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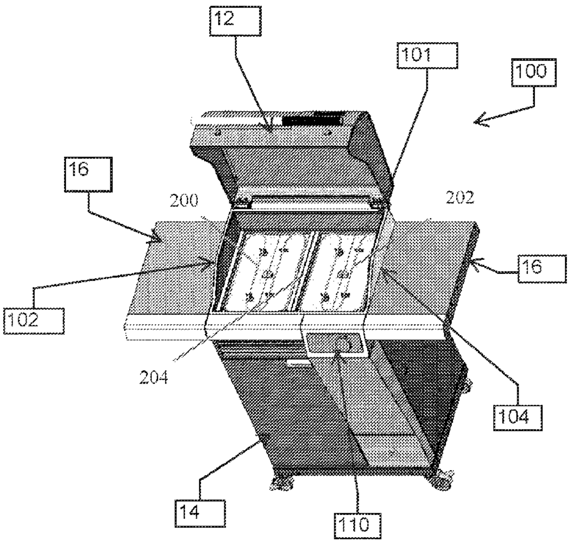

Figure 2

(57) Abstract: An electric grill includes a firebox divided into a plurality of zones. Each zones has an electric heating element, and a temperature probe. A controller having operative control to detect temperatures using the temperature probes adjusts power to the electric heating element for each of the plurality of zones.

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ZONAL ELECTRIC GRILL

CROSS-REFERENCE TO RELATED CASES

[0001] This application claims the benefit of U.S. provisional patent application Serial No. 63/440,573, filed on January 23, 2023, and incorporates such provisional application by reference into this disclosure as if fully set out at this point.

FIELD OF THE INVENTION

[0002] This disclosure relates to electric cooking devices in general and, more particularly, to an electric grill with separately controllable cooking zones.

BACKGROUND OF THE INVENTION

[0003] The traditional electric grills lack the ability to achieve a desired temperature with accuracy, and they cannot maintain the temperature steadily. Even if such a system can get close to the desired temperature initially, it is not thermostatically controlled and cannot adjust to any changes in ambient conditions without continuous involvement of the user and his/her guesswork.

[0004] On the other hand, some single-point-controlled electric grills can provide a reasonable performance when the cooking chamber is relatively small, the expected operation range is limited, and the entire cooking space is sought to have the same temperature. The control system of such a grill treats the entire cooking volume as a single zone, but does not provide ability for the user to fine-tune the temperature or to create and control different temperature zones inside the same cooking volume. This also rules out the possibility of indirect cooking. Even as a single-zone cooking device, a single-point-controlled system cannot precisely provide a uniform temperature across the cooking surface as it relies on a single point reading to assign a temperature value across the entire cooking surface. The limitations of such an approach become even more pronounced in units with larger volumes and wider range of operations. As the volume of the cooking chamber increases, the natural temperature gradient inside that chamber increases and the single-point-controlled system becomes more erroneous.

[0005] What is needed is a system and method to address the above, and related, issues.

SUMMARY OF THE INVENTION

[0006] The invention of the present disclosure, in one aspect thereof, comprises an electric grill having a firebox divided into a plurality of zones. Each zone includes an electric heating element, and a temperature probe. A controller having operative control to detect temperatures using the temperature probe adjusts power to the electric heating element for each of the plurality of zones.

[0007] In some embodiments, the controller operates each of the plurality of zones in a synchronized cycle wherein each of the plurality of zones is maintained at the same temperature. The controller may operates each of the plurality of zones in a desynchronized cycle wherein each of the plurality of zones is assigned maintained at its own temperature. The controller may also operate the plurality of zones in an indirect cycle wherein at least one of the plurality of zones is operated to utilize its electric heating element to maintain a temperature in another one of the plurality of zones.

[0008] The grill may include a divider between at least two of the plurality of zones. The divider may be insulated. The grill may include an additional temperature probe in the firebox separate from the zone temperature probes and communicatively coupled to the controller.

[0009] The invention of the present disclosure in another aspect thereof, comprises an electric grill including a firebox having at least first and second heating zones containing first and second heating elements, respectively. The grill includes first and second cooking surfaces above the first and second heating elements, respectively. The grill includes first and second temperature probes, in the first and second heating zones, respectively. An electric power supply is included. A controller has operative control to adjust electric power from the electrical power supply to the first and second heating elements. First and second temperature probes are situate to measure a temperature associated with the first and second heating zones, respectively, each being communicatively coupled to the controller to provide temperature information thereto. The controller executes a plurality of programs to control the first and second heating elements.

[0010] In some embodiments, one of the plurality of programs comprises a synchronized cycle wherein the first and second heating zones are maintained at the same temperature. One of the plurality of programs may comprise a desynchronized cycle wherein the first heating zone is maintained at a first temperature, and the second heating zone is maintained at a second temperature and the first and second temperatures may or may not be equivalent. One of the plurality of programs may utilize the first heating element to maintain a predetermined temperature in the second heating zone.

[0011] Some embodiments have an insulated divider interposes the first and second heating elements. At least one user control may be physically present on the grill, and may communicatively coupled to the controller to input which of the plurality of programs the controller executes. In some embodiments, the at least one user control communicates to the controller a target temperature for at least one of the first and second heating zones.

[0012] The first and second temperature probes may be calibrated to measure air temperature. The first and second temperature probes may be calibrated to measure surface temperature of the first and second cooking surfaces, respectively.

[0013] The invention of the present disclosure, in another aspect thereof, comprises a method of operating an electric grill. The method includes providing a firebox with at least first and second heating zones each containing first and second heating elements, respectively. The method includes providing a controller having operative control to power, and adjust power, to the first and second heating elements from a power supply. The method includes providing first and second temperature probes in the first and second heating zones, respectively, each being communicatively coupled to the controller. The controller is used to maintain a predetermined first and second temperature in each zone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1 is a perspective view of a zonal electric grill according to aspects of the present disclosure.

[0015] Figure 2 is a perspective view of the zonal electric grill of Figure 1 with cooking grates removed.

[0016] Figure 3 is an overhead view of the zonal electric grill as shown in Figure 2.

[0017] Figure 4 is a perspective view of a zonal electric grill according to aspects of the present disclosure with an additional temperature probe.

[0018] Figure 5 is a general control flow chart according to aspects of the present disclosure.

[0019] Figure 6 is a flowchart of a synchronized cooking cycle according to aspects of the present disclosure.

[0020] Figure 7 is a flowchart of a desynchronized cooking cycle according to aspects of the present disclosure.

[0021] Figure 8 is a flowchart of an indirect cooking cycle according to aspects of the present disclosure.

[0022] Figure 9 is a simplified schematic diagram of a control system for a zonal electric grill according to the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Referring now to Figure 1, a perspective view of a dual-zone digitally controlled electric grill **100** is shown. The grill **100** may include a firebox **101** with an openable lid **12** to cover a cooking surface **15**. The cooking surface **15** may comprise one or more cooking grates. As illustrated, the cooking surface **15** comprises two separate cooking grates **106**, **108**. In some the cooking surface **15** comprises one or more griddles or other cooking surfaces or implements. The firebox **101** may be supported on a cart **14** or other implement. The firebox **101** may also be permanently installed in a permanent outdoor location or elsewhere. Some embodiments provide side shelves **16** attached to the cart **14** or firebox **101,** as well as other accessories as known in the art.

[0024] In some embodiments, the firebox **101** is divided into two zones labeled as Zone 1 **(102)** and Zone 2 **(104)**. In Figure 1, cooking gates **106**, **108** can be seen in or covering Zones 1 **(102)** and Zone 2 **(104)**, respectively. It should be understood that a firebox, cooking surface, or grate could be separated or divided into more than two zones in other embodiments. For example, some embodiments could utilize three or four zones.

[0025] Referring now to Figure 2 another perspective view of the dual-zone digitally controlled electrical grill **100** is shown with grates **106, 108** removed to illustrate internal components of the firebox **101**. Each zone **102**, **104** has a separately-controlled heating element **200**, **202,** respectively, in the firebox **101**. According to the present disclosure, heating elements may comprise resistive heating elements as known in the art. The heating elements **102**, **202** may be separated by a boundary or divider **204**, which may also serve to divide or demarcate the zones **102**, **104**. This divider **204** may be insulated for temperature regulation of the zones **200**, **104**.

[0026] Referring now to Figure 3, an overhead view of the zonal electric grill **100** is shown. Each zone **102, 104** may be controlled based on information or data provided by a temperature probe **300**, **302** dedicated to the respective zone **102**, **104**. Locations of temperature probes **300**, **302** are exemplary only as shown. In some embodiments, more than one temperature probe may be utilized per zone to increase the available data. If additional zones are provided, each may have one or more temperature probes.

[0027] In the illustrated embodiment, each zone **102**, **104** has an independent element box, **303**, **304**, respectively, allowing the zones **102**, **204**. The divider **204** may be considered part of the element boxes **303**, **304**. The element boxes **303**, **304** may comprise thermally reflective materials and/or insulation. Element boxes **303**, **304** allow the heating elements **200**, **202** and the respective zones **102**, **104** to be thermally separated and insulated from each other.

[0028] Each zone (e.g., **102**, **104)** may be powered or heated by a single heating element dedicated to a given zone. Alternatively, each zone can be powered by more than one heating element. For instance, each zone may have one heating element providing sufficient heat for low-temperature cooking and one or more additional heating elements to provide for high-heat cooking. In another example, each zone has one heating element providing sufficient heat for a wide range of cooking under most ambient conditions, with one or more zones provided with one or more additional heating elements to provide "boosting." Such boosting may be utilized when shorter heat-up times (and shorter recovery time) are desired, or when extreme cold ambient requires a boost to the provided heat to the cooking zone, for example.

[0029] Feedback in the form of temperature readings may be provided the temperature probes **300**, **302** assigned to each zone **102**, **104**. Referring now to Figure 4 a perspective view of the zonal electric grill **100** with an additional temperature probe **400** is shown. Probe **400** may be placed inside the cooking chamber **101** to provide the air temperature of the cooking chamber cavity, when desired (for example for indirect cooking or for the low and slow smoking process). Temperature probes utilized with embodiments of the present disclosure may be resistivity based, or based upon other technology or methods known to the art.

[0030] Referring now to Figure 9 is a simplified schematic diagram **900** of a control system **110** for a zonal electric grill according to the present disclosure is shown. The control system **110** may comprise an electronic microcontroller **910**, which may comprise a programmable silicon device capable of executing the control methods described herein. The microcontroller **910** may comprise a system-on-a-chip device, as is known in the art, and may include on board memory, I/O ports, etc. The microcontroller **910** may also comprise a field programable gate array (FPGA) and application specific integrated circuit (ASIC) or another device capable of implementing the control methodology as may be known in the art.

[0031] The microcontroller is **910** communicatively coupled to temperature probes **300**, **302**, **400**.

[0032] In the present embodiment, a knob **902**, communicatively coupled to the microcontroller, allows for powering on and/or selection of the program to be followed (the programming and control methods being described further below). A knob **906** may be provided for selection of a desired temperature for Zone 1, and a knob **904** may be provided for selection of a desired temperature for Zone 2 (e.g., when the zone are not synchronized. One of skill in the art will appreciate that functions may be combined onto fewer knobs in some cases. Switches or sliders can also provide control inputs. Touch screens and remote control (e.g., via an app) are also provided in other embodiments. Wireless communications or commands may be received over the air (e.g., from the internet, a cloud server, a remote computer, or a mobile device). In some cases the microcontroller **910** provides such functionality natively. In other embodiments, separate communications chips or other devices may be employed.

[0033] Necessary relays, amplifiers, switch gear and other circuit components may be provided as needed to enable to control system **110** to operate as described herein, and particularly to allow the microcontroller **910** to have operative control over the heating elements. In the present embodiment, such devices are shown as a relay bank **912**. A power supply **914** for the system **900** may comprise household AC main power. In some embodiments, the power supply **914** may comprise a direct current source, such as a battery. AC to DC or DC to AC conversion may be provided as function of the relay bank **912** or in a separate device or component as known in the art.

[0034] Exemplary logic or methodology implemented by the control systems according to the present disclosure (e.g., control system **110**) is illustrated in Figs. 5-8. According to one control method, there are three main control cycles (each one with its own sub-cycles): a synchronized cycle, a desynchronized cycle, and an indirect cycle. Figure 5 is a general control flow chart according to aspects of the present disclosure wherein the various cycles are selected and started. Figure 6 is a flowchart of the synchronized cooking cycle; Figure 7 is a flowchart of the desynchronized cooking cycle; and Figure 8 is a flowchart of the indirect cooking cycle.

[0035] As shown in Figure 5, a general control cycle **500** may begin by reading the selected cooking mode at step **502**. Determination may then be made at steps **504** and **508** whether the synchronized cycle **506**, the desynchronized cycle **512** or the indirect cycle **510** is selected.

[0036] Beginning with Figure 5, the synchronized **506** cycle assigns the same setpoint to the entire grill **100**. Using the data provided by temperature probes **300**, **302** in each zone **102**, **104**, the system controls the heating elements **200**, **202** to provide precise uniform temperature across the entire cooking surface. Depending on the setpoint and desired type of cooking, the target temperature could be the cooking grate temperature (more suitable for applications such as grilling) or the cooking chamber air temperature (more suitable for applications such as slow cooking). Raw readings (possibly in the form of a voltage) from a temperature probe are calibrated appropriately for the chosen cooking method and setpoint as known in the art. Calibration may be based on temperature at a predetermined location (e.g., the cooking surface, or air temperature inside the firebox) correlated to the raw data received from a probe at such temperature.

[0037] The desynchronized cycle **512** may be used when different cooking methods and/or temperatures are desired. This allows for zonal cooking as each cooking zone **102**, **104** will be controlled exclusively with respect to its chosen setpoint.

[0038] The indirect cycle **510** may allow for cooking on one zone while the heat is provided indirectly from another zone. The control system **110** uses the temperature probe dedicated to the cooking zone to control the heating element in the neighboring zone(s) to provide precise indirect cooking. Again, depending on the setpoint for the indirect cooking, the target temperature could be the cooking grate temperature or the cooking chamber air temperature.

[0039] Referring particularly now to Figure 6, the synchronized cooking cycle **506** is more fully illustrated. When it is determined at step **504**, for example, that the synchronized cycle should run, all zones target the same setpoint (SP). For each given zone, the control system **110** checks the difference between the readings of the temperature for that zone (GT) and the target (SP) at step **604**. The control system **110** calculates the maximum power level required for each zone based on SP and GT for that zone at step **606**. This allows for smart power sharing management to optimize the power usage and maximize the system efficiency which becomes more important when the supply power is limited. It should also be noted that systems and methods of the present disclosure also allow for greater than half of the available power to be expended on a given zone (this presumes two zones, if there are 'n' zones in a system, then greater than 1/n of the available power can be expended in single zone). Stated another way, for each zone, depending upon current setpoints and grill temperatures, power allocated to a given zone can vary between zero and all of the power available to the system. This may be important, for example, if one zone has a larger food item and thus a larger heat sink to contend with.

[0040] As shown at steps **608A** and **608B** for Zone 2, if the temperature of the given zone is lower than the setpoint by more than a predetermined threshold (DT), then the control system **110** energizes that zone with the maximum power rate (determined for that zone) at step **610**. If the temperature of the given zone is higher than the setpoint by more than a predetermined threshold, then the control system **110** minimizes the power delivered to that zone at step **612**. If the temperature is in between (i.e., ABS(GT-SP)≤DT), then the control system **110** dynamically adjusts the rate of the power supply to that zone at step **614** (e.g., by varying the applied voltage).

[0041] Similar to the above, for Zone 1, as shown at steps **618A** and **618B** if the temperature of the given zone is lower than the setpoint by more than a predetermined threshold (DT), then the control system **110** energizes that zone with the maximum power rate (determined for that zone) at step **620**. If the temperature of the given zone is higher than the setpoint by more than a predetermined threshold, then the control system **110** minimizes the power delivered to that zone at step **622**. If the temperature is in between (i.e., ABS(GT-SP)≤DT), then the control system **110** dynamically adjusts the rate of the power supply to that zone at step **624** (e.g., by varying the applied voltage).

[0042] The predetermined threshold can be a function of the setpoint. It also can depend on whether the temperature value is above the setpoint or below the setpoint. Depending on the setpoint, the raw data provided by the temperature probes can be processed differently (using different calibrations) to determine either the grate temperature or the air temperature (whichever is more suitable for the sought method of cooking). Although all the zones are targeting the same setpoint, each zone is controlled individually.

[0043] It should be understood that the control branches for Zone 1 and Zone 2 may occur simultaneously, or as part of a threaded process such that the control for each occurs in real time. Following each control loop for Zone 2, a time interval may be allowed to pass at step **616** before repeating the control loop. Similarly, a time interval delay at step **626** may occur for Zone 1.

[0044] Figure 7 illustrates the desynchronized cooking cycle **700**. This would occur if the synchronized cycle is not selected at step **504** but direct cooking is selected at step **508**. All zones are involved in direct cooking, however, targeting different setpoints (SP). For each zone, the control system **110** checks the difference between the readings of the temperature for that zone (GT) and the target (SP). In the diagram **512**, reading Zone 1 SP and GT is at step **706**. Zone 2 SP and GT are read at step **710**. At step **708**, the range available for Zone 2 may be determined (assuming the first temperature set is for Zone 1). This may be based in part on the temperature selected for Zone 1, as a very high temperature setting for Zone 1 can limit the range available to Zone 2 based on power availability.

[0045] The system calculates the maximum power level required for each zone based on SP and GT for that zone at step **712**. If the temperature of Zone 2 is lower than the setpoint by more than a predetermined threshold (DT) as determined at steps **714A,B**, then the control system **110** energizes Zone 2 with the maximum power rate at step **716**. If the temperature of the Zone 2 is higher than the setpoint by more than a predetermined threshold, then the control system **110** minimizes the power delivered to Zone 2 at step **718**. If the temperature is in between, ABS(GT-SP)≤DT, then the control system **110** dynamically adjusts the rate of the power supply to Zone 2 at step **720** (e.g., by varying the applied voltage).

[0046] The process for Zone 1 mirrors that of Zone 2. If the temperature of Zone 1 is lower than the setpoint by more than a predetermined threshold (DT) as determined at steps **724A,B**, then the control system **110** energizes Zone 1 with the maximum power rate at step **726**. If the temperature of the Zone 1 is higher than the setpoint by more than a predetermined threshold, then the control system **110** minimizes the power delivered to Zone 1 at step **728**. If the temperature is in between, ABS(GT-SP)≤DT, then the control system **110** dynamically adjusts the rate of the power supply to Zone 1 at step **730** (e.g., by varying the applied voltage).

[0047] The predetermined threshold may be a function of the setpoint. The first chosen setpoint can impact the available range for the other zone(s). This is to prevent the situation that a user tries to choose a series of setpoints that cannot be achieved simultaneously. Depending on the setpoint, the raw data provided by the temperature probes may be processed differently (using different calibrations) to determine either the grate temperature or the air temperature.

[0048] It can also be seen that appropriate delays or time intervals may be built into the process (e.g., at steps **721**, **731**) to allow heating elements time to heat up or cool down rather than continually adjusting power before heating elements have had time to react. It should also be understood that the control processes for Zones 1 and 2 may occur sequentially or simultaneously. It should be pointed out here again that systems and methods of the present disclosure can provide from zero power up to maximum available power to a given zone if demands require it and the power is not currently needed for another zone. For example, in the desynchronized operation mode, one zone may reach its setpoint much sooner, or be able to maintain its setpoint with much less power, than another zone. The system may thus divert more power when needed to the zone with higher demands for power.

[0049] Figure 8 illustrates the indirect cooking cycle **510**. This cycle may occur when neither synchronized cooking is selected at step **504** nor direct cooking at step **508**. One zone is where the food is placed (main zone), and other zone(s) would provide the indirect heat for cooking. In this example, Zone 1 is to be used for cooking but Zone 2 or another zone in the case or three or more zones could be used for cooking. After stopping the energy supply at step **802**, for the zone with the food (here, Zone 1), the control system **110** checks the difference between the readings of the temperature for that zone (GT) and the target (SP) at step **804**. As determined at steps **806A** and **806B**, if the temperature of the given zone is lower than the setpoint by more than a predetermined threshold (DT), then the control system **110** energizes the neighbor zone(s) with the maximum power rate at step **808**. If the temperature is higher than the setpoint by more than a predetermined threshold, then the control system **110** minimizes the power rate at step **810**. If the temperature is in between, then the control system **110** dynamically adjusts the rate of the power supply to the neighbor zones at step **812**. The predetermined threshold can be a function of the setpoint. Depending on the setpoint, the raw data provided by the temperature probe can be processed differently (using different calibrations) to determine either the grate temperature of or the air temperature.

[0050] Although the illustrations are focused to a dual-zone grill, the application of this innovation can be applied by one of skill in the art to multi-zone electric grills with an even larger number of zones following the same principles provided herein.

* * * *

[0051] It is to be understood that the terms "including", "comprising", "consisting" and grammatical variants thereof do not preclude the addition of one or more components, features, steps, or integers or groups thereof and that the terms are to be construed as specifying components, features, steps or integers.

[0052] If the specification or claims refer to "an additional" element, that does not preclude there being more than one of the additional element.

[0053] It is to be understood that where the claims or specification refer to "a" or "an" element, such reference is not be construed that there is only one of that element.

[0054] It is to be understood that where the specification states that a component, feature, structure, or characteristic "may", "might", "can" or "could" be included, that particular component, feature, structure, or characteristic is not required to be included.

[0055] Where applicable, although state diagrams, flow diagrams or both may be used to describe embodiments, the invention is not limited to those diagrams or to the corresponding descriptions. For example, flow need not move through each illustrated box or state, or in exactly the same order as illustrated and described.

[0056] Methods of the present invention may be implemented by performing or completing manually, automatically, or a combination thereof, selected steps or tasks.

[0057] The term "method" may refer to manners, means, techniques and procedures for accomplishing a given task including, but not limited to, those manners, means, techniques and procedures either known to, or readily developed from known manners, means, techniques and procedures by practitioners of the art to which the invention belongs.

[0058] The term "at least" followed by a number is used herein to denote the start of a range beginning with that number (which may be a range having an upper limit or no upper limit, depending on the variable being defined). For example, "at least 1" means 1 or more than 1. The term "at most" followed by a number is used herein to denote the end of a range ending with that number (which may be a range having 1 or 0 as its lower limit, or a range having no lower limit, depending upon the variable being defined). For example, "at most 4" means 4 or less than 4, and "at most 40%" means 40% or less than 40%.

[0059] When, in this document, a range is given as "(a first number) to (a second number)" or "(a first number) – (a second number)", this means a range whose lower limit is the first number and whose upper limit is the second number. For example, 25 to 100 should be interpreted to mean a range whose lower limit is 25 and whose upper limit is 100. Additionally, it should be noted that where a range is given, every possible subrange or interval within that range is also specifically intended unless the context indicates to the contrary. For example, if the specification indicates a range of 25 to 100 such range is also intended to include subranges such as 26 -100, 27-100, etc., 25-99, 25-98, etc., as well as any other possible combination of lower and upper values within the stated range, e.g., 33-47, 60-97, 41-45, 28-96, etc. Note that integer range values have been used in this paragraph for purposes of illustration only and decimal and fractional values (e.g., 46.7 – 91.3) should also be understood to be intended as possible subrange endpoints unless specifically excluded.

[0060] It should be noted that where reference is made herein to a method comprising two or more defined steps, the defined steps can be carried out in any order or simultaneously (except where context excludes that possibility), and the method can also include one or more other steps which are carried out before any of the defined steps, between two of the defined steps, or after all of the defined steps (except where context excludes that possibility).

[0061] Further, it should be noted that terms of approximation (e.g., "about", "substantially", "approximately", etc.) are to be interpreted according to their ordinary and customary meanings as used in the associated art unless indicated otherwise herein. Absent a specific definition within this disclosure, and absent ordinary and customary usage in the associated art, such terms should be interpreted to be plus or minus 10% of the base value.

[0062] Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned above as well as those inherent therein. While the inventive device has been described and illustrated herein by reference to certain preferred embodiments in relation to the drawings attached thereto, various changes and further modifications, apart from those shown or suggested herein, may be made therein by those of ordinary skill in the art, without departing from the spirit of the inventive concept the scope of which is to be determined by the following claims.

CLAIMS

What is claimed is:

1. An electric grill comprising:

a firebox divided into a plurality of zones wherein each zone includes:

an electric heating element; and

a temperature probe;

a controller having operative control to detect temperatures using the temperature probe and adjust power to the electric heating element for each of the plurality of zones.

2. The electric grill of claim 2, wherein the controller operates each of the plurality of zones in a synchronized cycle wherein each of the plurality of zones is maintained at the same temperature.

3. The electric grill of claim 2, wherein the controller operates each of the plurality of zones in a desynchronized cycle wherein each of the plurality of zones is assigned maintained at its own temperature.

4. The electric grill of claim 2, wherein the controller operates the plurality of zones in an indirect cycle wherein at least one of the plurality of zones is operated to utilize its electric heating element to maintain a temperature in another one of the plurality of zones.

5. The electric grill of claim 2, further comprising a divider between at least two of the plurality of zones.

6. The electric grill of claim 5, wherein the divider is insulated.

7. The electric grill of claim 2, further comprising an additional temperature probe in the firebox separate from the zone temperature probes and communicatively coupled to the controller.

8. An electric grill comprising:

a firebox having at least first and second heating zones containing first and second heating elements, respectively;

first and second cooking surfaces above the first and second heating elements, respectively;

first and second temperature probes, in the first and second heating zones, respectively;

an electric power supply;

a controller having operative control to adjust electric power from the electrical power supply to the first and second heating elements; and

first and second temperature probes situated to measure a temperature associated with the first and second heating zones, respectively, each being communicatively coupled to the controller to provide temperature information thereto;

wherein the controller executes a plurality of programs to control the first and second heating elements.

9. The electric grill of claim 8, wherein one of the plurality of programs comprises a synchronized cycle wherein the first and second heating zones are maintained at the same temperature.

10. The electric grill of claim 8, wherein one of the plurality of programs comprises a desynchronized cycle wherein the first heating zone is maintained at a first temperature, and the second heating zone is maintained at a second temperature and the first and second temperatures may or may not be equivalent.

11. The electric grill of claim 8, wherein one of the plurality of programs utilizes the first heating element to maintain a predetermined temperature in the second heating zone.

12. The electric grill of claim 8, wherein an insulated divider interposes the first and second heating elements.

13. The electric grill of claim 8, further comprising at least one user control on the grill that is communicatively coupled to the controller to input which of the plurality of programs the controller executes.

14. The electric grill of claim 11, wherein the at least one user control communicates to the controller a target temperature for at least one of the first and second heating zones.

15. The electric grill of claim 8, wherein the first and second temperature probes are calibrated to measure air temperature.

16. The electric grill of claim 8, wherein the first and second temperature probes are calibrated to measure surface temperature of the first and second cooking surfaces, respectively.

17. A method of operating an electric grill comprising:

providing a firebox with at least first and second heating zones each containing first and second heating elements, respectively;

providing a controller having operative control to power, and adjust power, to the first and second heating elements from a power supply;

providing first and second temperature probes in the first and second heating zones, respectively, each being communicatively coupled to the controller; and

using the controller maintain a predetermined first and second temperature in each zone.

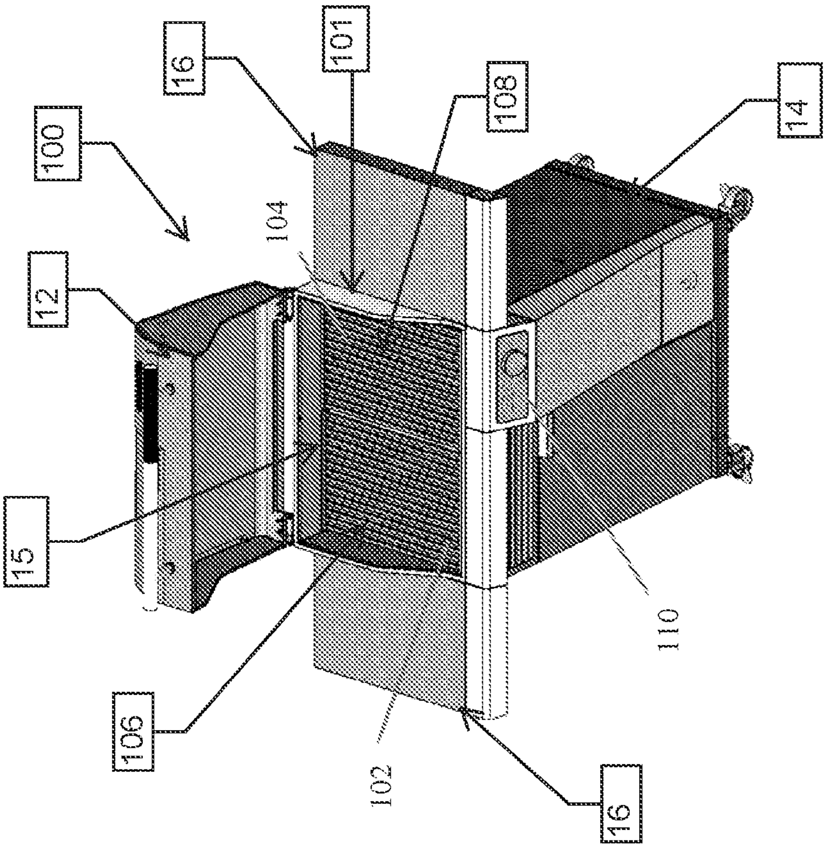


Figure 1

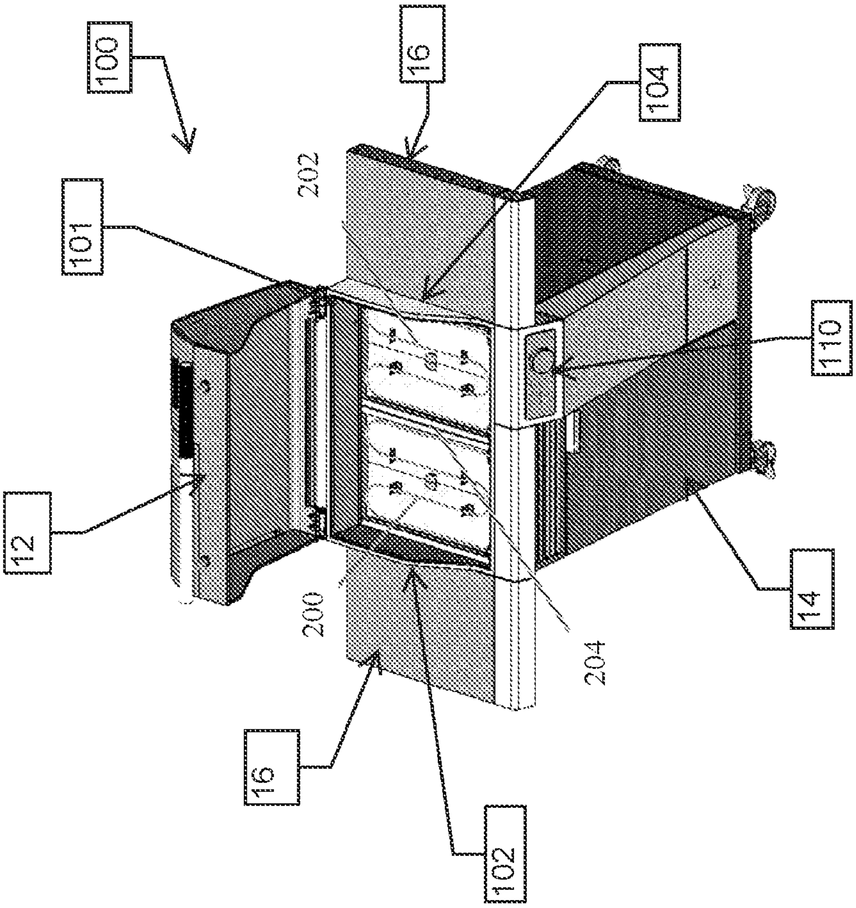


Figure 2

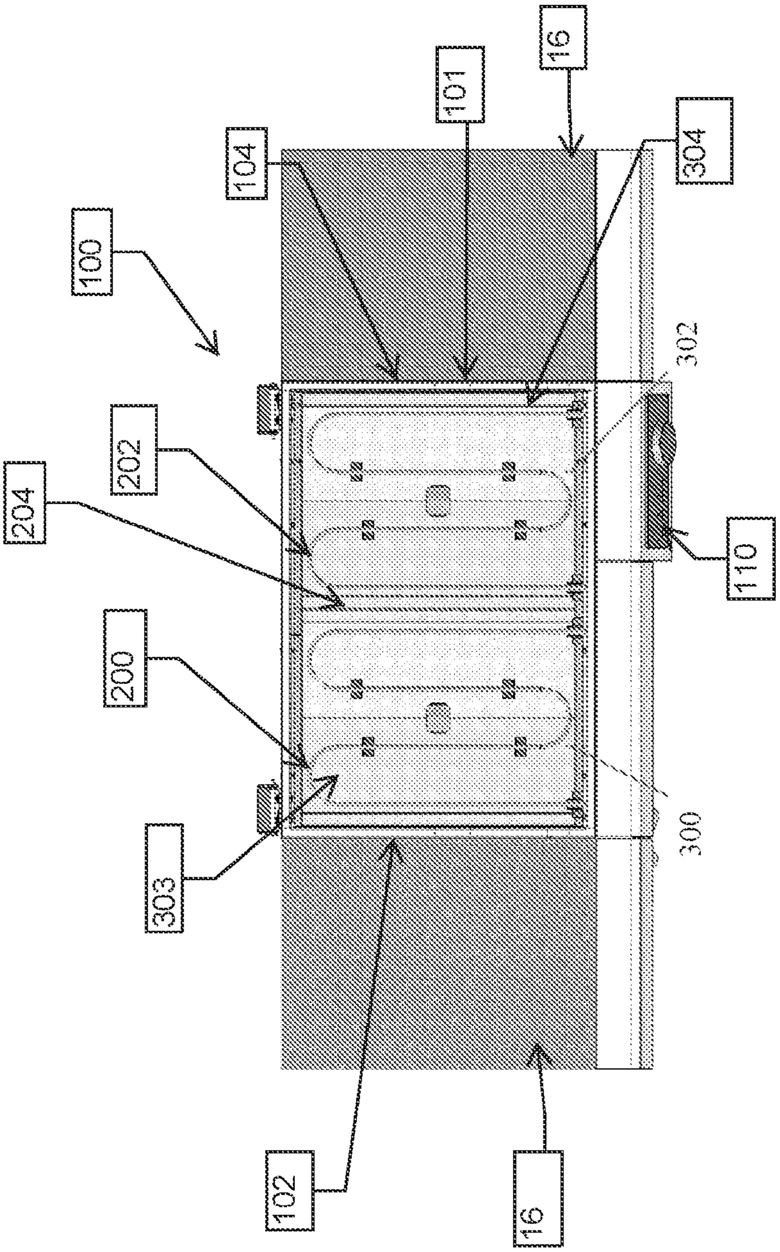


Figure 3

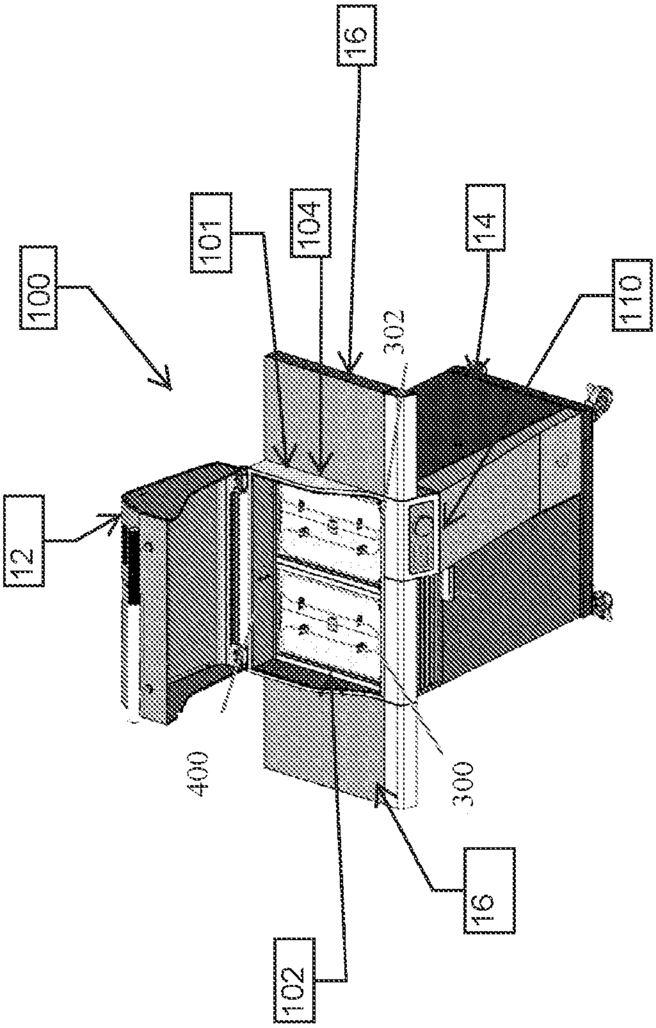


Figure 4

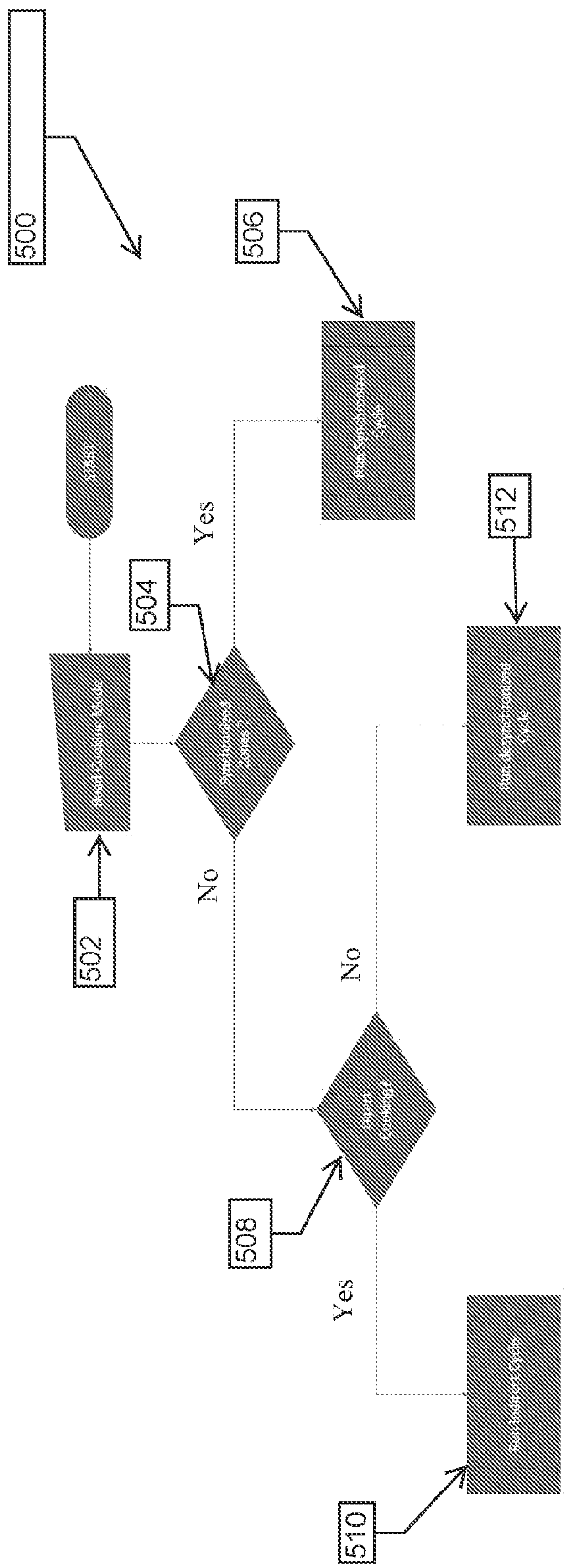
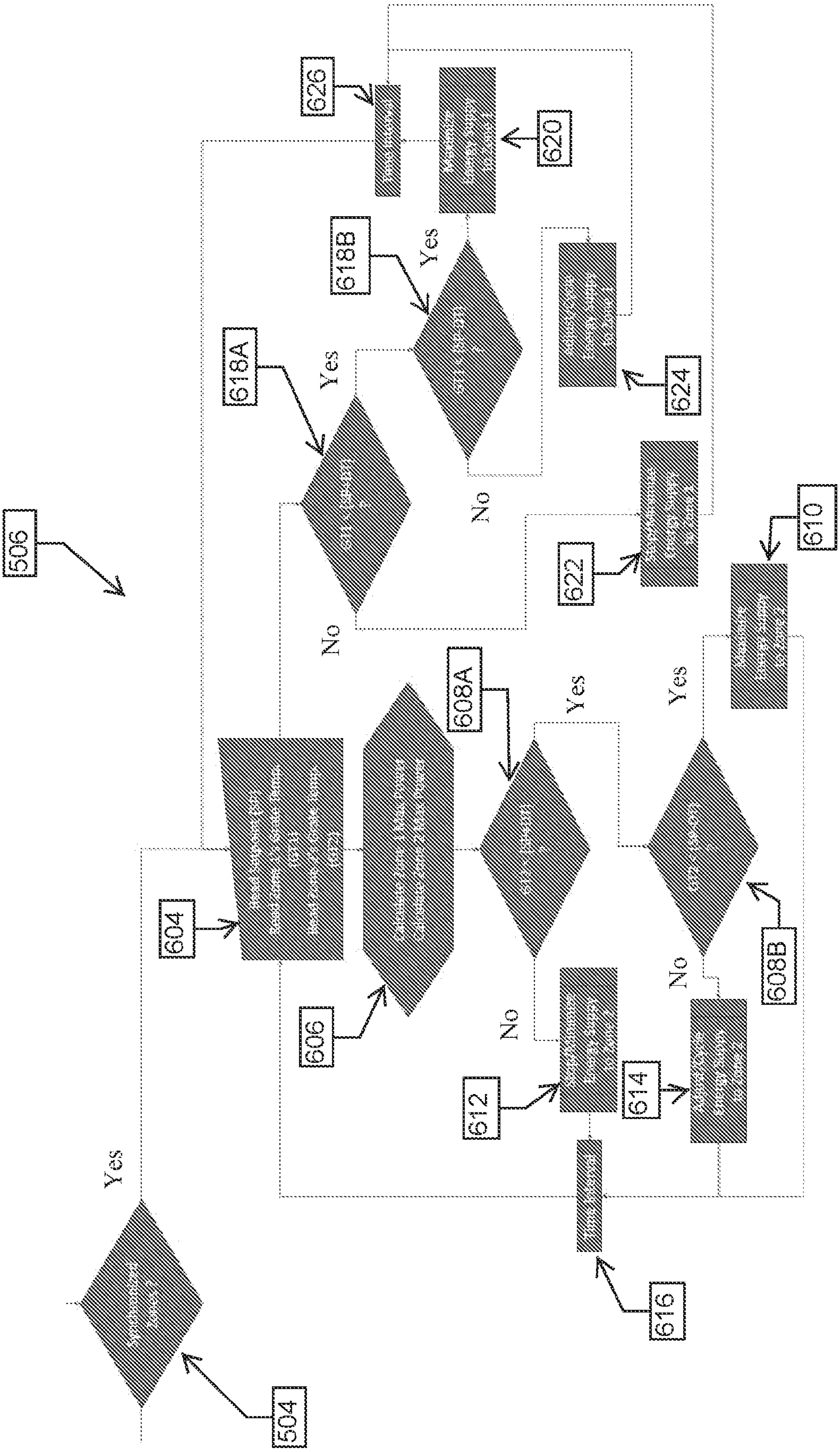


Figure 5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504
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604
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608A
608B
610
612
614
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618A
618B
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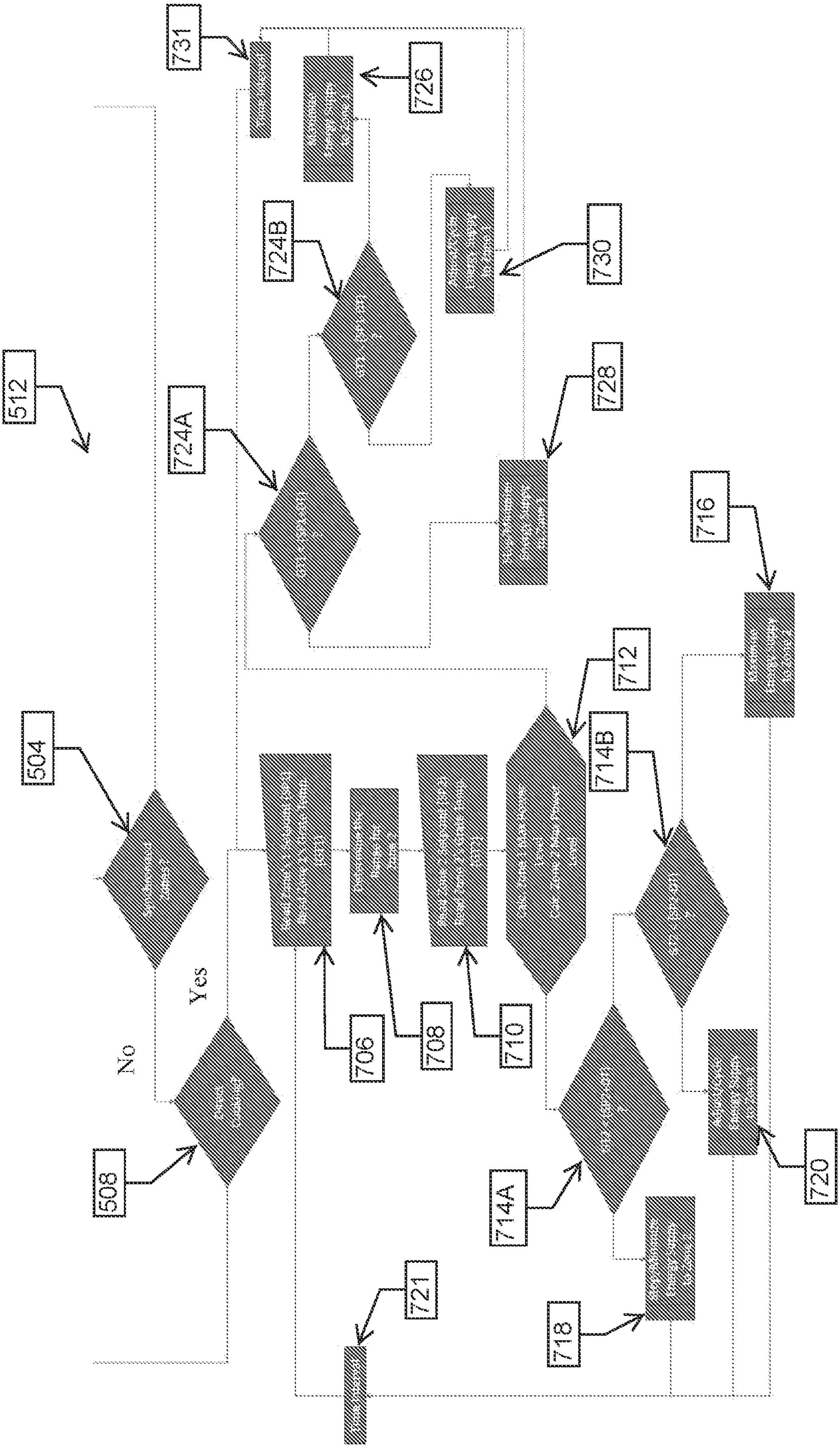
622
624
626
Yes
No
Yes
No
Yes
No
Yes
No
Yes

Figure 6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508
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Yes
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714A
714B
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718
720
721
724A
724B
726
728
730
731

Figure 7

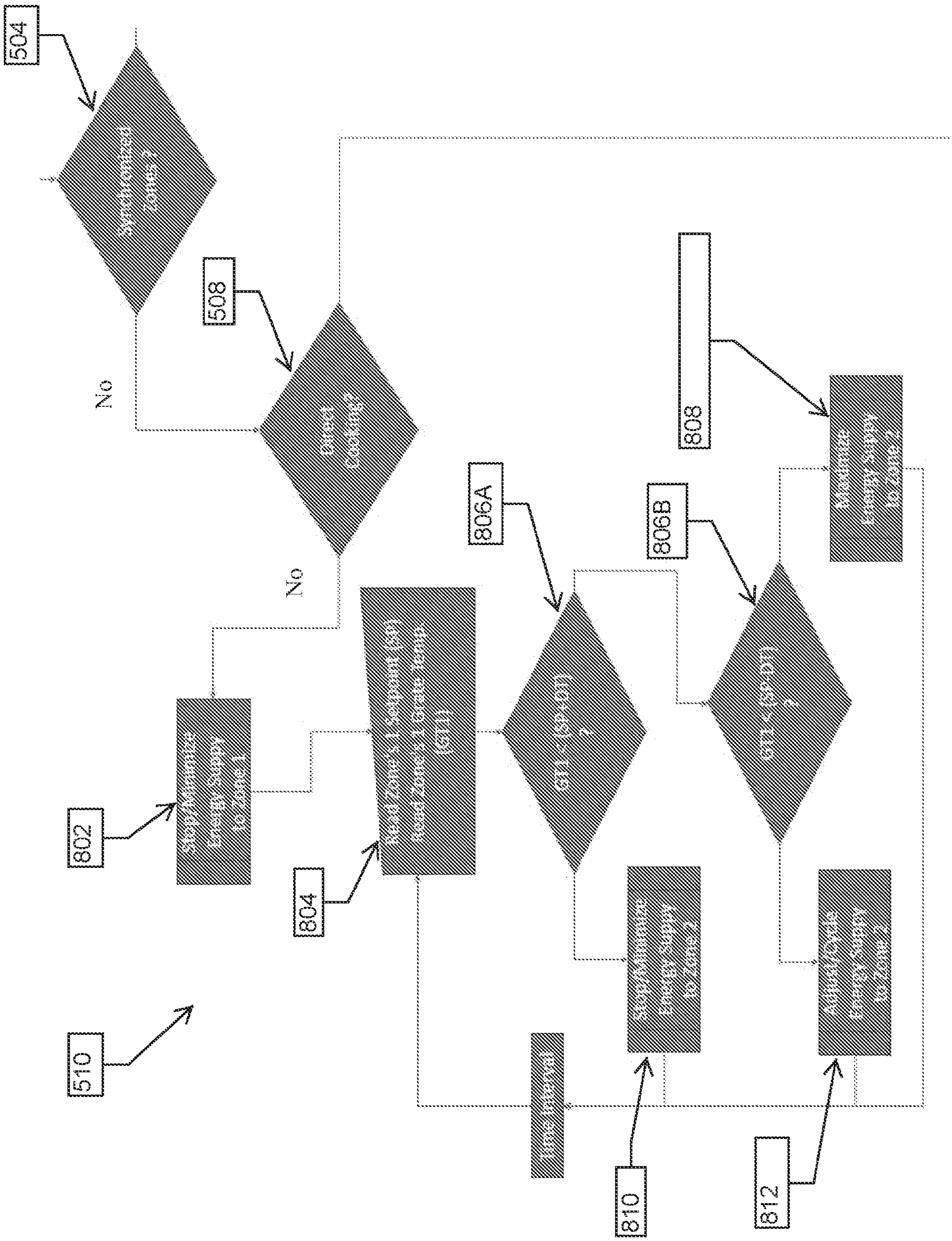
504
Synchronized Zones ?
508
No
Direct Cooking?
No
802
Stop/Minimize Energy Supply to Zone 1
804
Read Zone's 1 Setpoint (SP)
Read Zone's 1 Grate Temp (GT1)
806A
GT1 < (SP-DT) ?
806B
GT1 < (SP-DT) ?
808
Maximize Energy Supply to Zone 2
Stop/Minimize Energy Supply to Zone 2
Adjust/Cycle Energy Supply to Zone 2
Time Interval
510
810
812

Figure 8

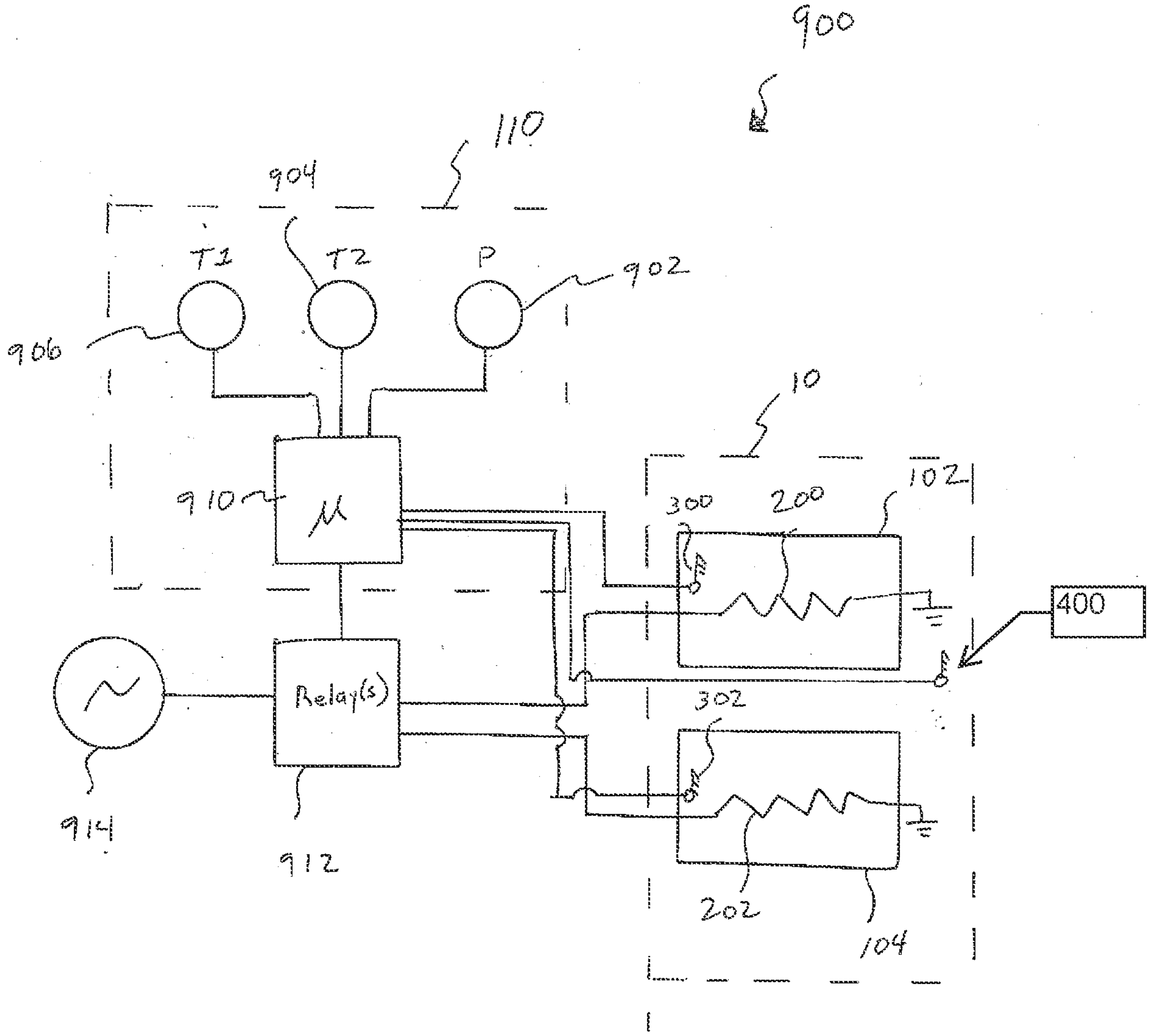
900
110
904
T1
T2
P
902
906
10
910
μ
300
200
102
400
Relay(s)
302
914
912
202
104

Figure 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 24/12628

A. CLASSIFICATION OF SUBJECT MATTER
IPC - INV. A47J 37/07 (2024.01)
ADD. A47J 27/00, A47J 27/62, G01K 7/00, G01K 7/04, H05B 3/00 (2024.01)

CPC - INV. A47J 37/0709

ADD. A47J 37/07, A47J 27/00, A47J 27/62, A47J 37/0704, A47J 37/0786, G01K 7/00

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)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2018/0007738 A1 (Knappenberger et al.) 4 January 2018 (04.01.2018), entire document	1-4, 8-11, 13-14, 16-17
Y		5-7, 12, 15
Y	US 2005/0205544 A1 (Bachinski et al.) 22 September 2005 (22.09.2005), entire document	5-7, 12, 15
A	US 2018/0116452 A1 (Reischmann et al.) 3 May 2018 (03.05.2018), entire document	1-17
A	US 2022/0304118 A1 (Kenyon International, Inc.) 22 September 2022 (22.09.2022), entire document	1-17
A	US 2022/0186937 A1 (Team International Group of America Inc.) 16 June 2022 (16.06.2022), entire document	1-17

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

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"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
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"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
14 April 2024	MAY 06 2024

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