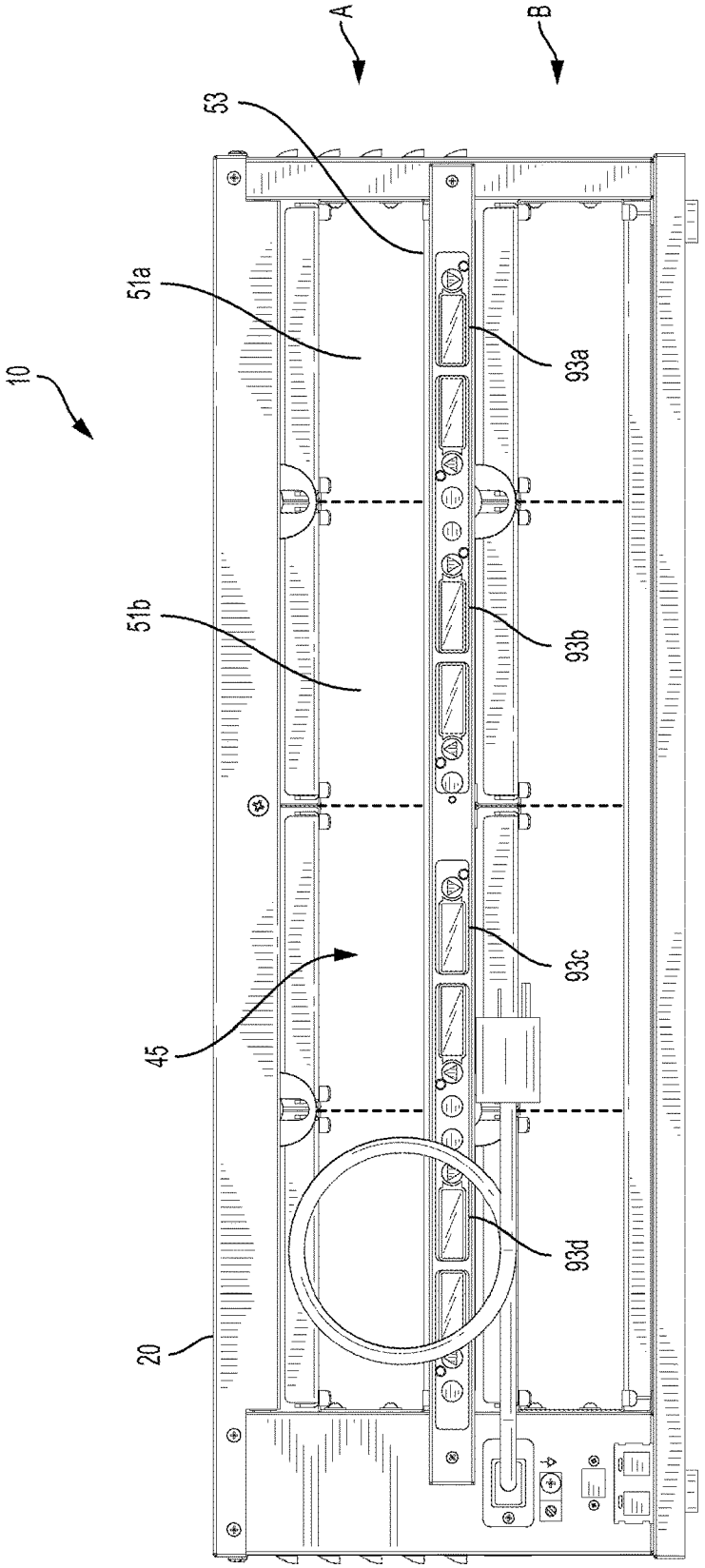
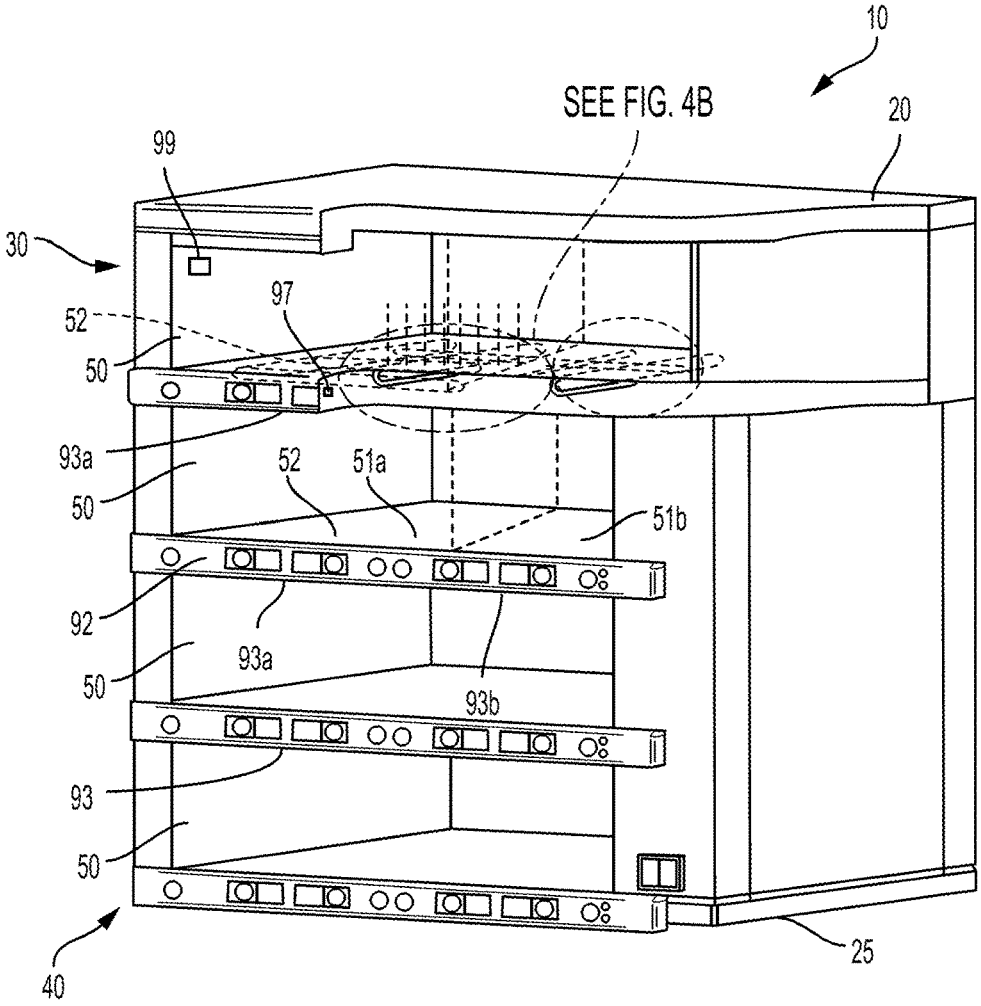


FIG. 3


10
SEE FIG. 4B
20
99
30
97
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93a
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51a
50
51b
92
93a
50
93b
93
50
40
25

FIG. 4A

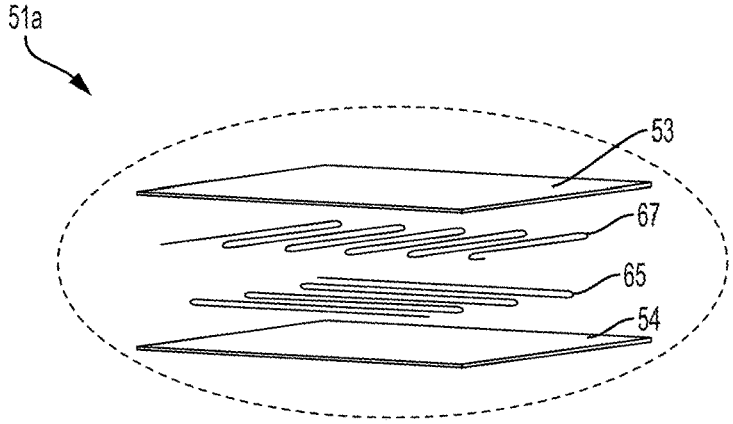
51a
53
67
65
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FIG. 4B

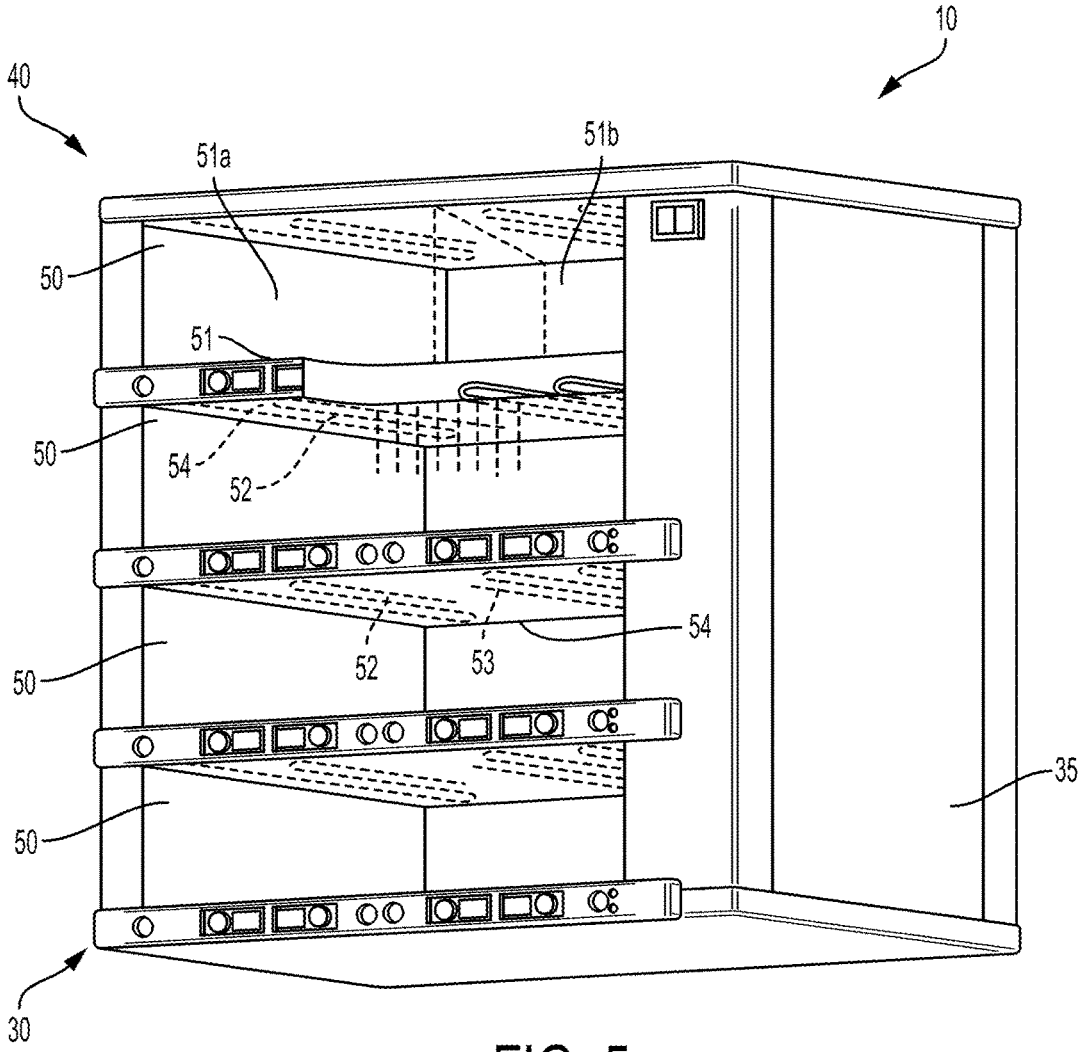

FIG. 5

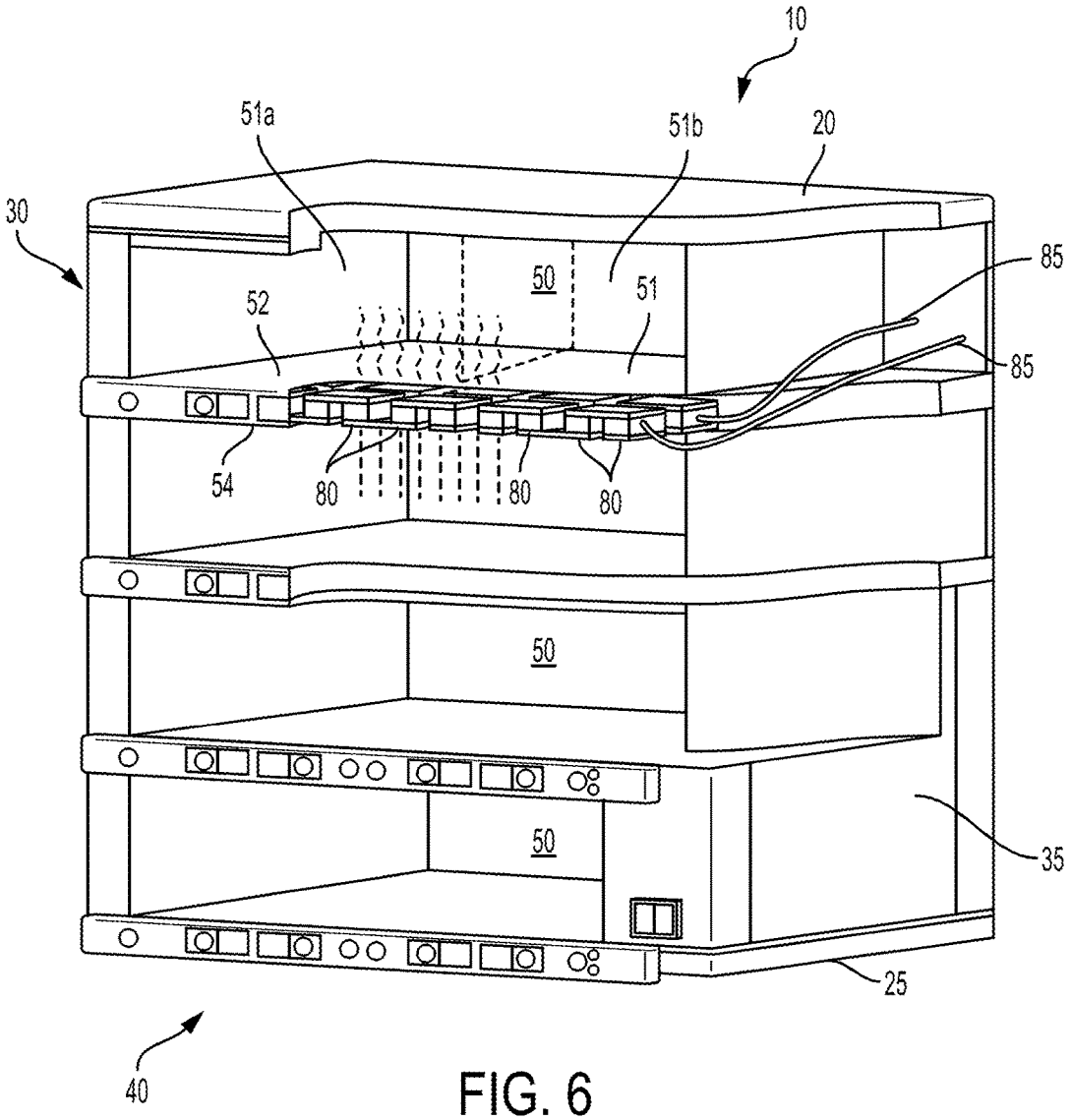

FIG. 6

MULTI-ZONE FOOD HOLDING BIN

RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 15/133,220, filed Apr. 19, 2016, the entirety of which is hereby incorporated by reference herein.

BACKGROUND

Often the success of a restaurant depends, at least in part, on how quickly customers can be served with ordered food items and also on the quality of the food items when served. If the rate of food preparation equals the rate at which the food is ordered and sold, a restaurant can theoretically have freshly-prepared foods ready to serve for customers as they arrive. Since it is not always possible to match food production with customer ordering rates, and since certain fast food restaurant customers expect to receive their ordered food items quickly, many fast food restaurants prepare various food items in advance and keep them ready for sale until a customer arrives and purchases a pre-cooked food item.

To facilitate the food holding process, holding bins or holding ovens are often used to keep the food warm. Known holding bins can allow a cooked food item to be inserted from one side and taken from the opposite side whereby food preparers add food to the holding bin on one side and food servers on the opposite take food from the holding bin. Food holding bins in which the cooked food item is inserted and removed from the same side are also known. The food items in the holding bins are kept warm by heating elements. However, food holding time in known holding bins or ovens is somewhat limited, generally less than 15 or 20 minutes before the food item must be discarded. As a result, restaurants can only keep a limited amount of pre-cooked food items on hand and often a significant amount of the pre-cooked food items must be discarded before they are sold, resulting in additional costs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a multi-zone food holding bin;

FIG. **2** is a front elevational view of the multi-zone food holding bin of FIG. **1**;

FIG. **3** is a rear elevational view of the multi-zone food holding bin of FIG. **1**;

FIG. **4**A is a partially cut-away top perspective view of an alternate embodiment of a multi-zone food holding bin, and FIG. **4**B is a close up of a shelf portion of the multi-zone food holding bin from circle **4**B in FIG. **4**A;

FIG. **5** is a partially cut-away bottom perspective view of the food holding bin of FIG. **4**; and

FIG. **6** is a partially cutaway top perspective view of yet another alternate embodiment of a multi-zone food holding bin.

DETAILED DESCRIPTION

Turning now to FIGS. **1-3**, a multi-zone food holding bin **10** includes two separate food holding compartments **50**. Additional food holding compartments **50** may also be included as explained in further detail below. Each separate food holding compartment **50** includes two or more separate food holding zones, for example, a first food holding zone **51***a* and a second food holding zone **51***b*. As illustrated in FIGS. **1-3**, the multi-zone food holding bin **10** also includes a third food holding zone **51***c* and a fourth food holding zone **51***d*. The food holding zones **51***a*, **51***b*, **51***c*, and **51***d* are illustrated as being separated from one another by a dashed line in FIGS. **1-3**. The dashed lines are for illustration only. The food holding zone need not have their boundaries identified with any sort of line or other indicia in food holding compartment **50**. Each food holding zone **51***a*, **51***b*, **51***c*, and **51***d* can be configured to maintain a different food holding temperature, advantageously allowing the operator to hold different food products with different heating requirements in the same food holding compartment **50**, thereby permitting increased energy efficiencies to be realized and potentially reducing the space requirements for holding different foods. For example, a first food product such as french toast can be held at a first temperature in the first food holding zone **51***a* and a second food product such as eggs can be held at a second temperature in the second food holding zone **51***b*, the second temperature capable of being independently set to be different from the first temperature. Similarly, a third food product such as sausage patties can be held at a third temperature in the third food holding zone **51***c*, the third temperature capable of being independently set to be the same or different from the first and second temperatures. And a fourth food product such as hash browns can be held at a fourth temperature in the fourth food holding zone **51***d*, the fourth temperature capable of being independently set to be the same or different from the first, second, and third temperatures. This can be particularly useful for restaurants during lower demand times and also for smaller restaurants and retail operations.

In one embodiment of the cabinet **10**, all of the compartments **50** are heated. In another embodiment, some compartments **50** may be refrigerated while other compartments **50** are heated. In yet another embodiment, one or more compartments **50** can be selectively heated or refrigerated.

The cabinet **10** includes a chassis **15**. As illustrated, the chassis **15** includes a top panel **20**, a bottom panel **25**, left-side panel **30**, right side panel **35**, an open front face **40** and an open rear face **45**. When the rear face **45** is open and uncovered, food items can be inserted by a first operator responsible for initial food preparation and passed through to a second operator responsible for final food preparation, for example, packaging and customization of a food product for serving to the ultimate customer. In another embodiment, the rear face **45** may be "closed" and provided by a rear panel such that access into the cabinet **10** is only provided by the open front face **40**. The panels may be insulated to reduce heat transfer between the interior of the cabinet **10** and the atmosphere surrounding the cabinet **10**.

The cabinet **10** illustrated in FIG. **1** is sized, shaped and arranged to have two compartments **50**, however, the cabinet can have any number of compartments **50**, including a single compartment **50**. For clarity, the two compartments **50** depicted in FIGS. **1-3** are denominated using the letters A and B. The "A" compartment is the top or uppermost compartment **50** and the "B" compartment is the bottom or lower-most compartment **50**.

In the embodiment illustrated in FIG. **1**, the top or "A" compartment is defined by the left and right sidewalls **30** and **35**, the chassis top panel **20** and a first or upper-most shelf **52**. Compartment "B" is defined by the two sidewalls **30** and **35**, the first or upper-most shelf **52**, and the chassis bottom panel **25**. In cabinet embodiments having only one compartment **50**, the single compartment is defined by opposing, left and right sidewalls **30** and **35**, a chassis top panel **20** and a chassis bottom panel **25**. For brevity, cabinet construction

and operation is described with regard to a cabinet **10** having two compartments **50** in FIGS. **1-3**. However, other embodiments may have more than two compartments **50** or less than two compartments **50**. For example, the embodiments illustrated in FIGS. **4**A, **4**B, **5**, and **6** have four compartments **50**. Again, other configurations are also possible.

The shelf **52**, which partially defines the compartments **50**, is planar or at least substantially planar and supported in the chassis **15** at opposing side ends by the two chassis side walls **30** and **35**. The shelf **52** includes a planar and continuous top surface, which forms a planar and continuous bottom surface **53** of the upper compartment **50**. The planar and continuous bottom surface **53** of the upper compartment **50** is configured to support food items (as used herein, the term "food item" includes but is not limited to containers or trays containing food products such as cooked protein patties, fried foods, and the like). In the illustrated embodiment, food items can be placed onto the planar and continuous bottom surface **53** and removed from the planar and continuous bottom surface **53** through the open front face **40** or through the open rear face **45**. Because the bottom surface **53** is planar and continuous and substantially free of any dividing walls or other structure between the holding zones **51***a*, **51***b*, **51***c*, and **51***d*, cleaning of the bottom surface **53** can be easily accomplished.

A face plate or bezel **92** is generally attached to the front of the chassis **15**. For example, the bezel can be attached to the sidewalls **30** and **35** of the chassis **15** so as to be disposed underneath a top surface of the shelf **52**. In cabinet embodiments having only one compartment **50**, the bezel **92** may be attached to either of the chassis top or bottom panels **20**, **25** of the cabinet **10**. In the illustrated embodiment of FIGS. **1-3**, the bezel **92** is set forward from the shelf **52** by a space **55**. The space **52** forms a slot in which one or more latches **23** translate and/or rotate to release lids held in lid holding ledges **31** as will be discussed further below.

The bezels **92** include information displays and controls, which are collectively identified by reference numeral **93**. Although the chassis **15** can include panels concealing the heat generating devices located within a shelf, the bezel **92** also can conceal heating elements, which are located within the shelf **52**, such that a separate panel is not present.

Each food holding zone **51***a*, **51***b*, **51***c*, **51***d* may include a dedicated display and control **93***a*, **93***b*, **93***c*, **93***d*, respectively. In the embodiment illustrated in FIGS. **1-3**, the display and control **93***a*, **93***b*, **93***c*, and **93***d* displays the temperature setpoint of a respective food holding zone **51***a*, **51***b*, **51***c*, **51***d*. Moreover, each display and control **93***a*, **93***b*, **93***c*, **93***d* controls heating elements that maintain the temperature setpoint of the respective food holding zones **51***a*, **51***b*, **51***c*, **51***d*. The displays and controls **93***a*, **93***b*, **93***c*, **93***d* may be grouped together (i.e., arranged horizontally beneath the respective food holding zone **51***a*, **51***b*, **51***c*, **51***d*) in the bezel **92** for a corresponding compartment **50**. In the embodiment illustrated in FIGS. **1-3**, a single bezel **92** is used to provide the display and control elements for two vertically adjacent compartments **50**, but of course discrete bezels can also be used. The displays and controls **93***a*, **93***b* provide a user graphical interface to one or more controllers (not shown) for the cabinet.

Each food holding zone **51***a*, **51***b*, **51***c*, **51***d* may be sized to receive a food holding tray **27** and lid **21** (see FIG. **2** where the tray **27** is illustrated in broken lines). In order to conveniently store the lid **21**, each food holding zone **51***a*, **51***b*, **51***c*, **51***d* may also include a dedicated lid holding shelf **31** that is sized to receive and store the lid **21** when the lid **21** is desired for use in combination with a food holding tray **27**, such as when protein patties are contained within the tray **27**. Generally, a top surface **27***a* of a food holding tray **27**, when received in the lid holding shelf **31**, is substantially flush with a top surface of the lid holding shelf **31** such that when the tray **27** is disposed in the food holding zone **51***c*, the tray **27** can be in contact with and engaged by the lid **21** in the lid holding shelf **31** so as to retain moisture within the tray **27**-lid **21** assembly. In some embodiments, the lid holding shelf **31** may be provided by formed sheet metal. In other embodiments, the lid holding shelf **31** may be provided by a wire form. Other structures are also possible.

Adjacent to each lid holding shelf **31** is one or more latches **23** having an open center portion. In the illustrated embodiment, the latches **23** have a round or curved body **29** that is rotatable and/or translatable (because of the open center) about a retaining element such as a pin or screw (not shown). In other embodiments, the latches **23** may have straight or angled outer surfaces that form other shapes, such as a square, a pentagon, a hexagon, or any other polygonal shape. The latches **23** may be disposed adjacent an opening into the food holding compartment **50** above the lid holding shelf **31**. In one example, the latches **23** may be captured on a cylindrical retaining element between the chassis **15** and a top of the food holding compartment **50** above the lid holding shelf **31**. In other embodiments, one or more washers (not shown), such as metal, nylon, or plastic washers, may be disposed on the cylindrical retaining element to space the latches **23** apart from the bezel **92** and the shelf **52** to prevent metal galling and/or to reduce friction between the latches **23** and the bezel **92** or shelf **52** to ease actuation of the latches **23**.

The round body **29** may be oriented substantially parallel to a front face of the chassis **15** or the bezel **92** in a locked or default position, as illustrated by reference numeral **23***a*, which prevents inadvertent removal of a lid **21** from the lid holding shelf **31** when a tray **27** is withdrawn. The latch **23** is in its default or locked position simply because of gravity, thus re-positioning the latch to an unlocked state advantageously requires simply overcoming the weight of the latch **23** by translational and/or rotational movement. The round body **29** may be rotated and/or translated upwards relative to the bezel **92** or lid holding shelf **31** from the locked or default position to an unlocked position, as illustrated by the dotted lines referencing latch **23** between food holding zone **51***a* and food holding zone **51***b* in FIG. **1**; this rotational and/or translational movement of the latch **23** about the retaining element allows facile insertion or removal of a lid **21** to/from the lid holding shelf **31**. The round body **29** may be mounted on a retaining element such as a pin (not shown), which retains the round body **29** and allows the round body **29** to translate along the open center portion and/or to at least partially rotate about the pin when the round body **29** translates. The lid holding shelf **31** also allows the food holding compartment **50** to have the planar and continuous bottom surface **52** by storing the lids **27***a* in an elevated position, with the lid holding shelf **31** being suspended above the continuous bottom surface **52**, typically by fixedly attaching a base of the shelf to a top surface of the food holding compartment **50** at one or more positions. Such continuous planar and continuous bottom surfaces **52** are much easier to clean than compartmentalized or divided heating chambers. Furthermore, the round body **29** of the latch **23** and the translation/rotation movement of the latch allow easy removal of the lids **27** from the lid holding tray **31** with one hand while positioning the latch **23** to the unlocked position with another hand.

From a purely functional standpoint, a preferred latch **23** might simply include a locking portion that is able to prevent inadvertent displacement of the lid **21** when the tray **27** is purposefully removed. Thus, a number of different configurations and shapes can be used for the latch **23**. The latch **23** illustrated here with the round body **29**, on the other hand, has an alternative, ornamental arrangement for the round body **29** in which the edges of the round body **29** include an arc-shaped, curved surface. This illustrated arrangement may add to the cost of manufacture, so the illustrated latch does not provide all of the possible economic advantages that might be derived from the invention. On the other hand, this arrangement is believed to be aesthetically pleasing and is likely to be recognized and relied upon by purchasers to identify the source of the food holding bin.

FIGS. **4**A, **4**B, and **5** are perspective views of an alternate embodiment of a multi-zone food holding bin **10**, the embodiment of FIGS. **4**A, **4**B, and **5** including four separate food holding compartments **50**. The embodiment of FIGS. **4**A, **4**B, and **5** is identical to the embodiment of FIGS. **1-3** with the exception that the embodiment of FIGS. **4**A, **4**B, and **5** includes four food holding compartments **50** instead of two. Thus, reference numbers identifying identical elements are the same in FIGS. **1-3** and in FIGS. **4**A, **4**B, and **5**. Moreover, elements not illustrated in one of the embodiments are understood to be present in the other embodiment. For example, the embodiment illustrated in FIGS. **4**A, **4**B, and **5** includes cut-away views showing internal components that are not visible in FIGS. **1-3**. Nevertheless, these internal components are understood to be present in the embodiment illustrated in FIGS. **1-3** as well.

Similar to the embodiment of FIGS. **1-3**, each separate food holding compartment **50** in the food holding bin **10** of FIGS. **4**A, **4**B, and **5** includes at least two separate food holding zones, a first food holding zone **51***a* and a second food holding zone **51***b*. Each food holding zone **51***a*, **51***b* is configured to maintain a different temperature. Of course, it is not necessary for the food holding zones **51***a*, **51***b* to be operated at different temperatures in practice.

The cabinet **10** illustrated in FIG. **4**A is sized, shaped and arranged to have four compartments **50**, however, cabinets in accordance with the disclosure can have any number of compartments, including a single compartment.

In FIG. **4**A, the first or top compartment is defined by the left and right sidewalls **30** and **35**, the chassis top panel **20** and the first or upper-most shelf **52**. The second compartment is defined by the two sidewalls **30** and **35**, the shelf **52** for the first compartment and the second shelf **52**. The third compartment is defined by the two sidewalls **30**, **35**, the second shelf **52** and the third shelf **52**. The fourth compartment is defined by the two sidewalls **30** and **35**, the third shelf and the chassis bottom **25**.

The shelves **52**, which partially define the compartments **50**, are planar or at least substantially planar and supported in the chassis **15** at their opposing side ends by the two chassis side walls **30** and **35**. Each shelf **52** forms a planar and continuous top surface, which defines a planar and continuous bottom surface **53** of the compartment **50**. The planar and continuous bottom surface **53** of the compartment is configured to support food items (as mentioned above, the term "food item" includes but is not limited to containers or trays containing food products such as cooked protein patties, fried foods, and the like). Food items can be placed onto the planar bottom surface **53** and removed from the planar bottom surface **53** through the open front face **40** or through the open rear face **45**.

Each food holding zone **51***a*, **51***b* may include a dedicated display and control **93***a*, **93***b*, respectively. Each display and control **93***a*, **93***b* displays the temperature setpoint of a respective food holding zone **51***a*, **51***b*. Moreover, each display and control **93***a*, **93***b* controls heating elements that maintain the temperature setpoint of the respective food holding zones **51***a*, **51***b*. The displays and controls **93***a*, **93***b* may be grouped together (i.e., arranged horizontally beneath the respective food holding zone **51***a*, **51***b*) in the bezel **92** for a corresponding compartment **50**. In the embodiment illustrated in FIGS. **4**A, **4**B, and **5**, a single bezel **92** is used to provide the display and control elements for a single compartment **50**. The displays and controls **93***a*, **93***b* provide a graphical user interface to one or more controllers (not shown) for the cabinet.

Cabinet control and control of the food holding zone **51** temperature is effectuated in part by using one or more microcontrollers or microprocessors **97** in combination with temperature sensors **99**. US 2011-0114624 A1 entitled "Food Holding Cabinet Power Supplies with Downloadable Software," the entirety of which is hereby incorporated by reference herein, discloses among other things, apparatuses and methods by which compartments of a food holding cabinet can be controlled using microprocessors having downloadable software. Compartment temperature control is preferably effectuated using a semiconductor temperature sensor, thermally coupled to each food holding zone **51** and electrically connected to a processor, such as those disclosed in US 2011-0114624 A1.

A semiconductor apparatus and method for measuring temperature of a plate or shelf in a food holding cabinet is disclosed in U.S. Pat. No. 8,247,745, which is entitled "Temperature Sensor for a Food Holding Cabinet" the entirety of which is hereby incorporated by reference herein.

The shelf **52** includes a lower heating element **67** for the first food holding zone **51***a* in a first or top food holding compartment **50**, and an upper heating element **65** for a second food holding zone **51***a* in a second or lower food holding compartment **50**, directly below the first food holding compartment **50**. While the first heating element **67** is illustrated as providing heat to the upper first food holding zone **51***a* (from below) and the second heating element **65** is illustrated as providing heat to the lower first food holding zone **51***a* (from above), heating elements that are not shown include at least a heating element that provides heat to the upper first food holding zone **51***a* from above and another heating element that provides heat to the lower first food holding zone **51***a* from below. Additionally, the second food holding zones **51***b*, which are adjacent to the first food holding zones **51***a*, are heated in the same way as the first food holding zones, but with independent heating elements. The heating elements of the second food holding zone **51***b* are independently controllable from the heating elements of the first food holding zones **51***a*. Referring to the inset FIG. **4**B, the shelf **52** includes an upper thermally conductive plate, which forms the continuous planar bottom surface **53** of the first (or upper) food holding compartment **50** and a lower thermally conductive plate, which forms a continuous planar upper surface **54** of the second (or lower) food holding compartment **50**. The planar bottom surface **53** and the planar upper surface **54** are spaced apart from each other by a distance sufficient to accommodate the inclusion of at least two heating elements, which are illustrated in the figures as the separate first heating element **67** and the separate second heating element **65**, respectively. Insulative materials may be provided between the first heating element **67** and the second heating element **65** to provide better

thermal control over the food holding zones **51***a*, **51***b*. The first heating element **67** is a lower heating element for the upper food holding compartment **50** and the second heating element **65** is an upper heating element for the lower food holding compartment **50**.

The continuous planar bottom surface **53** of the top food holding compartment **50** and the continuous planar upper surface **54** of the bottom food holding compartment are preferably made of aluminum, between about one-eighth and about one-quarter inch-thick. Alternate embodiments of the shelf **52** may use a thermally-conductive panel made of glass-ceramic or an ultra-low expansion glass for one or both of the lower surface **53** and the upper surface **54**. Glass-ceramics and ultra-low expansion glass are considered herein to be "good" thermal conductors in that their conduction of heat energy is localized. Such materials also make excellent shelves for a heated, multi-zone food holding bin because they permit localized areas of a shelf to be heated to a first temperature, without having the entire shelf reach the same temperature.

The first heating element **67** is disposed between the planar bottom surface **53** and the planar upper surface **54** and the first heating element **67** is in thermal communication with the planar bottom surface **53**. The first heating element **67** may be mechanically attached to the planar bottom surface **53** by a thermally-conductive adhesive, in one embodiment. The first heating element **67** may also be attached to the planar bottom surface **53** by brackets or clamps.

The second heating element **65** is disposed between the planar bottom surface **53** and the planar upper surface **54** and the second heating element **65** is in thermal communication with the planar upper surface **54**. The second heating element **65** may be mechanically attached to the planar upper surface **54** by a thermally-conductive adhesive, in one embodiment. The second heating element **65** may also be attached to the planar upper surface **54** by brackets or clamps.

In the embodiment illustrated in FIGS. **4**A, **4**B, and **5**, the first heating element **67** can be located above the second heating element **65** but in thermal communication with the planar bottom surface **53** such that when the temperature of the first heating element **67** rises, it provides heat energy into the planar bottom surface **53** in a region around the first heating element **67**, and more specifically, within the first food holding zone **51***a* of the first or top food holding compartment **50**. Thermally insulating the first heating element **67** from the planar upper surface **54** and thermally insulating the second heating element **65** from the planar bottom surface **53**, enables the first heating element **67** to provide a first amount of heat energy into the planar bottom surface **53** (and thus into the first food holding zone **51***a* of the upper food holding compartment **50**), while the second heating element **65** provides a second amount of heat energy into the planar upper surface **54** (and thus into the first food holding zone **51***a* of the lower food holding compartment **50**). In this manner, each food holding zone **51***a*, **51***b* may be configured to have an independent and unique temperature profile from top to bottom of the food holding zone **51***a*, **51***b*. For example, one food holding zone **51***a*, **51***b* may have a temperature profile that generally decreases from top to bottom (i.e., the top of the food holding zone **51***a*, **51***b* is hotter than the bottom of the food holding zone **51***a*, **51***b*).

In some embodiments, the second heating element **65** may comprise a radiant heating source that projects radiant heat through the planar upper surface **54** and into the first food holding zone **51***a* of the lower food holding compartment **50**. In other words, in one embodiment, the first heating element **67** provides heat energy into the first food holding zone **51***a* of the upper food holding compartment **50** through conduction, while the second heating element **65** provides heat energy into the first food holding zone **51***a* of the lower food holding compartment through radiation. Similarly, a radiant heating element may be provided at a top interior surface of the first or top food holding compartment **50** beneath the chassis top panel **20**. In this manner, the top and bottom of a food product placed into the first food holding zone **51***a* may absorb different amounts of heat energy, customized depending on the type of food product. Thus, the heat profile in the first food holding zone **51***a* may be customized vertically as well as differentiated from the heat profile in the second food holding zone **51***b*. As a result, a single food holding compartment **50** (e.g., the upper compartment in FIGS. **4**A and **5**) may be customized to store different types of food products in the first food holding zone **51***a* and the second food holding zone **51***b*, each food holding zone **51***a*, **51***b* having a different temperature profile. As a result, the disclosed food holding bin **10** is flexible in that it can keep multiple different types of food products at their ideal holding temperatures in a single food holding compartment, thus increasing efficiency and adaptability to different food demands.

Because of this flexibility, it has been found that a food holding bin constructed in accordance with the disclosure can extend the palatability time of a food item by a factor of two or more.

An alternate embodiment, as illustrated in FIG. **6**, may use the thermoelectric effect provided by one or more Peltier devices **80** to heat one or more of the compartments **50**.

The thermoelectric effect is a direct conversion of a temperature difference into an electric voltage and vice versa. When a voltage is applied to a thermoelectric device, a temperature difference is created across the two sides of the device. The temperature difference created in response to an applied voltage is known as the Peltier effect. Devices that produce temperature differences in response to an applied voltage are considered herein to be Peltier devices. A Peltier device **80** is therefore considered herein to be a heat source or heating element.

Peltier devices have a "cold" side and a "hot" side. The cold side absorbs heat whereas the hot side emits heat. Heat emitted from the hot side includes at least some of the heat absorbed from the cold side. A Peltier device **80** is therefore considered herein to be a solid-state heat pump or heat-sinking device.

FIG. **6** is a cutaway view of another embodiment of a point-of-use holding cabinet using Peltier devices to heat the food holding compartments **50**. In one embodiment, one or more Peltier devices **80** are "sandwiched" between, and in thermal communication with the bottom planar surface **53** and the upper planar surface **54** described above. Electrical energy is provided to the Peltier devices **80** through wires **85**, under the control of a controller.

"Sandwiching" the Peltier devices in a shelf **52** as shown in FIG. **6** provides a shelf **52** cold on one side and hot on the other. Such a shelf **52** structure thus enables a dual-mode food holding cabinet **10** having a "first" food holding compartment **50** that is warm and a vertically adjacent "second" food holding compartment **50** that is cold.

Temperature control of a thermoelectric, Peltier device **80** may be accomplished by controlling the electric energy provided to the device. Temperature control of one side of the Peltier device **80** can also be effectuated by controlling heat transferred into or out of the opposite side of the device,

as described in US 2010-0307168 A1, entitled "Thermo Electric Cooler," the disclosure of which is incorporated herein by reference in its entirety.

In another embodiment of a multi-zone food holding bin **10**, multiple Peltier devices **80** are mounted between the bottom surface **53** and the upper surface **54** but have only their hot sides thermally coupled to the bottom surface **53** and to the upper surface **54**. Air is then moved through the inter-plate space to heat the cool sides of the Peltier devices therein.

Peltier devices as disclosed herein and similar heat transfer devices are thermally coupled to the shelf **52**, preferably by way of mechanical attachment to at least one of the plates that form the lower planar surface **53** and the upper planar surface **54**. Mechanical attachment and the resultant thermal coupling is preferably accomplished by a thermally-conductive adhesive, however, clamps that are attached to a plate by screws driven into a plate can also be used.

The shelves are mechanically coupled to the side panels **30** and **35**. The side panels are also preferably made from thermally-conductive material such as aluminum. Thermally coupling a heat transfer device to one or more plates that comprise a shelf therefore also thermally couples the heat transfer device to the side walls and thus to the compartment. Heat transfer devices coupled to a shelf are therefore also thermally coupled to the corresponding compartment.

While the temperature of a Peltier device can be controlled by controlling the heat dissipated from the hot side and/or the heat absorbed into the cold side, cabinet embodiments disclosed herein preferably control compartment temperature using one or more semiconductor temperature sensors, thermally coupled to one or more of the thermally-conductive structures that comprise a compartment. Cabinet embodiments disclosed herein preferably use a semiconductor temperature sensor that is directly coupled and therefore thermally coupled to the heated surfaces **53** and/or **54** provided by the shelves **52**.

Semiconductor temperature sensors used in preferred embodiments disclosed herein are disclosed in U.S. Pat. No. 8,247,745, which is entitled "Temperature Sensor for a Food Holding Cabinet" the entirety of which is hereby incorporated by reference herein, especially the teachings of the structure and use of a semiconductor temperature sensor.

Thus, suitable heating elements for use in accordance with the disclosure include electrically-resistive heating elements, such as heated coils, radiant heating elements that provide heat energy via radiation, and devices and ancillary equipment that provide heat to a working fluid. As described above, Peltier devices may also be used as heating elements in accordance with the disclosure.

The foregoing description is for purposes of illustration only and not for purposes of limitation. The true scope of the invention is set forth by the appended claims.

What is claimed is:

1. A multi-zone food holding bin comprising:

a chassis having a top panel, a first side panel, a second side panel, a bottom panel, a front face, and an opposing rear face;

a first food holding compartment within the chassis, the first food holding compartment being defined by the first side panel, the second side panel, the top panel and a shelf, the top panel including at least one downwardly depending lid holding shelf, the first food holding compartment being substantially unobstructed between the first side panel and the second side panel and below the downwardly depending lid holding shelf;

a second food holding compartment disposed below the first food holding compartment within the chassis, the second food holding compartment being defined by the first side panel, the second side panel, the bottom panel and the shelf, the shelf including at least one downwardly depending lid holding shelf, the second food holding compartment being substantially unobstructed between the first side panel and the second side panel and below the downwardly depending lid holding shelf;

wherein the shelf is located between the first and second food holding compartments and comprises a first side and a second side, the first side facing into the first food holding compartment, the second side facing into the second food holding compartment, the first side defining a first substantially planar surface comprising a thermally conductive material forming a top surface of the shelf and forming a bottom surface of the first food holding compartment, the first substantially planar surface adapted to receive a tray for food items;

and wherein the bottom panel includes a second substantially planar surface comprising a thermally conductive material forming a bottom surface of the second food holding compartment, the second substantially planar surface adapted to receive a tray for food items;

a first opening in the front face of the chassis defined by the first substantially planar surface, the first side panel, the second side panel and the top panel, the first opening configured to allow the tray for food items to be passed through the first opening and onto the first substantially planar surface;

a second opening in the front face of the chassis defined by the second substantially planar surface, the first side panel, the second side panel and the shelf, the second opening configured to allow the tray for food items to be passed through the second opening and onto the second substantially planar surface;

a third opening in the rear face of the chassis defined by the first substantially planar surface, the first side panel, the second side panel and the top panel, the third opening configured to allow the tray for food items to be passed through the third opening from the first substantially planar surface;

a fourth opening in the rear face of the chassis defined by the second substantially planar surface, the first side panel, the second side panel and the shelf, the fourth opening configured to allow the tray for food items to be passed through the fourth opening from the second substantially planar surface;

a first food holding zone formed in the first food holding compartment, the first food holding zone having at least one independently controllable heating element disposed at a top portion of the first food holding compartment, and at least one independently controllable heating element disposed at a bottom portion of the first food holding compartment, the first food holding zone having a controllable first food holding temperature;

a second food holding zone formed in the first food holding compartment, the second food holding zone having at least one independently controllable heating element disposed at the top portion of the first food holding compartment and at least one independently controllable heating element disposed at the bottom portion of the first food holding compartment, the second food holding zone having a controllable second food holding temperature;

a third food holding zone formed in the second food holding compartment, the third food holding zone having at least one independently controllable heating element disposed at a top portion of the second food holding compartment, and at least one independently controllable heating element disposed at a bottom portion of the third food holding compartment, the third food holding zone having a controllable third food holding temperature;

a fourth food holding zone formed in the second food holding compartment, the fourth food holding zone having at least one independently controllable heating element disposed at the top portion of the second food holding compartment and at least one independently controllable heating element disposed at the bottom portion of the second food holding compartment, the fourth food holding zone having a controllable fourth food holding temperature;

at least one user interface for controlling the food holding temperature of each food holding zone; and

a controller operatively coupled to the user interface and each heating element, the controller configured to independently operate each heating element such that each food holding zone has an independently controlled food holding temperature.

2. The food holding bin of claim **1** wherein each interface is a graphical interface that displays the food holding temperature of each food holding zone.

3. The food holding bin of claim **1**, further comprising a first bezel attached to the chassis, the first bezel providing at least one user interface comprising dedicated controls and/or dedicated displays for each of the first, second, third, and fourth food holding zones.

4. The food holding bin of claim **3**, wherein the first bezel is set forward from the shelf and defining a space between the first bezel and the front face.

5. The food holding bin of claim **4**, further comprising a latch moveable from a locked position to an unlocked position within the space between the first bezel and the front face.

6. The food holding bin of claim **3**, wherein the first bezel provides at least one graphical interface comprising at least one dedicated display and the dedicated display displays a temperature setting for a corresponding food holding zone.

7. The food holding bin of claim **3**, wherein the dedicated display displays additional information about a food item stored in the corresponding food holding zone.

8. The food holding bin of claim **6**, wherein the dedicated display displays additional information about a food item stored in the corresponding food holding zone.

9. The food holding bin of claim **3**, wherein the first bezel provides two user interfaces arranged horizontally beneath the first food holding zone and the second food holding zone, respectively.

10. The food holding bin of claim **3**, wherein the first bezel is located proximate the front face of the chassis, the food holding bin further comprising a second bezel located proximate the opposing rear face of the chassis.

11. The food holding bin of claim **1**, further comprising a latch disposed adjacent the first opening.

12. The food holding bin of claim **11**, wherein the latch is located between the first food holding bay and the second food holding bay.

13. The food holding bin of claim **11**, wherein the latch is rotatable or translatable from a first position to a second position.

14. The food holding bin of claim **1**, further comprising at least one food holding tray resting on at least one substantially planar surface within one food holding zone.

15. The food holding bin of claim **14**, wherein the independently controllable heating elements disposed at the bottom portion of the first and second food holding compartments provide heat energy to at least one food holding tray through conduction.

16. The food holding bin of claim **14**, wherein the independently controllable heating elements disposed at the top portion of the first and second food holding compartments provide radiant heat to at least one food holding tray.

17. The food holding bin of claim **14**, wherein the independently controllable heating elements disposed at the top portion of the first and second food holding compartments provide radiant heat energy to at least one food holding tray and the independently controllable heating elements disposed at the bottom portion of the first and second food holding compartments provide heat energy through conduction to at least one holding tray.

18. The food holding bin of claim **1**, wherein the independently controllable heating elements comprise a resistive wire.

19. The food holding bin of claim **1**, wherein at least one of the substantially planar surfaces is a continuous surface.

20. The food holding bin of claim **1**, wherein at least one of the substantially planar surfaces is substantially free of any dividing walls or other structure between the first, second, third, and fourth food holding zones.

21. The food holding bin of claim **14**, wherein each food holding zone further comprises a lid holding shelf elevated above the substantially planar bottom surface in the first food holding compartment and the second food holding compartment, each lid holding shelf being configured to receive and store a lid for the food holding tray.

22. The food holding bin of claim **21**, wherein a latch is disposed adjacent the first opening and is moveable between a locked position in which the latch prevents a lid from being removed from the lid holding shelf, and an unlocked position in which the latch allows removal of a lid from the lid holding shelf.

23. The food holding bin of claim **22**, wherein the latch is rotatable and is biased into the locked position by gravity.

24. The food holding bin of claim **21**, wherein the lid holding shelf comprises sheet metal.

25. The food holding bin of claim **21**, wherein the lid holding shelf comprises a wire form.

26. The food holding bin of claim **1**, wherein each independently controllable heating element disposed at the top portion of the first and second food holding compartments is adapted to output more heat energy than the independently controllable heating elements disposed at the bottom portion of the first and second food holding compartments.

27. The food holding bin of claim **1**, wherein at least one substantially planar surface comprises aluminum.

28. The food holding bin of claim **1**, wherein the first food holding zone and the second food holding zone are heated to different temperatures.

29. The food holding bin of claim **1**, wherein each of the food holding zones are each heated to different temperatures.

30. The food holding bin of claim **1**, wherein the shelf comprises an upper thermally conductive plate disposed in the shelf and in thermal communication with the first side, a lower thermally conductive plate disposed in the shelf and in thermal communication with the second side, a first set of independently controllable heating elements in thermal

communication with the upper thermally conductive plate, and a second set of independently controllable heating elements in thermal communication with the lower thermally conductive plate;

wherein the first set of independently controllable heating elements are capable of providing different amounts of heat energy into the first and second food holding zones of the first food holding compartment; and

wherein the second set of independently controllable heating elements are capable of providing different amounts of heat energy into the third and fourth food holding zones of the second food holding compartment.

31. The food holding bin of claim **30**, wherein an insulating material is provided between the first and second sets of independently controllable heating elements.

32. The food holding bin of claim **30**, wherein each of the first and second sets of independently controllable heating elements comprise two heating elements.

33. The holding bin of claim **1**, wherein the at least one user interface is configured to set the food holding temperature of each food holding zone, and the first food holding zone is maintained at first set food holding temperature, the second food holding zone is maintained at a second set food holding temperature, the third food holding zone is maintained at a third set food holding temperature, and the fourth food holding zone is maintained at a fourth food set holding temperature.

34. The holding bin of claim **1**, wherein the at least one user interface is configured to set the food holding temperature of each food holding zone and the controller independently operates each heating element such that each food holding zone is maintained at an independently set food holding temperature.

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