



22 09 21

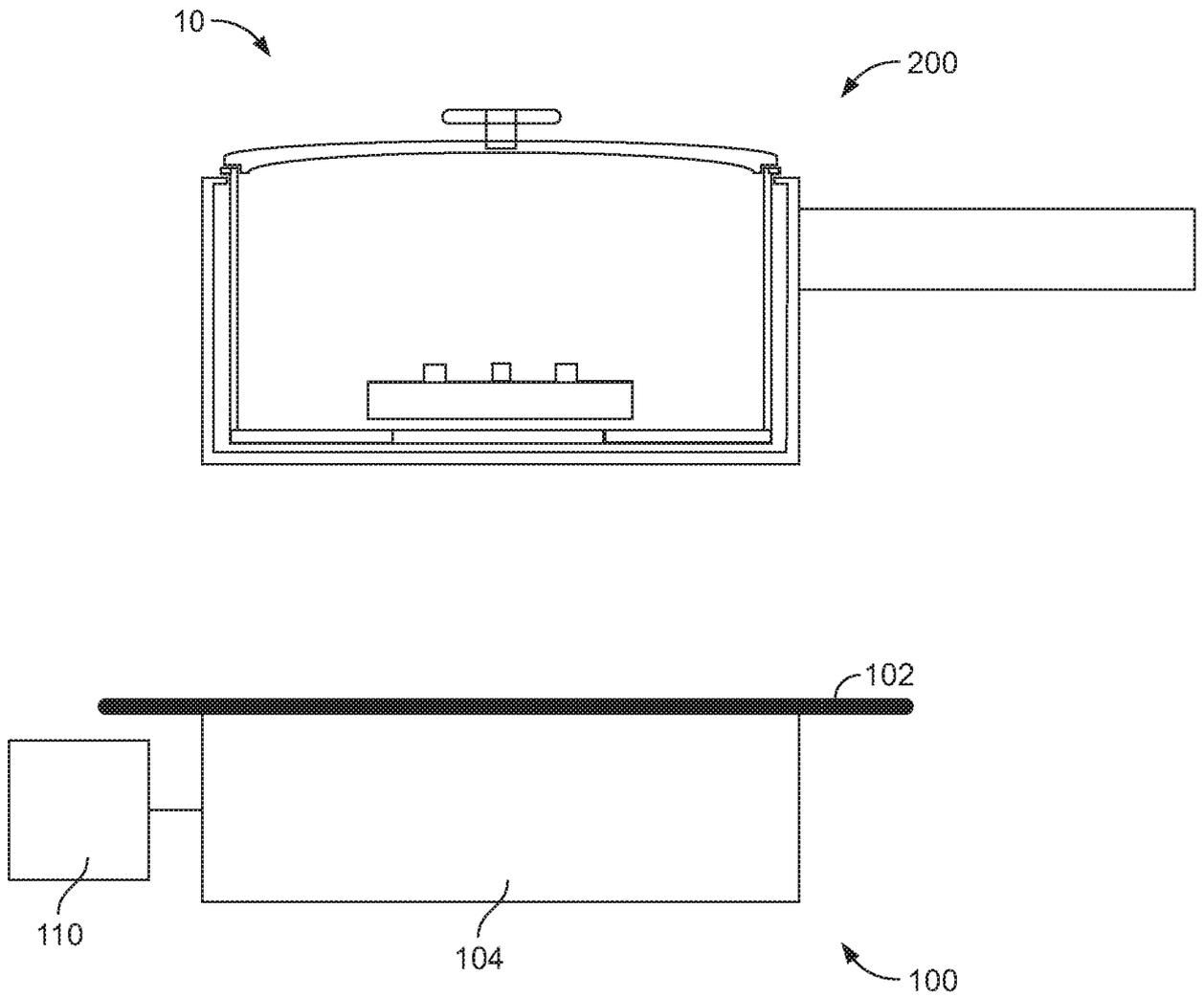


FIG. 1

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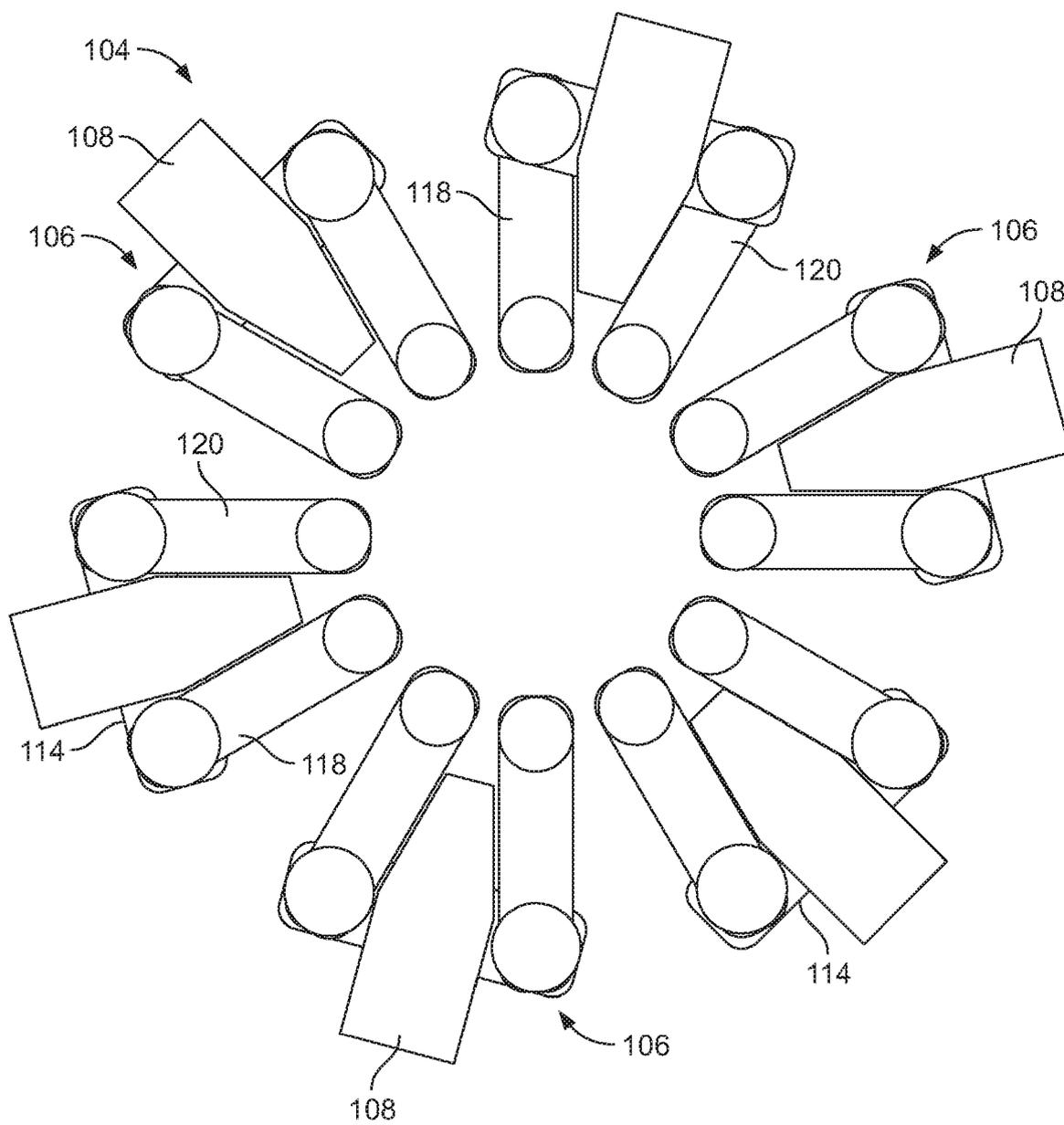


FIG. 2

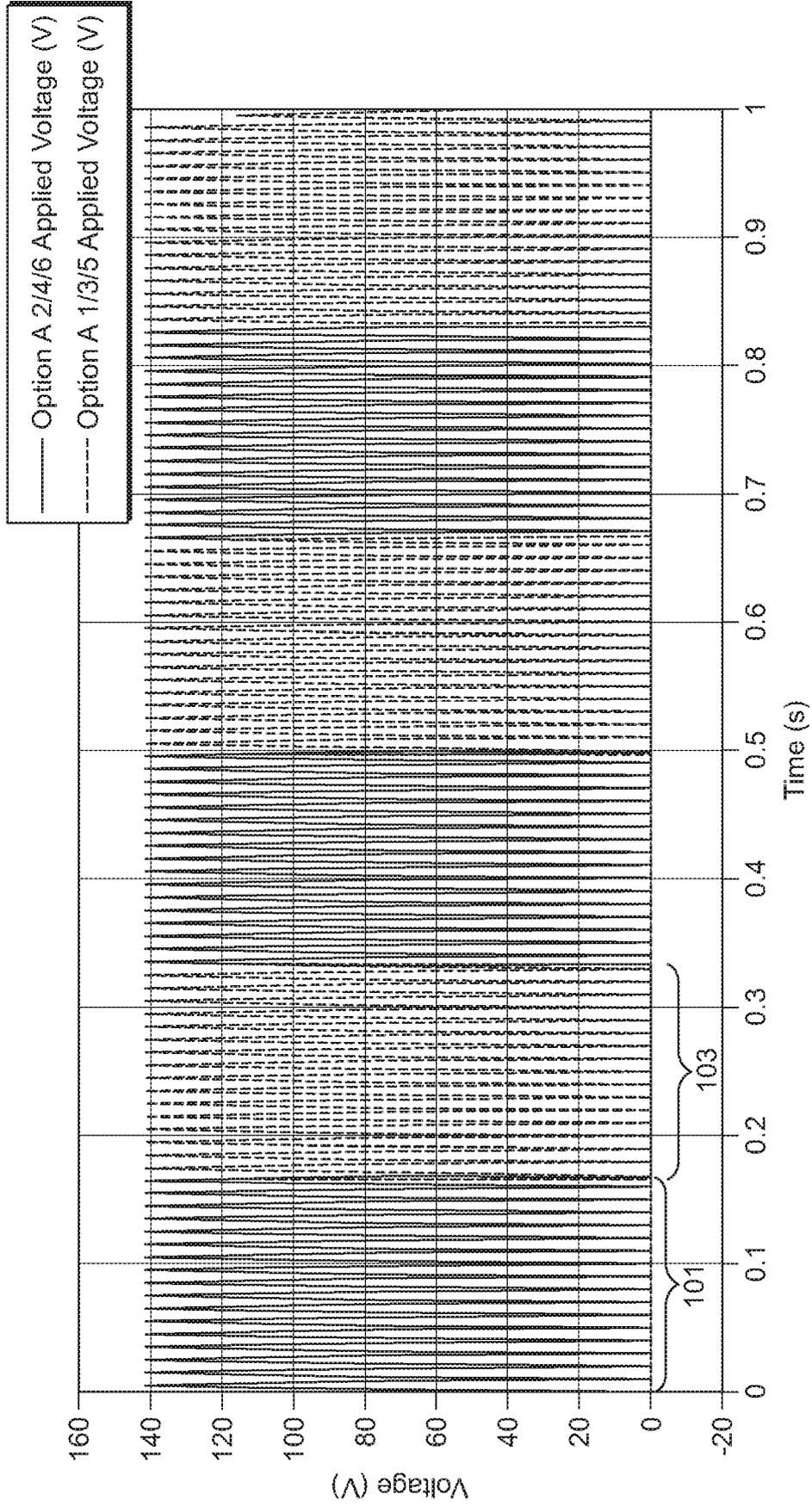


FIG. 3A

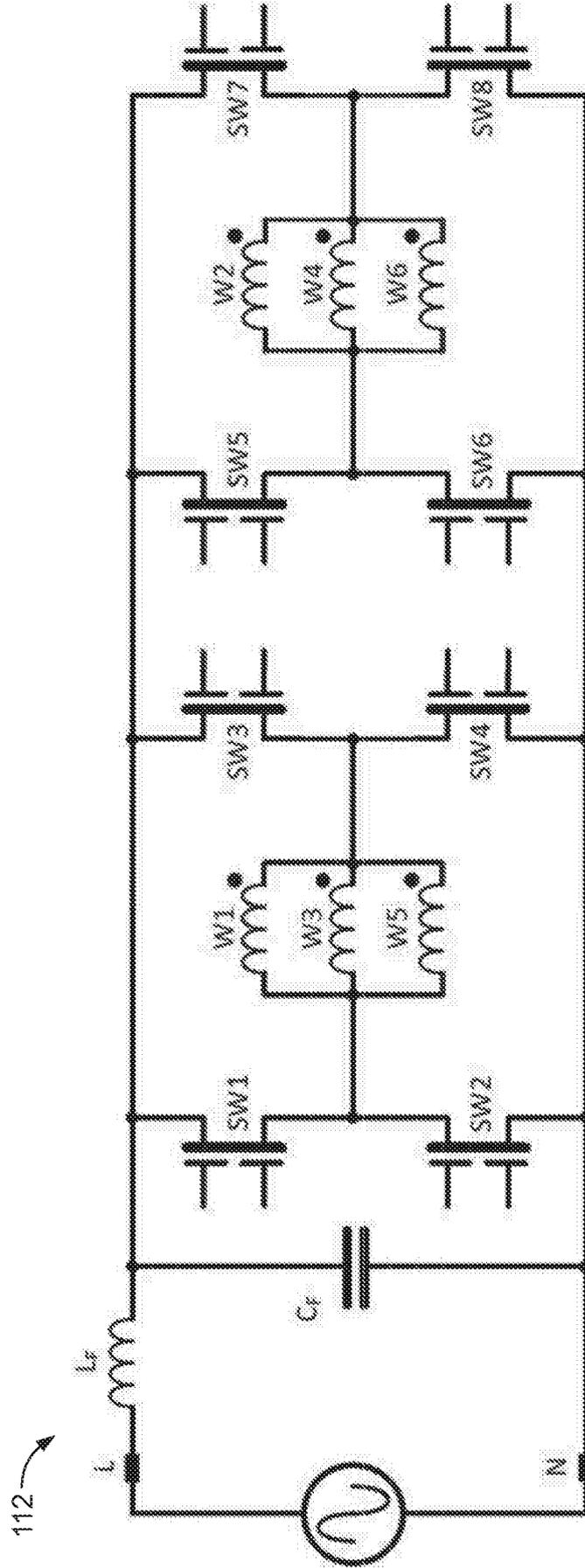


FIG. 3B

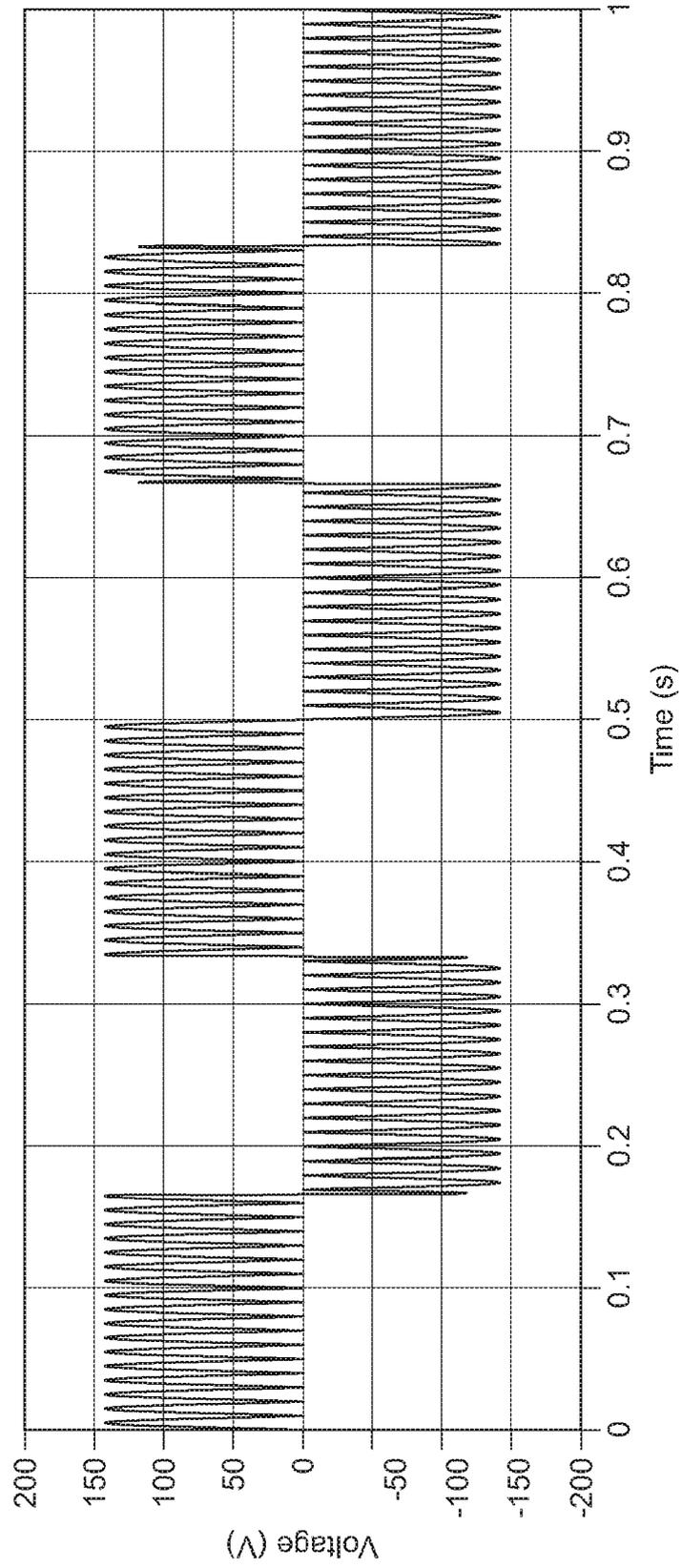


FIG. 3C

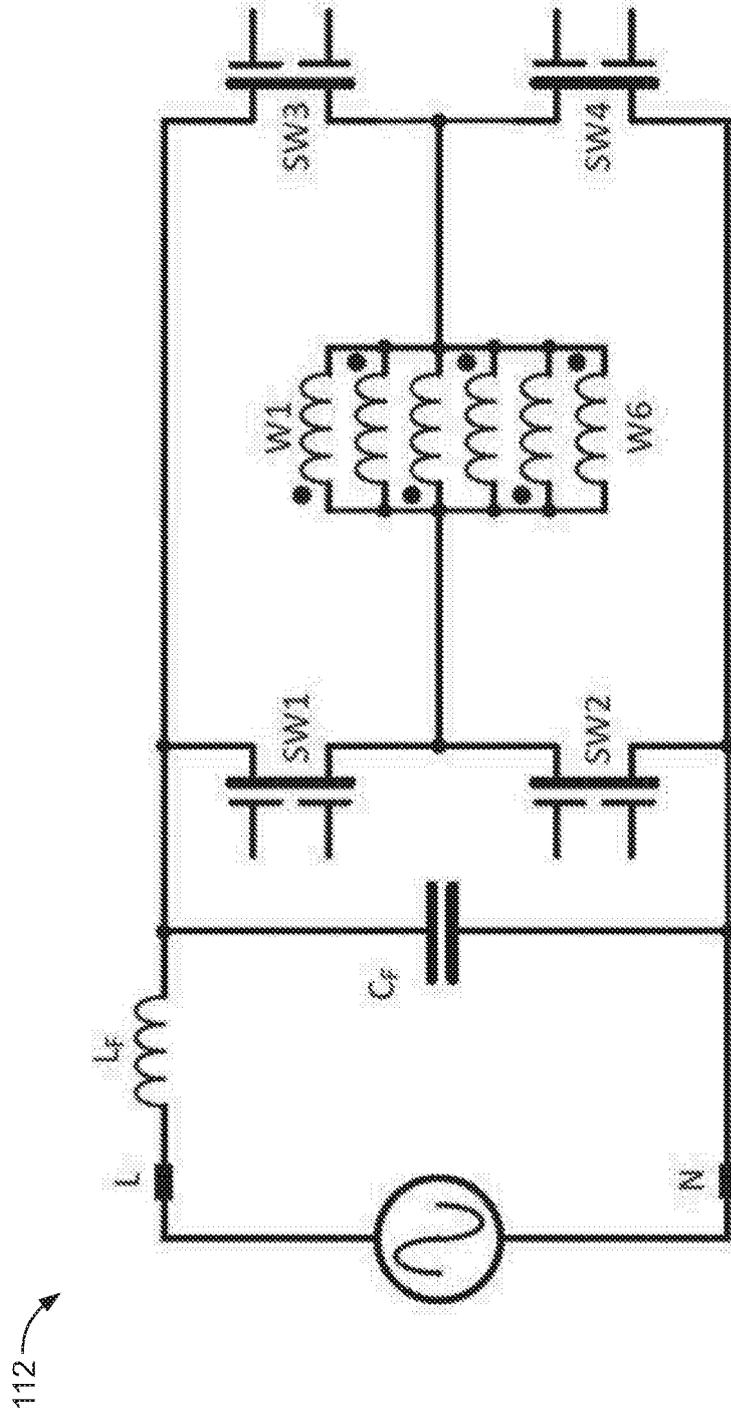


FIG. 3D

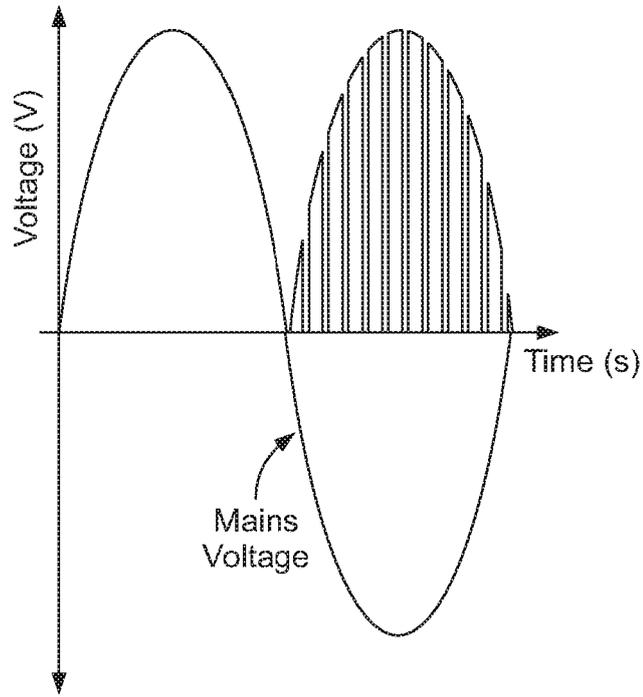


FIG. 3E

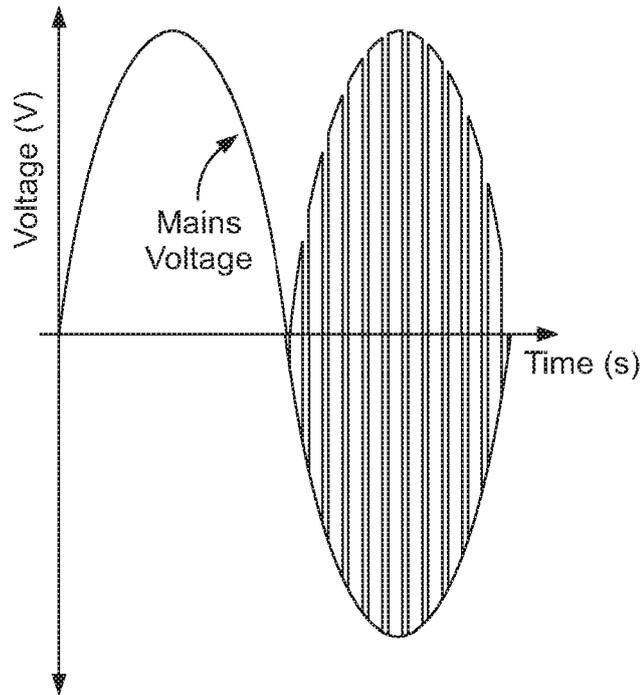


FIG. 3F

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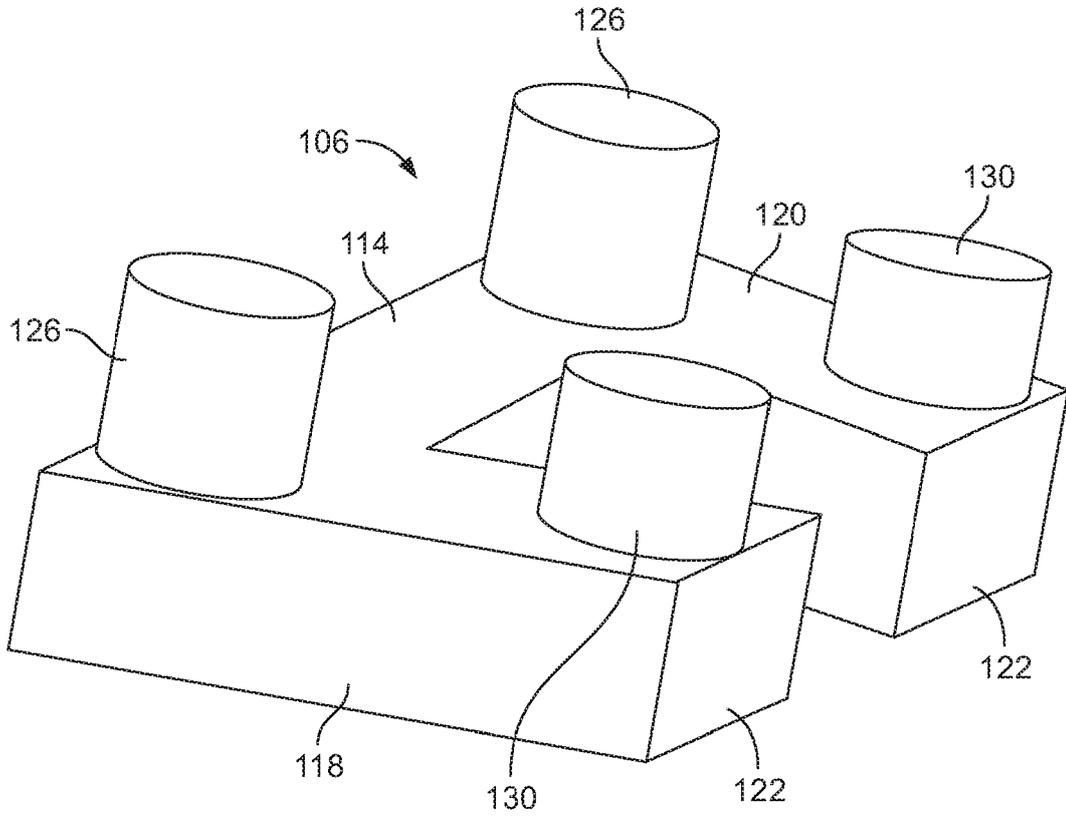


FIG. 4A

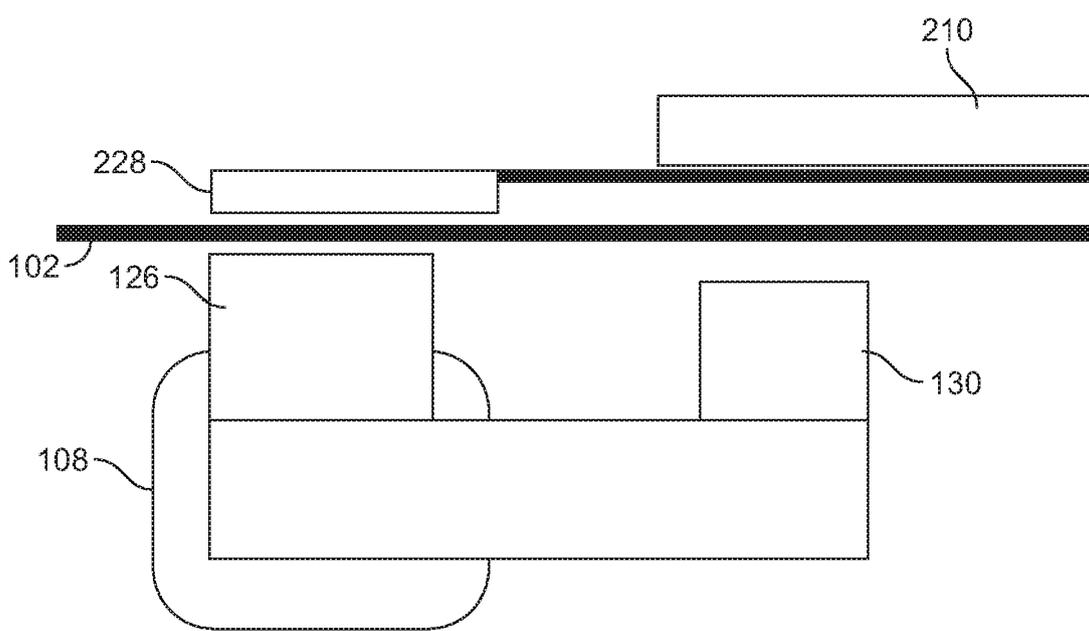


FIG. 4B

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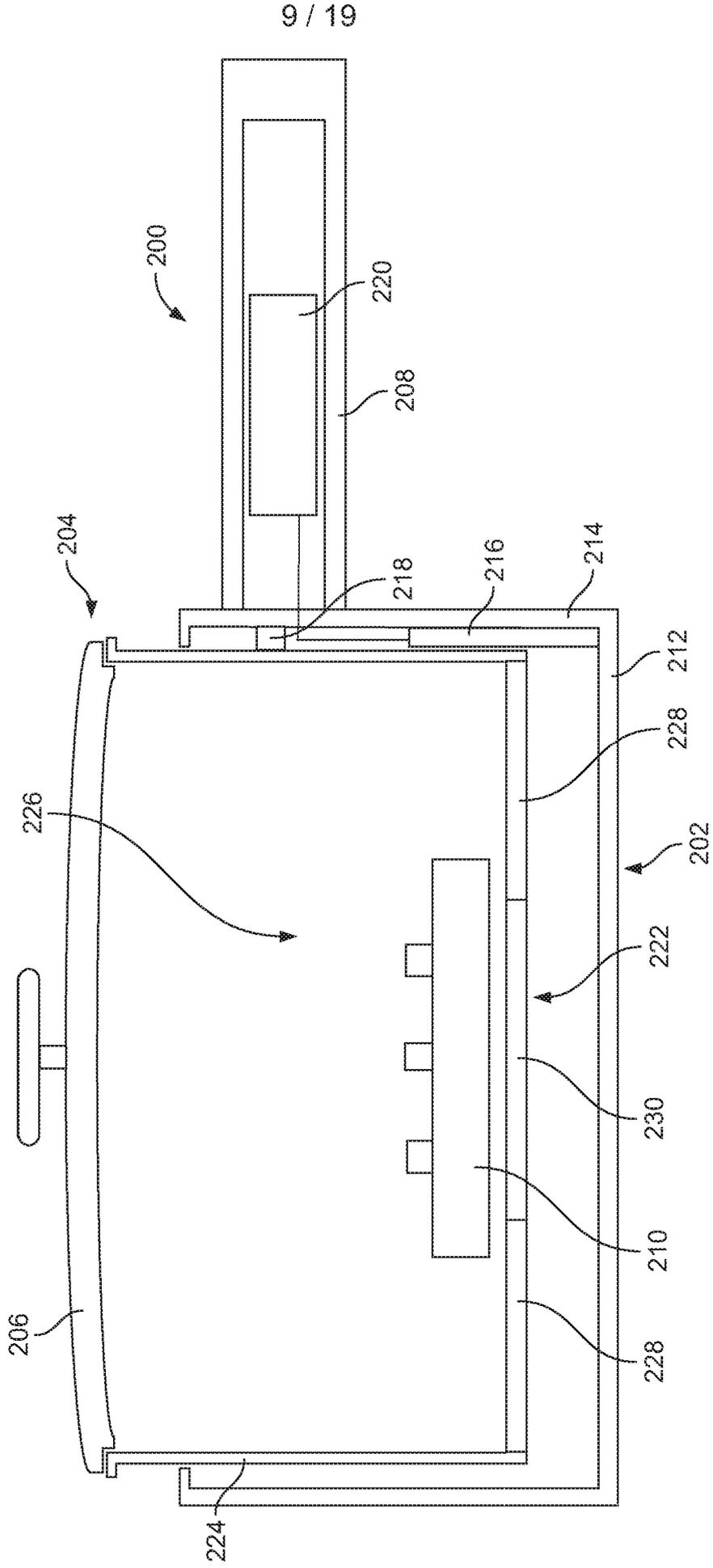


FIG. 5

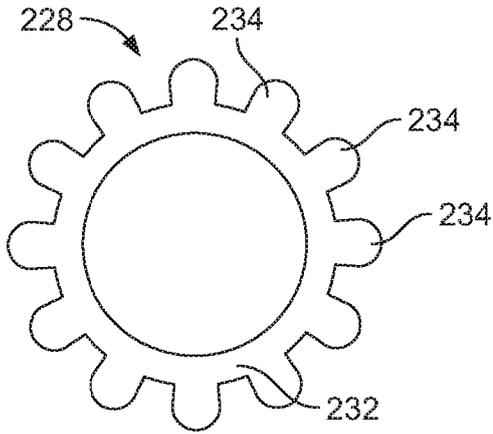


FIG. 6A

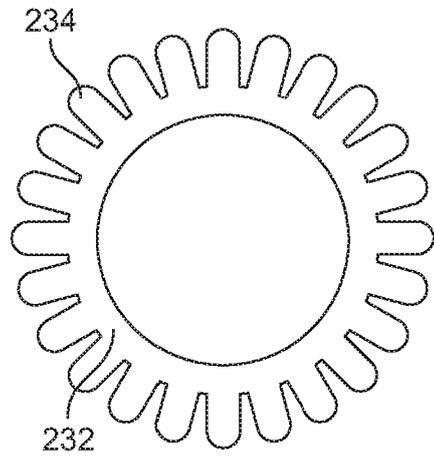


FIG. 6B

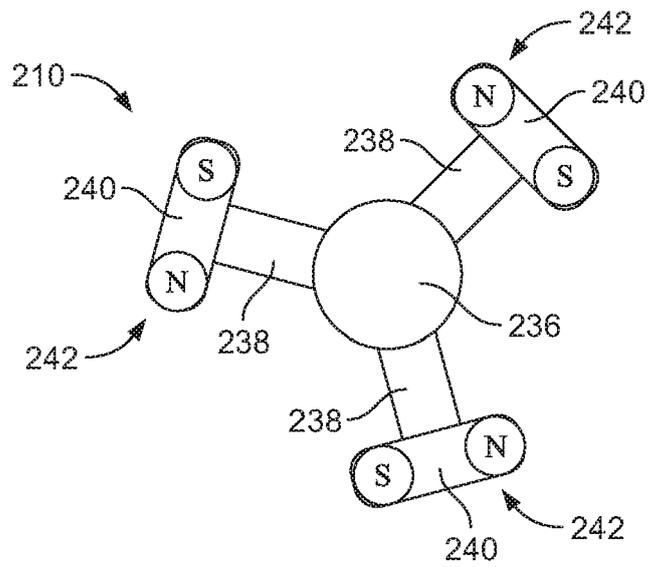


FIG. 7

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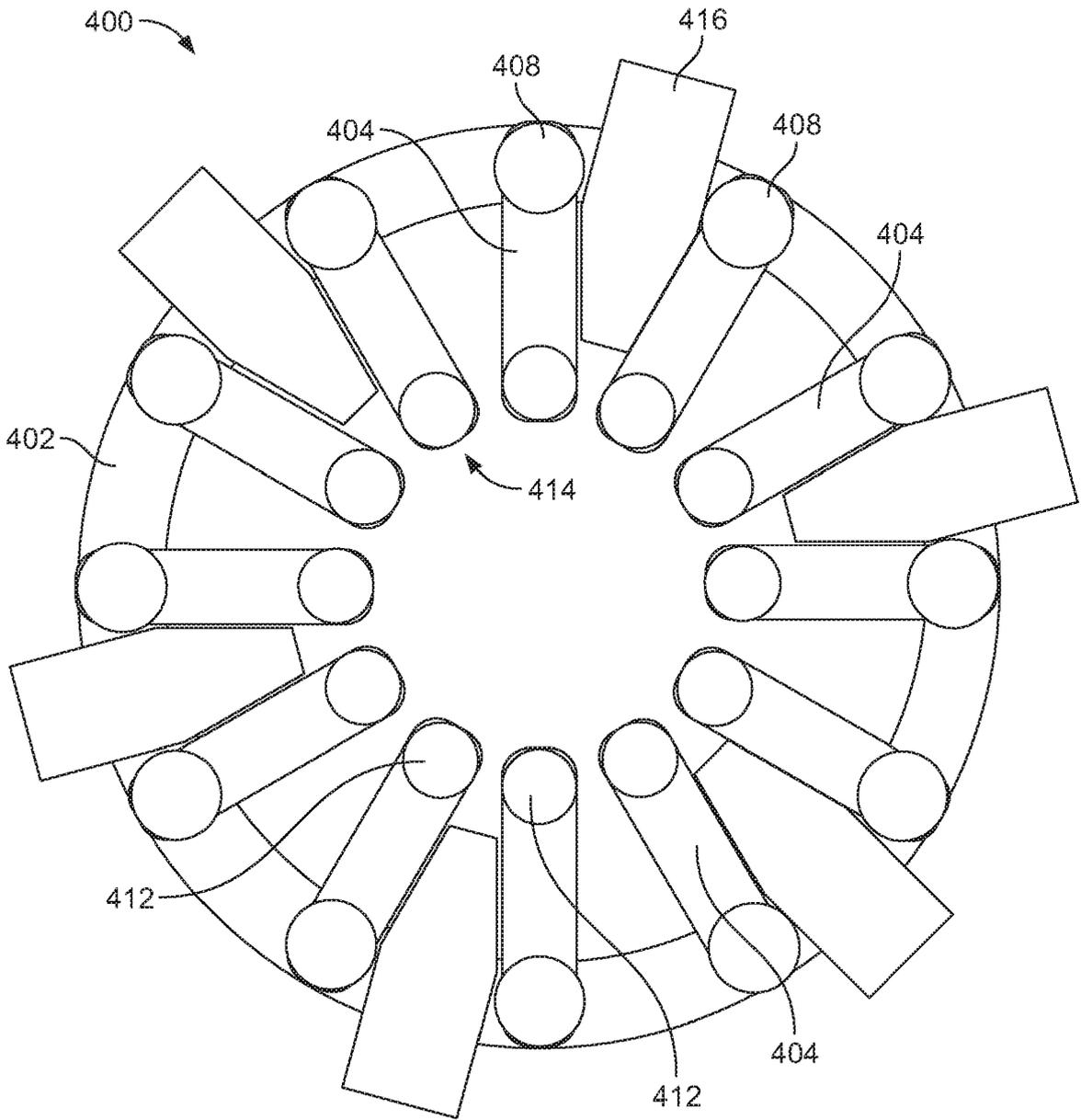


FIG. 8

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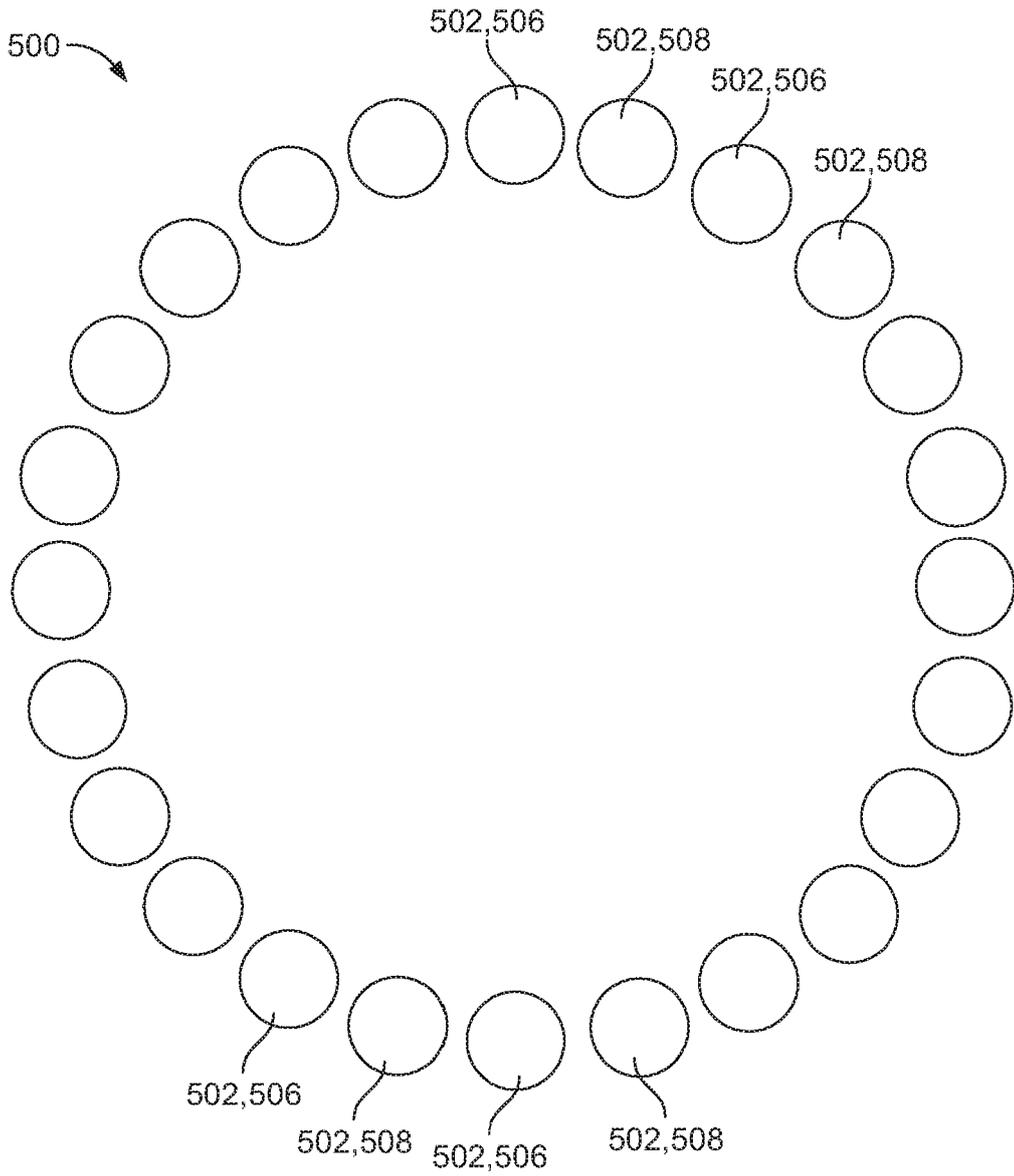


FIG. 9

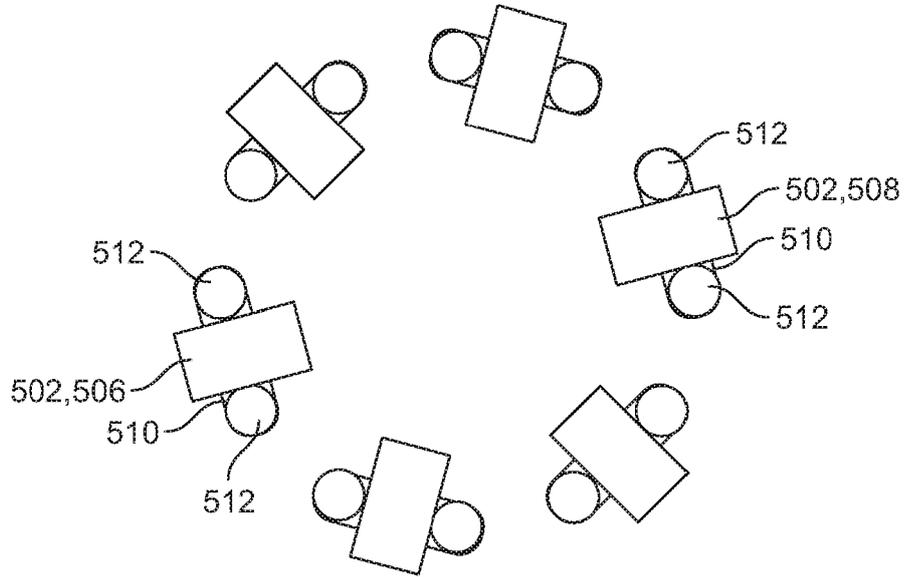


FIG. 10

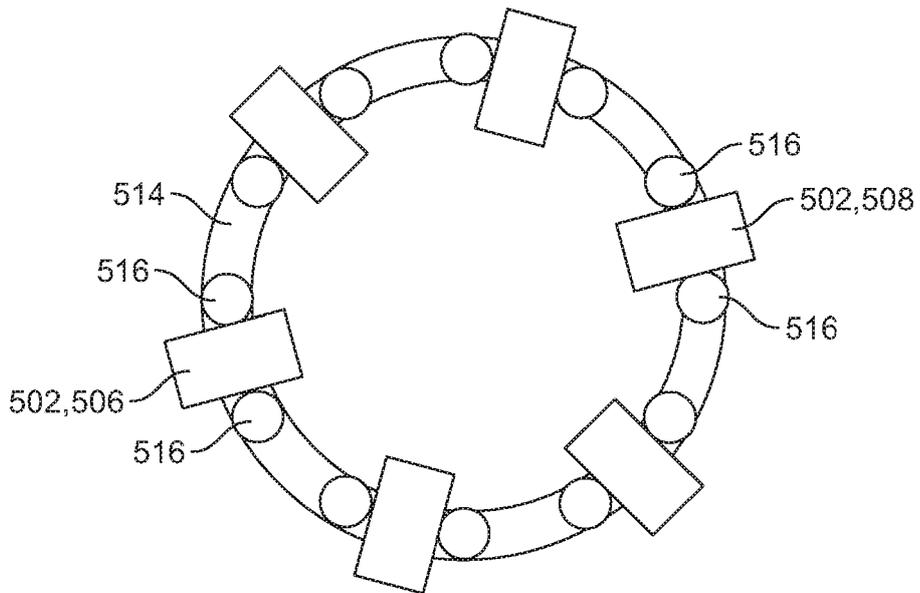


FIG. 11

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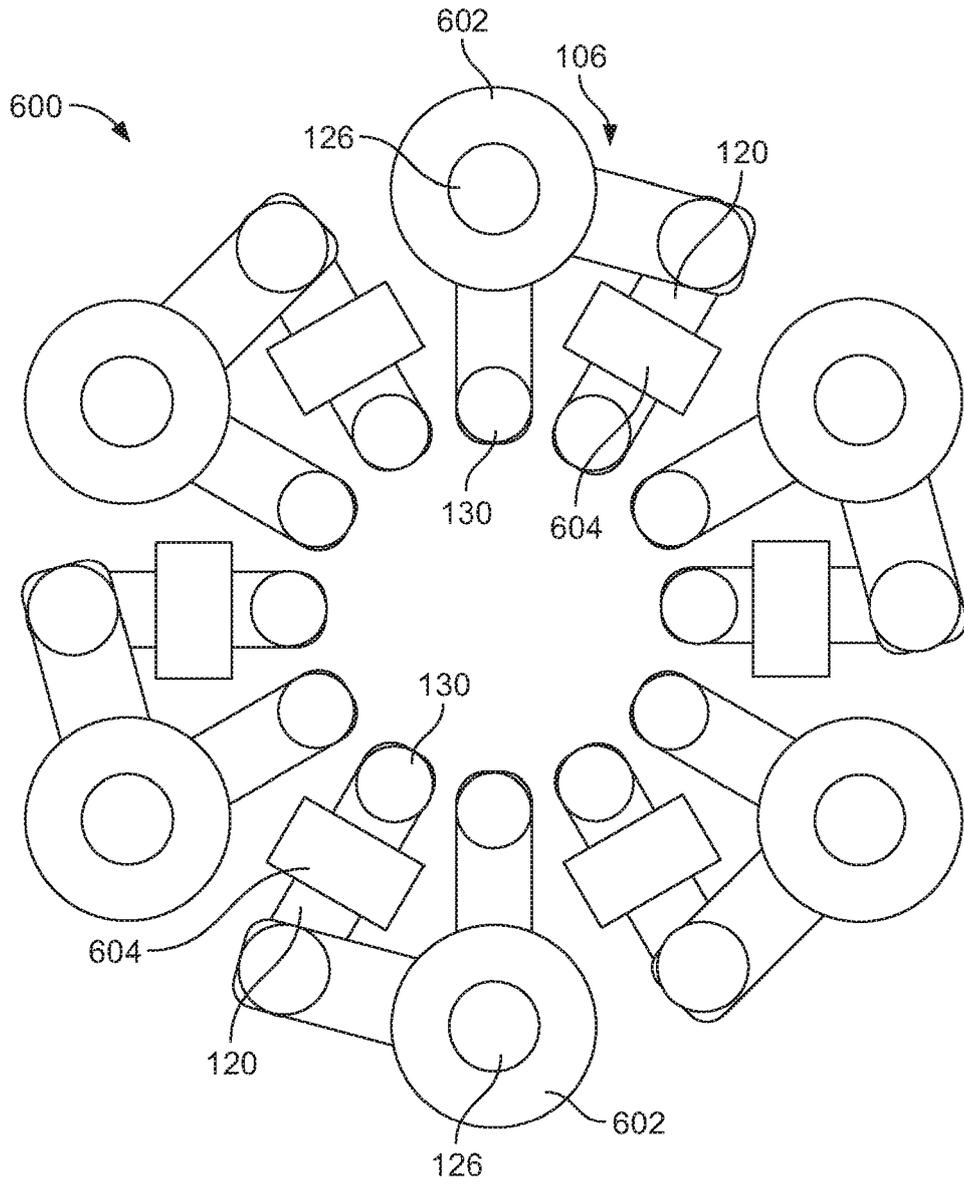


FIG. 12

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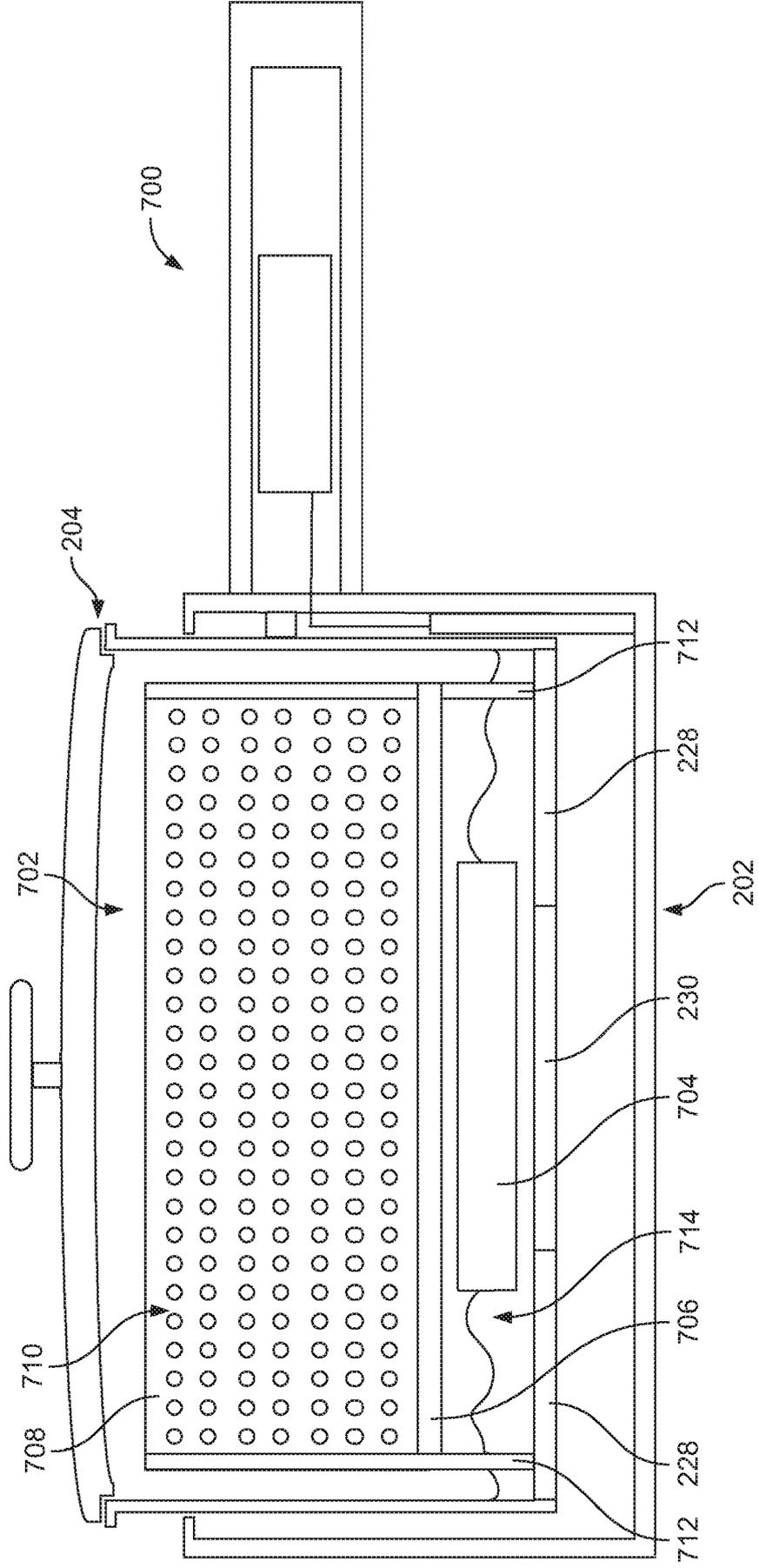


FIG. 13

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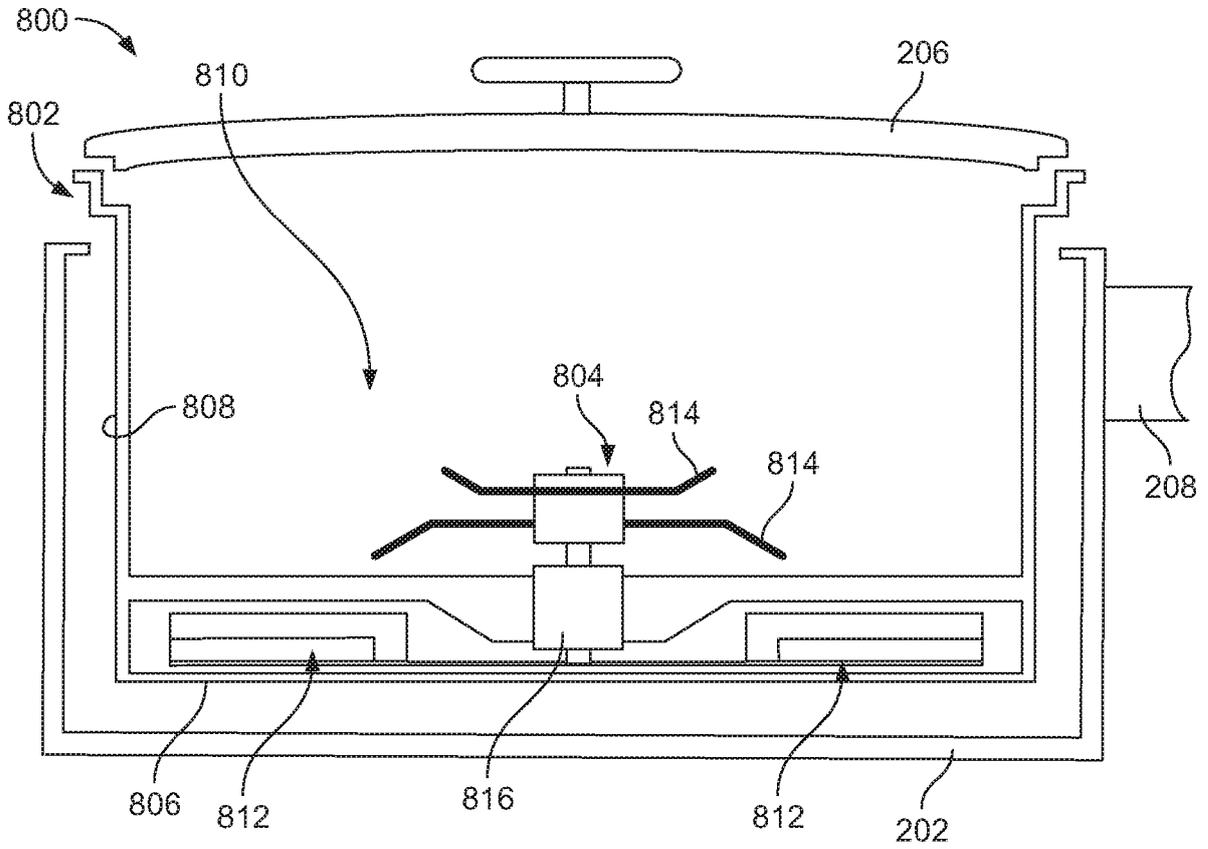


FIG. 14

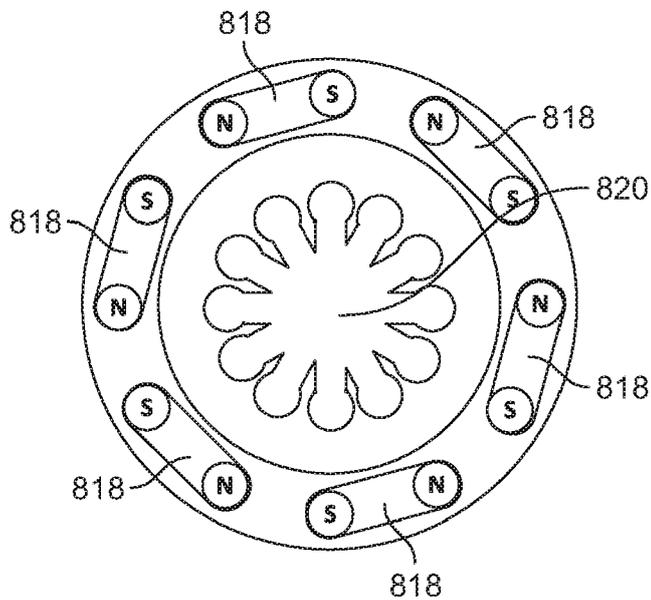


FIG. 15

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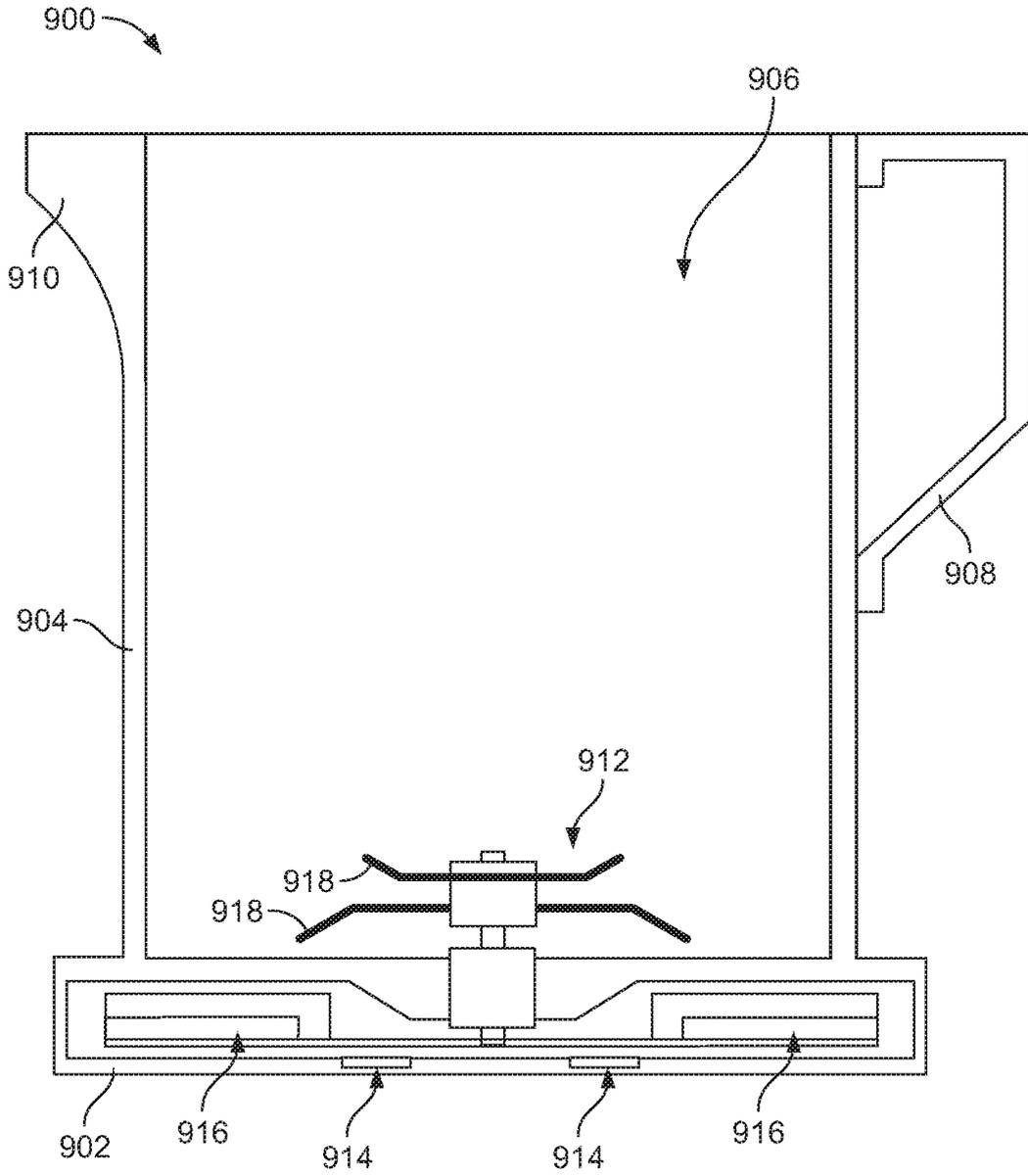


FIG. 16

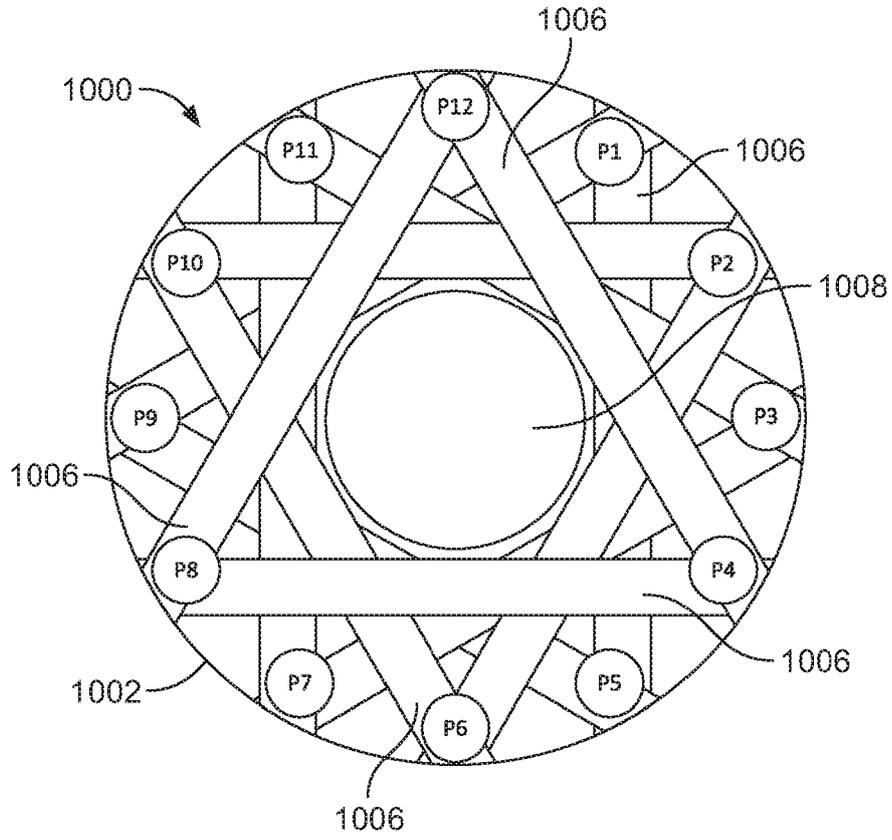


FIG. 17

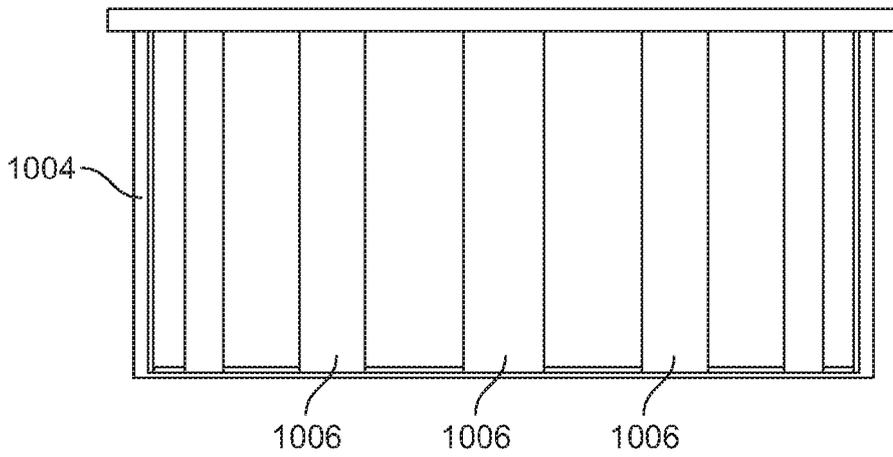


FIG. 18

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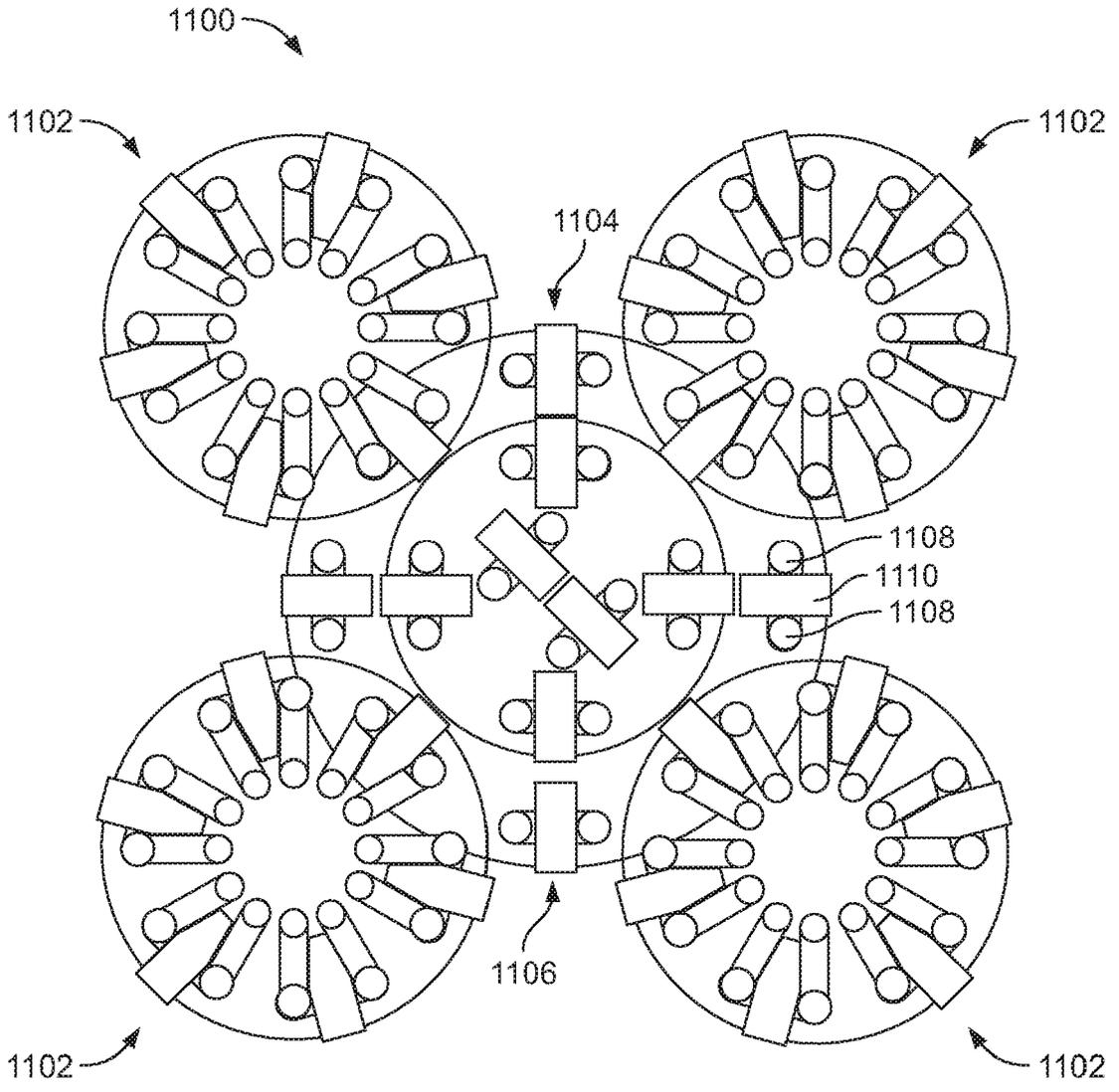


FIG. 19

## A FOODSTUFF RECEPTACLE

### Field of the Invention

- 5 The present invention relates to a foodstuff receptacle, and a foodstuff preparation system comprising such a foodstuff receptacle.

### Background of the Invention

- 10 In the field of foodstuff preparation, conventional methods of cooking on a hob, for example where the hob is gas or electrically powered, can be energy inefficient. Hobs that heat pans via magnetic induction, ie so called induction hobs, are known to provide increased energy efficiency over gas or electrically powered hobs.

15 Summary of the Invention

- According to a first aspect of the present invention there is provided a foodstuff receptacle for use with a foodstuff preparation device, the foodstuff receptacle comprising a receiving space for receiving foodstuffs, a liquid reservoir for receiving liquid, a susceptor for heating liquid within the liquid reservoir, and an agitator within the liquid reservoir, the susceptor configured to interact with a first magnetic field of the foodstuff preparation device to heat liquid within the liquid reservoir, and the agitator configured to interact with a second magnetic field of the foodstuff preparation device such that the agitator is movable within the liquid reservoir to displace liquid from the liquid reservoir to the receiving space.
- 20
- 25

- The foodstuff receptacle according to the first aspect of the present invention may be advantageous principally as the susceptor is configured to interact with a first magnetic field of the foodstuff preparation device to heat liquid within the liquid reservoir, and the agitator is configured to interact with a second magnetic field of the foodstuff preparation
- 30

device such that the agitator is movable within the liquid reservoir to displace liquid from the liquid reservoir to the receiving space.

5 In particular, this may enable the foodstuff receptacle to be used for a splash cooking method, where foodstuffs are cooked via interaction with heated droplets of liquid, for example heated water droplets. Such splash cooking may have a relatively high level of energy efficiency as heat induced in the liquid reservoir is retained within the food receptacle and no phase change is required, but may typically require an increased length of cooking time. As the foodstuff receptacle of the present invention provides automation  
10 of the heating and movement of the agitator, the foodstuff receptacle may be left unattended in use, which may lend itself to a cooking method such as splash cooking.

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15 The foodstuff receptacle may comprise a base and a sidewall defining the liquid reservoir, the susceptor may be located in the base and the base may comprise a non-susceptor portion aligned with the agitator. This may enable improved interaction with the first magnetic field of the foodstuff preparation device compared to, for example, an arrangement where a susceptor portion extends across substantially the entirety of the base.

20 The susceptor and the non-susceptor portion may be concentrically arranged within the base. This may provide a relatively simple arrangement, and may also enable heating of a full annular section of the liquid reservoir and/or movement of the agitator about a full annular section of the liquid reservoir, for example. The base may be substantially circular in form. The agitator may be configured to interact with the second magnetic  
25 field of the foodstuff preparation device such that the agitator is rotatable within the liquid reservoir, for example rotatable about a central axis of the foodstuff receptacle.

30 The non-susceptor portion may be arranged substantially centrally on the base, and the susceptor may extend annularly about the non-susceptor portion. This may be beneficial as it may ensure that the agitator moves about a substantially central point of the base, and may ensure that the agitator moves generally uniformly within a pre-determined

portion of the liquid reservoir. This may also enable the susceptor to extend from the central region of the base to the sidewall, for example such that heating can be provided across a relatively large extent of the liquid reservoir.

- 5 The susceptor may be arranged centrally on the base, and the non-susceptor portion may extend annularly about the susceptor. This may be beneficial as the non-susceptor portion may have an increased radius compared to an arrangement where the non-susceptor portion is arranged substantially centrally on the base and the susceptor extends annularly about the non-susceptor portion. An increased radius for the non-susceptor portion may  
10 allow for increased levels of torque to be imparted to the agitator.

The foodstuff receptacle may comprise a first salient magnetic assembly configured to interact with a second salient magnetic assembly of a foodstuff preparation device when the foodstuff receptacle is placed on the foodstuff preparation device to inhibit motion of  
15 the foodstuff receptacle relative to the foodstuff preparation device. This may be beneficial as it may effectively lock the foodstuff receptacle to the foodstuff preparation device, for example such that rotation of the foodstuff receptacle relative to the foodstuff preparation device is inhibited. This may be particularly beneficial where, for example, the agitator becomes caught on an item within the liquid reservoir, which would otherwise  
20 cause rotation of the foodstuff receptacle relative to the foodstuff preparation device. This may allow the foodstuff receptacle to be left unattended in use, which may be particularly beneficial for a splash cooking method which typically takes a relatively long amount of time.

- 25 Provision of corresponding first and second salient magnetic assemblies in the foodstuff receptacle and the foodstuff preparation device may also allow for the foodstuff receptacle to be guided to a pre-determined orientation relative to the foodstuff preparation device during placement of the foodstuff receptacle on the foodstuff preparation device.

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The first salient magnetic assembly may comprise an annular ring with a plurality of protrusions extending from the annular ring. This may allow for a plurality of orientations of the foodstuff receptacle relative to the foodstuff preparation device, for example with each protrusion defining a corresponding orientation. A higher number of protrusions may reduce the extent to which relative motion between the foodstuff receptacle and foodstuff preparation device is enabled, which may, for example, prevent over-rotation of the foodstuff receptacle during placement on the foodstuff preparation device.

The susceptor may define the first salient magnetic assembly. This may provide dual functionality, and may reduce the number of components and manufacturing cost compared to an arrangement with a separate susceptor and salient magnetic assembly.

The agitator may comprise a pair of magnetic poles for interaction with the second magnetic field of the foodstuff preparation device.

The agitator may comprise a blade for displacing liquid from the from the liquid reservoir to the receiving space

The agitator may be removable from the foodstuff receptacle. This may allow for easier cleaning of both the foodstuff receptacle and the agitator, and may, for example, allow for replacement of the agitator. The agitator may comprise any of a plurality of types of agitator, and hence the agitator may be interchangeable to allow for increased functionality.

The foodstuff receptacle may comprise a retention surface at least partially defining the receiving space, the retention surface disposed above the liquid reservoir. This may be beneficial as it may space foodstuffs from the susceptor in use, thereby providing greater control over heating and inhibiting overcooking of foodstuffs.

The retention surface may comprise a plurality of apertures that allow fluid communication between the liquid reservoir and the receiving space. This may assist

with displacement of liquid from the liquid reservoir to the receiving space, and vice versa.

The susceptor may comprise a plurality of continuous filaments extending along the base and up the sidewall. Extension of the susceptor up the sidewall may provide improved heat distribution relative to an arrangement where the susceptor is only located in the base, for example. Use of filaments for the susceptor may reduce a required thickness of the base, which may allow for enhanced interaction of the agitator with the first magnetic field of the foodstuff preparation device, for example by bringing the agitator closer to the foodstuff preparation device.

The foodstuff receptacle may comprise a thermally insulating layer disposed on the base and the sidewall. This may reduce the risk of a heated surface being touched in use. The thermally insulating layer may be attached to the base and the sidewall via any appropriate mechanical connection, for example via adhesive or a screw thread connection or the like.

According to a second aspect of the present invention there is provided a foodstuff preparation system comprising a foodstuff preparation device and a foodstuff receptacle according to the first aspect of the present invention, wherein the foodstuff preparation device comprises a magnetic field generator configured to generate the first and second magnetic fields.

The foodstuff preparation device may comprise a contact surface, with the magnetic field generator disposed below the contact surface.

The magnetic field generator may comprise a magnetic core structure, a coil wrapped around the magnetic core structure, and an energisation device configured to energise the coil, the magnetic core structure may comprise a first pole pair configured to interact with the susceptor of the foodstuff receptacle to define a first magnetic flux path, and the magnetic core structure may comprise a second pole pair configured to interact with the agitator of the foodstuff receptacle to define a second magnetic flux path. Thus the first

and second magnetic flux paths may allow generation of the first and second magnetic fields in use. The arrangement of the first and second pole pairs may be tuned to provide optimised magnetic fields for heating and motion respectively. For example, relative sizing of the poles of the pole pairs may impact the magnetic field generated in use.

5

The magnetic field generator may comprise a plurality of first pole pairs configured to interact with the susceptor of the foodstuff receptacle to define respective first magnetic flux paths, and a plurality of second pole pairs configured to interact with the agitator of the foodstuff receptacle to define respective second magnetic flux paths, the first and  
10 second pole pairs being annularly arranged. This may be beneficial as it may enable heating around a full annular extent of the foodstuff receptacle as well as allowing for efficient rotational motion of the agitator.

15

The plurality of second pole pairs may be sequentially energised to drive motion of the agitator.

20

The magnetic field generator may define a salient magnetic assembly, for example the second salient magnetic assembly discussed above. This may act to inhibit motion, for example rotational motion, of the foodstuff receptacle relative to the foodstuff preparation device.

Preferential features of aspects of the present invention may be equally applied to other aspects of the present invention, where appropriate.

## 25 Brief Description of the Drawings

**Figure 1** is a schematic view of a foodstuff preparation system according to an example;

**Figure 2** is a schematic view of a first embodiment of a magnetic field generator for the  
30 foodstuff preparation system of Figure 1;

**Figure 3a** is a schematic view of a first energisation waveform for an energisation device of the magnetic field generator of Figure 2;

**Figure 3b** is a schematic view of electronic circuitry for generating the energisation waveform of Figure 3a;

**Figure 3c** is a schematic view of a second energisation waveform for an energisation device of the magnetic field generator of Figure 2;

**Figure 3d** is a schematic view of electronic circuitry for generating the energisation waveform of Figure 3c;

**Figure 3e** is a schematic view of a first embodiment of applied voltage relative to mains voltage;

**Figure 3f** is a schematic view of a first embodiment of applied voltage relative to mains voltage;

**Figure 4a** is a schematic perspective view of a magnetic core of the magnetic field generator of Figure 2;

**Figure 4b** is a schematic side view of the magnetic core of Figure 4a placed below a foodstuff receptacle;

**Figure 5** is a schematic view of a first embodiment of a foodstuff receptacle for the foodstuff preparation system of Figure 1;

**Figure 6a** is a schematic view of a first embodiment of a susceptor portion of the foodstuff receptacle of Figure 5;

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**Figure 6b** is a schematic view of a first embodiment of a susceptor portion of the foodstuff receptacle of Figure 5;

**Figure 7** is a schematic view of an agitator of the foodstuff receptacle of Figure 5;

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**Figure 8** is a schematic view of a second embodiment of a magnetic field generator for the foodstuff preparation system of Figure 1;

**Figure 9** is a schematic view of a third embodiment of a magnetic field generator for the foodstuff preparation system of Figure 1;

10

**Figure 10** is a schematic view of the magnetic field generator of Figure 9 utilising a first magnetic core arrangement;

**Figure 11** is a schematic view of the magnetic field generator of Figure 9 utilising a second magnetic core arrangement;

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**Figure 12** is a schematic view of a fourth embodiment of a magnetic field generator for the foodstuff preparation system of Figure 1;

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**Figure 13** is a schematic view of a second embodiment of a foodstuff receptacle for the foodstuff preparation system of Figure 1;

**Figure 14** is a schematic view of a third embodiment of a foodstuff receptacle for the foodstuff preparation system of Figure 1;

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**Figure 15** is a schematic view of a magnetic assembly of the foodstuff receptacle of Figure 14;

**Figure 16** is a schematic view of a fourth embodiment of a foodstuff receptacle for the foodstuff preparation system of Figure 1;

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**Figure 17** is an underside schematic view of a fifth embodiment of a foodstuff receptacle for the foodstuff preparation system of Figure 1;

5 **Figure 18** is a side schematic view of the foodstuff receptacle of Figure 17; and

**Figure 19** is a schematic view of a fifth embodiment of a magnetic field generator for the foodstuff preparation system of Figure 1.

10 Detailed Description of the Invention

A foodstuff preparation system according to the present invention, generally designated 10, is shown schematically in Figure 1. The foodstuff preparation system 10 includes a foodstuff preparation device 100 and a foodstuff receptacle 200 for placement on the  
15 foodstuff preparation device 100. The foodstuff preparation device 100 takes the form of an induction hob, and may be used for heating foodstuffs received within the foodstuff receptacle 200 in use, as will be described hereafter.

The foodstuff preparation device 100 comprises a contact surface 102 on which the  
20 foodstuff receptacle 100 can be placed, and a magnetic field generator 104 disposed beneath the contact surface 102. It will be appreciated that the foodstuff preparation device 100 may include further features such as a user input, for example in the form of one or more user actuable buttons or the like, but that such features are not shown here.

25 A first embodiment of the magnetic field generator 104 is shown schematically in an upper view in Figure 2. The magnetic field generator 104 comprises six magnetic cores 106, each magnetic core 106 wound with a respective coil 108, and an energisation device 110 (shown in Figure 1) for energising the coils 108. The energisation device 110 comprises electronic circuitry 112 capable of converting mains power into a form  
30 suitable for energising the coils 108. Examples of appropriate energisation patterns and

electronic circuitry 112 for the energisation device 110 are described with reference to Figures 3a-d.

As mentioned above, the foodstuff preparation device 100 takes the form of an  
5 induction hob. Induction hobs function by inducing eddy currents in electrical  
conductors by changing the applied magnetic field in the electrical conductor. Where  
the electrical conductor is fixed, as in the case of an induction hob, the applied magnetic  
field must be varied to induce the required eddy current. Such variation can be achieved  
10 using pulse width modulation (PWM), and adjusting the duty and/or frequency of the  
PWM can provide variable heating control. It is further known to synthesise a low  
frequency voltage waveform from a DC voltage. If the frequency of PWM is  
sufficiently high the PWM frequency can be thought of as largely independent to the  
synthesis of the lower frequency voltage. Thus the present invention may provide  
15 variable induction heating whilst maintaining a lower frequency voltage that can be  
used to drive an agitator of the foodstuff receptacle 200.

In some embodiments, as will be described hereafter, not all of the coils 108 are  
required to be energised at the same time. This may lead to an arrangement where  
discrete energisation patterns are required for different subsets of coils 108. For  
20 example, an energisation pattern where a first subset of coils 108 is energised for a first  
time period 101 whilst a second subset of coils 108 is not energised during the first time  
period 101, and where the second subset of coils 108 is energised for a second time  
period 103 whilst the first subset of coils 108 is not energised during the second time  
period 103. Such an energisation pattern is shown in Figure 3a.

25 Electronic circuitry 112 for implementing the energisation pattern of Figure 3a is shown  
in Figure 3b. The electronic circuitry 112 is embodied as an AC-AC converter. The  
electronic circuitry 112 comprises an inductor  $L_F$  and a capacitor  $C_F$  that collectively  
define a low pass filter, a first bridge of switches SW1-4 for a first subset of coils 108,  
30 and a second bridge of switches SW5-8 for a second subset of coils 108. The provision  
of two such bridges of switches SW1-8 enables the independent energisation of the first

and second subsets of coils 108. Thermal and speed ripple may be acceptable for the foodstuff preparation system 10 of the present invention, thus the electronic circuitry 112 may not require a large energy storage component such as a DC link capacitor.

5 In other embodiments, each coil 108 may be energised at the same time as each other coil 108. Thus only one energisation pattern is needed, and such an energisation pattern is shown in Figure 3c. As can be seen from Figure 3c, the applied voltage to the coils 108 alternates between positive and negative, and here the voltage is applied with positive voltage being applied during a negative period of an AC mains cycle, and  
10 negative voltage being applied during a positive period of an AC mains cycle.

Electronic circuitry 112 for implementing the energisation pattern of Figure 3c is shown in Figure 3d. The electronic circuitry 112 is embodied as an AC-AC converter. The electronic circuitry 112 comprises an inductor  $L_F$  and a capacitor  $C_F$  that collectively  
15 define a low pass filter, and a single bridge of switches SW1-4 for the plurality of coils 108.

The electronic circuitry 112 of Figure 3d may be simpler than the electronic circuitry 112 of Figure 3b by virtue of needing fewer switches. In some examples the switches  
20 may be bidirectional gallium nitride (BiGaN) switches, which may be capable of operating at relatively high switching frequencies, for example at greater than 100kHz. Reducing the number of BiGaN switches needed may reduce costs.

It will be appreciated that in some embodiments it may be beneficial to provide  
25 individual converters to each coil 108. In such embodiments, the applied PWM to each of the converters can be phase shifted which is a common method used in parallel converter arrangements to increase the effective operating frequency seen by the input low pass filter allowing a more compact and cost-effective component selection for  $L_F$  and  $C_F$ .

30

The energisation patterns of Figures 3a and 3c depict embodiments where the applied voltage is in a single direction only per energisation cycle, as shown in Figure 3e. In other embodiments, as shown in Figure 3f, the applied voltage may be in both directions, ie positive and negative, during a single energisation cycle. This may provide a desired net positive voltage whilst maximising high frequency content, which is good for inducing eddy currents in a susceptor material. However, in the embodiment of Figure 3f a mains input filter may be required to provide a generic low pass characteristic, which is in contrast to the embodiments of Figures 3a and 3c.

Referring back to Figure 2, the six magnetic cores 106 are disposed in an annular array. Each magnetic core 106 comprises a coreback 114, and first 118 and second 120 arms extending from the coreback 114 and having respective free ends 122. A coil 108 is wound around each coreback 114. The first 118 and second 120 arms extend inwardly toward a centre of the annular array of magnetic cores 106 in Figure 2, but it will be appreciated that in an alternative embodiment the first 118 and second 120 arms may extend outwardly from the corebacks 114. The first 118 and second 120 arms are angled toward one another, such that a distance between the arms 118,120, for example a slot width, decreases from the coreback 114 to the free ends 122.

The form of the magnetic cores 106 can be more clearly seen in Figure 4, where a single magnetic core 106 is shown in isolation. Each magnetic core 106 has a first pair of poles 126 located on the coreback 114, and a second pair of poles 130 located on the first 118 and second arms 120, such that one pole 130 of the second pair is located on each arm 118,120.

25

Each pole 126 of the first pair of poles has generally the same form, and has a substantially circular cross-sectional shape such that the pole 126 is substantially cylindrical. It will of course be appreciated that other cross-sectional shapes may be utilised as appropriate. The poles 126 of the first pair extend upwardly from the coreback 114, such that the poles 126 extend toward the contact surface 102. The poles 126 of the first pair are spaced apart along the coreback 114, such that the poles 126 are

30

located at opposing ends of the coreback 114. Collectively the poles 126 of the first pair define flux guides for guiding magnetic flux generated when the coil 108 is energised in use, such that the poles 126 form part of a first magnetic circuit.

5 Each pole 130 of the second pair of poles has generally the same form, and has a substantially circular cross-sectional shape such that the pole 130 is substantially cylindrical. The poles 130 of the second pair have a smaller diameter than the poles 126 of the first pair, such that poles 130 of the second pair are smaller than poles 126 of the first pair. The poles 130 of the second pair extend upwardly from respective free ends  
10 122 of the first 118 and second 120 arms, such that the poles 130 extend toward the contact surface 102. As shown in Figures 4 and 4b, the poles 130 of the second pair have a smaller length than the poles 126 of the first pair, although it will be appreciated that the relative lengths may be tailored according to a desired application. Collectively the poles 130 of the second pair define flux guides for guiding magnetic flux generated  
15 when the coil 108 is energised in use, such that the poles 130 form part of a second magnetic circuit.

As mentioned above, the first 118 and second 120 arms are angled toward one another, seen most clearly in Figure 2, such that a distance between the arms 118,120 decreases  
20 from the coreback 114 to the free ends 122. As the poles 126 of the first pair are located at opposing ends of the coreback 114, and the poles 130 of the second pair are located at the free ends 122 of the first 118 and second 120 arms, a distance between poles 126 of the first pair, ie an airgap between poles 126 of the first pair, is greater than a distance between poles 130 of the second pair, ie greater than an airgap between poles 130 of the  
25 second pair.

The poles 126 of the first pair are longer than poles 130 of the second pair, as can be seen in Figure 4b. This means that an airgap between the poles 126 of the first pair and relevant portions of the foodstuff receptacle 200, is smaller than a corresponding airgap  
30 between the poles 130 of the second pair and relevant portions of the foodstuff receptacle 200. Thus, when the coil 108 is energised, first and second magnetic flux

circuits, ie first and second magnetic fields, having different characteristics, are generated at the poles 126 of the first pair and relevant portions of the foodstuff receptacle 200, and the poles 130 of the second pair and relevant portions of the foodstuff receptacle 200, which allows for different functionality for different portions of the foodstuff receptacle 200, as will be described hereafter. The relevant ratio of flux between the first and second magnetic flux circuits can be tailored by altering the relative ratios of the airgap between the poles 126 of the first pair and relevant portions of the foodstuff receptacle 200, and the corresponding airgap between the poles 130 of the second pair and relevant portions of the foodstuff receptacle 200.

The airgaps between the poles 126 of the first pair and relevant portions of the foodstuff receptacle 200, and the poles 130 of the second pair and relevant portions of the foodstuff receptacle 200, are chosen to be smaller than the airgaps between pole pairs such that as much flux as possible is linked with the relevant portions of the foodstuff receptacle 200 in use. By increasing the airgaps between pole pairs, flux leakage may be reduced such that more flux is coupled to the relevant portions of the foodstuff receptacle 200 in use.

It will also be appreciated that, given the form of the plurality of magnetic cores 106, a number of poles are defined about the annular array, and the plurality of magnetic cores 106 define a first salient magnetic assembly in the foodstuff preparation device 100.

A first embodiment of a foodstuff receptacle 200 for use with the foodstuff preparation device 100 is shown schematically in cross-section in Figure 5.

The foodstuff receptacle 200 comprises an outer pan 202, an inner pan 204, a lid 206, a handle 208, and an agitator 210. Here, the foodstuff receptacle 200 generally takes the form of a saucepan.

The outer pan 202 comprises a generally circular base 212, and a sidewall 214 extending upwardly from the perimeter of the base 212 to define a hollow interior for

receiving the inner pan 204. The outer pan 202 is formed from a thermally insulating material, for example an appropriate plastic material, such that the outer pan 202 is safe to touch in use and also reduces thermal losses, thereby improving thermal efficiency. A pick-up power coil 216 and a temperature sensor 218 are attached to the sidewall 214 in a region of connection of the handle 208 to the sidewall 214. In some embodiments the temperature sensor 218 is maintained in contact with the inner pan 204 by a loading mechanism to ensure good thermal contact in use. The handle 208 is attached to the sidewall 214, is substantially hollow, and houses one or more electronic components 220, for example a transceiver or the like configured to communicate a temperature within the foodstuff receptacle 200 to a user. The pick-up power coil 216 is able to interact with magnetic fields generated by the magnetic field generator 104 in use to power the temperature sensor 218 and/or other electronic components housed within the handle 208. As the outer pan 202 does not generally come into contact with foodstuffs in use, and hence may not require as much cleaning, electrical components, for example the pick-up power coil 216, the temperature sensor 218 and electronic components 220 within the handle 208 are attached to the outer pan 202.

The inner pan 204 comprises a generally circular base 222 and a sidewall 224 extending upwardly from the base 222 to define a receiving space 226 for receiving foodstuffs. The base 222 of the inner pan 204 has a diameter smaller than a diameter of the base 212 of the outer pan 202, such that that inner pan 202 is receivable within the outer pan 202. The inner pan 204 is shown partially received within the outer pan in Figure 5, and in a fully inserted state, the base 22 of the inner pan 204 sits on top of the base 212 of the outer pan 202. In some embodiments, an interlock mechanism (not shown) is provided to lock the inner pan 204 to the outer pan 202 such that relative motion between the inner pan 204 and the outer pan 202 is inhibited., and such that foodstuffs within the receiving space 226 can be poured in use. The lid 206 is attachable to an upper periphery of the inner pan 204 to seal the receiving space 226. In some embodiments the lid 206 may be releasably locked to the inner pan 204, for example with a small gap between the lid 206 and the inner pan 204 to allow for pressure equalisation.

The base 222 of the inner pan 204 comprises a susceptor portion 228 and a non-susceptor portion 230. The susceptor portion 228 comprises an electrically conductive, for example ferrous, material for interaction with a magnetic field generated by the magnetic field generator 104 to cause eddy currents to flow within the susceptor portion 228, thereby causing heating of the receiving space 226. Thus the foodstuff receptacle 200 may be heated by so-called induction heating.

In some embodiments, the susceptor portion 228 comprises an annular ring 232 with a plurality of protrusions 234 on the outer perimeter of the annular ring 232, as shown schematically in Figure 6a. Thus the susceptor portion defines a second salient magnetic assembly for interaction with the first salient magnetic assembly in the foodstuff preparation device 100.

In use, when the foodstuff receptacle 200 is placed on the foodstuff preparation device 100, the first salient magnetic assembly defined by the plurality of magnetic cores 106 interacts with the second salient magnetic assembly defined by the susceptor portion 228 such that motion of the foodstuff receptacle 200, ie rotation, relative to the foodstuff preparation device 100 is inhibited. This may be beneficial as it may effectively lock the foodstuff receptacle 200 to the foodstuff preparation device 100, for example such that rotation of the foodstuff receptacle 200 relative to the foodstuff preparation device 100 is inhibited. This may be particularly beneficial where, for example, the agitator 210 becomes caught on an item within the foodstuff receptacle 200, which would otherwise cause rotation of the foodstuff receptacle 200 relative to the foodstuff preparation device 210. This may allow the foodstuff receptacle 200 to be left unattended in use.

Provision of corresponding salient magnetic assemblies in the foodstuff receptacle 200 and the foodstuff preparation device 100 may also allow for the foodstuff receptacle 200 to be guided to a pre-determined orientation relative to the foodstuff preparation device 100 during placement of the foodstuff receptacle 200 on the foodstuff preparation device 100.

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In the embodiment of Figure 6a, the number of protrusions 234 corresponds to the number of poles 130 of the second pairs of poles of the magnetic cores 106 of the magnetic field generator 104. In an alternative embodiment, as shown in Figure 6b, the number of protrusions 234 is twice the number of poles 130 of the second pairs of poles of the magnetic cores 106 of the magnetic field generator 104. This may reduce an extent to which the foodstuff receptacle 200 can rotate relative to the foodstuff preparation device 100 before being locked in position, for example during placement of the foodstuff receptacle 200 on the contact surface 102, but may result in a reduction of area of the relevant pole face of the susceptor portion 228, which may reduce saliency. It will be appreciated that the number of poles of the susceptor portion 228 may be chosen to reduce allowable rotational extent during foodstuff receptacle 200 placement whilst retaining good levels of saliency to lock the foodstuff receptacle 200 in place, and that matching the number of protrusions 234 to the number of poles 130 of the second pairs of poles of the magnetic cores 106 may provide an appropriate balance.

The non-susceptor portion 230 is formed of electrically insulating material that allows the passage therethrough of a magnetic field generated by the magnetic field generator 104. In the embodiment of Figure 5, the non-susceptor portion 230 is located substantially centrally on the base 222, and is generally circular in form. The susceptor portion 228 extends annularly about the non-susceptor portion 230, and extends substantially to the sidewall 224.

The agitator 210 is shown schematically in Figure 7, and comprises a central body 236, and a plurality of arms 238 extending outwardly from the central body 236. In this embodiment, the agitator 210 is a stirrer, and each arm 238 has a stirrer blade 240 extending substantially orthogonally to an end of the arm 238, to either side of the arm 238. Each stirrer blade 240 is provided with a bar magnet 242 having north and south poles. The bar magnets 242 interact with a magnetic field generated by the magnetic field generator 104, as will be described hereafter. Although shown here with bar magnets 242, it will be appreciated that in some embodiments the agitator may simply

comprise a ferrous structure. It will also be appreciated that, in practice, the structure of the agitator 210 described above encased within a housing that rotates with the structure in use.

5 The agitator 210 has a diameter less than or equal to a diameter of the non-susceptor portion 230, and is placed within the receiving space 226 of the inner pan 204 such that the agitator 210, and particularly the bar magnets 242 are positioned above the non-susceptor portion 230. This may facilitate interaction of the bar magnets 242 with a magnetic field of the magnetic field generator 104. In some embodiments, the inner pan  
10 204 and the agitator 210 may comprise respective locating features, for example a corresponding projection and recess, which act to locate the agitator 210 relative to the inner pan 204 whilst also allowing for rotation of the agitator 210 relative to the inner pan 204.

15 In use, the foodstuff receptacle 200 is placed on the foodstuff preparation device 100, for example with the first and second salient magnetic assemblies interacting to guide the foodstuff receptacle 200 into position on the contact surface 102 of the foodstuff preparation device 100. The foodstuff receptacle 200 is positioned on the contact  
20 surface 102 such that the susceptor portion 228 of the inner pan 204 overlies the poles 126 of the first pair of poles of each magnetic core 106, and the non-susceptor portion 230 of the inner pan 204, and the agitator 210, overlie the poles 130 of the second pair of poles of each magnetic core 106, as can be seen in Figure 4b.

25 The coils 108 are energised by the energisation device 110 such that first and second magnetic flux circuits, ie first and second magnetic fields, are generated between the poles 126 of the first pair and the susceptor portion 228, and the poles 130 of the second pair and the agitator 210, of each of the magnetic cores 106. Given the difference in relative distances between the poles 126 of the first pair and the susceptor portion 228,  
30 and the poles 130 of the second pair and the agitator 210, as seen in Figure 4b, the first and second magnetic circuits have different reluctances. As mentioned above, due to the different reluctances of the first and second magnetic flux circuits, the magnetic

fields generated at the first pairs of poles 126 and the second pairs of poles 130 have different characteristics. In the present embodiment, the magnetic field produced at each of the first pairs of poles 126 is a first varying, ie alternating, magnetic field that interacts with the susceptor portion 228 such that eddy currents are generated within the susceptor portion 228, and the receiving space 226 is heated. The magnetic field  
5 produced at each of the second pairs of poles 130 is a second varying, ie alternating, magnetic field that interacts with the bar magnets 242 such that the agitator 210 is rotated within the receiving space 226. In such a manner the agitator 210 may be used to stir foodstuffs received within the receiving space 226. The coils 108 are energised  
10 and the heights and spacings of the poles 126,130 are chosen, such that less magnetic flux flows in the second magnetic field relative to the first magnetic field thereby controlling the speed of rotation of the agitator 210 to a reasonable level for stirring.

In the manner described above, the foodstuff preparation system 10 may allow for heating and automated stirring of the foodstuff receptacle 200, with the salient magnetic  
15 assemblies enabling the foodstuff preparation system to be left unattended in use. The temperature sensor 218 may monitor the temperature of foodstuffs in the receiving space 226, and communicate the temperature to a user, for example a remote user, via a transceiver within the handle 208. Additionally or alternatively, the temperature sensor  
20 218 may communicate the temperature to the energisation device 110, which may, in response, control the energisation of coils 108 so as to adjust the rate of heating. As the foodstuff receptacle 200 comprises both a susceptor 228 and an agitator 210, for example a susceptor 228 and an agitator 210 as discrete components, an improved heating pattern may be provided compared to an instance where the agitator 210 also  
25 acts as a susceptor 228. For example, in an instance where the agitator 210 also acts as a susceptor 228, heating may only be provided in the immediate region of the current position of the agitator 210. In contrast, use of a separate susceptor 228 and agitator 210 may allow for heating to be provided in regions remote from a current position of the agitator 210. This may, for example, provide a more even heating of the receiving  
30 space 226.

Whilst the agitator 210 described above has stirrer blades 240, it will be appreciated that other forms of agitator that utilise rotational motion may be utilised with the foodstuff receptacle 200. For example, an agitator having a plurality of cutting blades may be utilised with the foodstuff receptacle 200. Thus the agitator 210 of the foodstuff  
5 receptacle 200 may be removable and replaceable within the foodstuff receptacle 200. The agitator 210 may also be removable for cleaning, for example. Given the use of bar magnets 242, a utensil having magnets or ferrous portions at one end may be used to engage and then remove the agitator 210 from the foodstuff receptacle 200. In this way, the agitator 210 may be removed safely during use due to the lack of direct user contact  
10 with the agitator 210.

Whilst described above as having a plurality of discrete magnetic cores 106, other embodiments of a magnetic field generator 400, as shown schematically in Figure 8 may comprise a single annular coreback 402, with a plurality of arms 404 extending  
15 inwardly from the single annular coreback 402. In a similar manner to the embodiment of the magnetic field generator 104 of Figure 2, first pairs of poles 408 are positioned on the annular coreback 402, and second pairs of poles 412 are located at free ends 414 of the arms 404. Coils 416 are wound on the single annular coreback 402 between poles 406 of first pairs. Such a magnetic field generator 400 may operate in a similar manner  
20 to the magnetic field generator 104 of Figure 2. Use of a single annular coreback may provide for increased ease of alignment during manufacture, for example, but may result in increased magnetic losses through flux leakage along the annular coreback 402.

In some embodiments, not all of the second pairs of poles 130 of the magnetic field  
25 generator 104 may be needed to implement rotation of the agitator 210. For example, it may be the case that only every other second pair of poles 130 is needed to implement rotation of the agitator 210. In such an instance, the coils 108 corresponding to second pairs of poles 130 not needed to implement rotation may be energised in a different manner to the coils 108 corresponding to second pairs of poles 130 needed to  
30 implement rotation, for example at a higher frequency, such that the second pairs of poles 130 not needed to implement rotation of the agitator 210 instead define a

magnetic flux circuit, and generate a varying magnetic field, for interaction with a susceptor of the foodstuff receptacle 200 to heat the receiving space 226. It will be appreciated that in such an embodiment the shape of the susceptor portion 228 may be changed accordingly, or even that the agitator 210 may comprise a susceptor, for  
5 example an additional susceptor. In such an embodiment, it may be considered that coils 108 in a single annular array are used to provide both heating and rotation, with the coils for rotation intermediate coils for heating.

Another embodiment of a magnetic field generator 500 is shown schematically in  
10 Figure 9. In this embodiment, the magnetic field generator comprises a plurality of coils 502 arranged in an annular array, with the coils 502 in the annular array at a substantially common radial distance from a centre point of the annular array. The coils 502 comprise a first subset 506 of coils and a second subset 508 of coils. Each coil 502 of the second subset of coils 508 is located intermediate adjacent ones of the first subset  
15 506 of coils in the annular array.

The first subset 506 of coils are configured to generate respective first magnetic fields in use. In particular an energisation device of the magnetic field generator 500 is configured to pass a varying voltage across the first subset 506 of coils such that the  
20 respective first magnetic fields are generated. The frequency of energisation is chosen such that the respective first magnetic fields are capable of interaction with a susceptor of a foodstuff receptacle to heat the foodstuff receptacle.

The second subset 508 of coils are configured to generate respective second magnetic  
25 fields in use. In particular an energisation device of the magnetic field generator 500 is configured to pass a varying voltage across the second subset 506 of coils such that the respective second magnetic fields are generated. The frequency of energisation is chosen such that the respective second magnetic fields are different to the first magnetic fields, and such that the respective second magnetic fields are capable of interaction  
30 with an agitator of a foodstuff receptacle.

As coils 502 of the second subset 508 of coils are located intermediate adjacent coils 502 of the first subset 506 of coils, interaction of the foodstuff preparation device with both a susceptor and agitator of a foodstuff receptacle may be achieved at a common radial distance. Further, such an arrangement may be a relatively compact arrangement and/or  
5 an arrangement with less component parts, for example compared to an arrangement which has nested annular arrays with one array configured to interact with a susceptor and one array configured to interact with an agitator.

The foodstuff receptacle 200 of Figure 5 may be suitable for use with the magnetic field  
10 generator 500 of Figure 9 when the foodstuff receptacle 200 comprises a susceptor portion 228 having a shape as shown in Figure 6a. In particular, the foodstuff receptacle 200 may be placed on the contact surface 102 of the foodstuff preparation device 100 such that protrusions 234 of the susceptor portion 228 are aligned with coils 502 of the first subset 506 of coils, such that first magnetic fields generated by the first  
15 subset 506 of coils can interact with the susceptor portion 228 to cause heating of the receiving space 226 of the foodstuff receptacle 200. The plurality of coils 502 define a first salient magnetic assembly for interaction with the second salient magnetic assembly defined by the susceptor portion 228, as previously described.

20 It will be appreciated that some modification of the agitator 210 previously described may be adopted to facilitate use with the magnetic field generator 500 of Figure 9. In particular, the length of the plurality of arms 238 may be extended such that bar magnets 242 are located at substantially the same radial distance as the protrusions 234, or the number of magnetic poles present in the agitator 210 may be varied such that  
25 poles of the agitator 210 are always visible to allow rotation.. In such an instance, the coils 502 of the second subset 508 of coils may be located intermediate adjacent protrusions 234 of the susceptor portion 228 of the foodstuff receptacle 200 when placed on the contact surface 102 of the foodstuff preparation device 100, for example such that a non-susceptor portion overlies the coils 502 of the second subset 508 of  
30 coils. This may facilitate interaction between the second magnetic fields generated by

the second subset 508 of coils and the agitator 210 to cause rotation of the agitator 210 within the receiving space 226 of the foodstuff receptacle 200.

In some embodiments, not all coils 502 of the second subset 508 of coils may be needed simultaneously to cause rotation of the agitator 210. This the coils 502 of the second subset 50 of coils may be energised in a sequence to drive rotation of the agitator 210.

In such embodiments, the coils 502 of the second subset 508 of coils may be thought of as having a first energisation state in which the coils 502 generate their respective second magnetic fields, and a second energisation state in which the coils 502 do not

generate their respective second magnetic fields. In some embodiments the coils 502 of the second subset 508 of coils may have a third energisation state in which they interact with a susceptor portion of a foodstuff receptacle to cause heating of the foodstuff receptacle. In such embodiments, modification of the susceptor portion and/or agitator compared to the previously described embodiments may be required, for example by providing an agitator that also comprises susceptor material.

Whilst shown schematically in Figure 9 as just a plurality of coils 502, in practice the plurality of coils 502 may be wound about a magnetic core for guiding flux generated in use. Example embodiments utilising a magnetic core with the plurality of coils 502 are shown in Figures 10 and 11. In the embodiment of Figure 10, each of the plurality of coils is wound about the coreback 510 of a discrete core, with each core comprising a pair of upwardly extending poles 512. In the embodiment of Figure 11, each of the plurality of coils 502 is wound about a common annular coreback 514, with a plurality of pairs 516 of poles extending upwardly from the common annular coreback 514. It will be appreciated that the number of coils 502 has been reduced in the embodiments of Figures 10 and 11 for ease of representation, and that the number of coils and poles may be chosen depending on a susceptor portion of a foodstuff receptacle, for example.

Another embodiment of a suitable magnetic field generator 600 is shown in Figure 12.

The magnetic field generator 600 of Figure 12 utilises the same plurality of magnetic cores 106 as the magnetic field generator 104 of Figure 2 (which will not be described

again here for the sake of brevity), but differs in that each of the magnetic cores 106 is wound with respective first 602 and second 604 coils. The first coil 602 is wound about a pole 126, in this a left-hand pole 126, of the first pole pair, whilst the second coil 604 is wound about the second arm 120.

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In use, the first coil 602 is energised to generate a first magnetic flux circuit, ie a first magnetic field, at the poles 126 of the first pole pair, and the second coil 604 is energised to create a second magnetic flux circuit, ie a second magnetic field, at the poles 130 of the second pole pair. As separate coils are used to generate the first and second magnetic fields, the energisation of the first 602 and second 604 coils may be chosen such that the first and second magnetic fields are tailored to provide different functionalities when interacting with the foodstuff receptacle 200 in use, for example to provide heating and rotation as discussed above. Such an arrangement provides two independent magnetic circuits whilst using a common coreback. In some embodiments, the first coil 602 is energised at a greater frequency than the second coil 604.

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An alternative embodiment of a foodstuff receptacle 700 for use with the magnetic field generator 104 of Figure 2 is shown schematically in cross-section in Figure 13.

20 The foodstuff receptacle 700 of Figure 13 is substantially the same as the foodstuff receptacle of Figure 5, and differs only in the presence of a foodstuff retention basket 702 and the form of agitator 704.

The foodstuff retention basket 702 comprises a base 706, a sidewall 708 extending upwardly from the base 706 to define an enclosure 710, and a plurality of legs 712 extending downwardly from the base 706. The legs 712 have a length such that the base 706, and hence the enclosure 710, are located within the receiving space 226 at a level above the agitator 704. This divides the receiving space 226 into a liquid reservoir portion 714 below the base 706, and a foodstuff receiving portion above the base 706, defined by the enclosure 710. The base 706 thereby acts as a foodstuff retention surface. The base 706 and the sidewalls 708 have a plurality of apertures which enable

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the passage of liquid from the liquid reservoir portion 714 to the enclosure 710, and vice versa.

5 The agitator 704 has a form that is sufficient to transfer liquid droplets from the liquid reservoir portion 714 to the enclosure upon rotation of the agitator 704 within the liquid reservoir portion 714, for example with an appropriately shaped blade or the like.

10 In use, foodstuffs are placed in the enclosure 710, liquid, for example water, is placed in the liquid reservoir portion 714 of the foodstuff receptacle 700, and the foodstuff receptacle 700 is placed on the foodstuff preparation device 100 of Figure 2, for example with the first and second salient magnetic assemblies interacting to guide the foodstuff receptacle 700 into position on the contact surface 102 of the foodstuff preparation device 100. The foodstuff receptacle 700 is positioned on the contact surface 102 such that the susceptor portion 228 of the inner pan 204 overlies the poles 15 126 of the first pair of poles of each magnetic core 106, and the non-susceptor portion 230 of the inner pan 204, and the agitator 704, overlie the poles 130 of the second pair of poles of each magnetic core 106.

20 The coils 108 are energised by the energisation device 110 such that first and second magnetic flux circuits, ie first and second magnetic fields, are generated at the poles 126 of the first pair of poles and the poles 130 of the second pair of poles 130 of each of the magnetic cores 106. As mentioned above, due to the different reluctances of the first and second magnetic flux circuits, and the frequency of energisation of the coils 108, the magnetic fields generated at the first pairs of poles 126 and the second pairs of poles 25 130 may have different characteristics. In the present embodiment, the magnetic field produced at the first pairs of poles 126 is a first varying, ie alternating, magnetic field that interacts with the susceptor portion 228 such that eddy currents are generated within the susceptor portion 228, and the liquid within the liquid reservoir 714 is heated.

30 The magnetic field produced at the second pairs of poles 130 is a second varying, ie alternating, magnetic field that interacts with the agitator 704, for example with magnets

of the agitator 704, such that the agitator 704 is rotated within the liquid reservoir portion 714. Rotation of the agitator 704 within the liquid reservoir portion 714 displaces droplets of heated liquid from the liquid reservoir portion 714 to the enclosure 710, where the droplets of heated liquid contact foodstuffs retained within the enclosure 710, and act to cook the foodstuffs. Droplets of heated liquid can then return to the liquid reservoir portion 710 by virtue of the apertures formed in the base 706 and the sidewall 708 of the foodstuff retention basket 702. It will be appreciated that in some embodiments the base 706 may not comprise apertures whilst the sidewall 708 does, and vice versa.

The foodstuff receptacle 700 may thus be used for a splash cooking method, where foodstuffs are cooked via interaction with heated droplets of liquid, for example heated water droplets. Such splash cooking may have a relatively high level of energy efficiency as no phase change is required, but may typically require an increased length of cooking time. As the foodstuff receptacle 700 provides automation of the heating and movement of the agitator, the foodstuff receptacle 700 may be left unattended in use, which may lend itself to a cooking method such as splash cooking.

Furthermore, interaction of the salient magnetic assemblies of the foodstuff receptacle 700 and the foodstuff preparation device 100 may effectively lock the foodstuff receptacle 700 to the foodstuff preparation device 100, for example such that rotation of the foodstuff receptacle 700 relative to the foodstuff preparation device 100 is inhibited. This may be particularly beneficial where, for example, the agitator becomes caught on an item that falls into the liquid reservoir portion 714, which would otherwise cause rotation of the foodstuff receptacle 700 relative to the foodstuff preparation device 100. This may allow the foodstuff receptacle 700 to be left unattended in use, which may be particularly beneficial for a splash cooking method which typically takes a relatively long amount of time.

As the droplets of heated liquid are returned to the liquid reservoir portion 714 in use, a relatively small amount of liquid may be required, thereby providing improvements in liquid efficiency.

5 The foodstuff retention basket 702 and the agitator 704 may be removable from the foodstuff receptacle 700, and in particular removable from the inner pan 204. This may allow for the foodstuff receptacle to provide for both the stirring functionality of the embodiment of Figure 2 and the splash cooking functionality of Figure 13 whilst minimising components required, for example by allowing the outer 202 and inner 204  
10 pans to be used for both functions. In other embodiments, the foodstuff retention basket may be integrally formed with the inner pan 204, for example, and the inner pan 204 may be interchangeable to provide different functionality.

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15 A further alternative embodiment of a foodstuff receptacle 800 for use with the magnetic field generator 104 of Figure 2 is shown schematically in cross-section in Figure 14.

The foodstuff receptacle 800 shares the outer pan 202, lid 206, handle 208, and associated features of the embodiment of the foodstuff receptacle of Figure 5, but differs  
20 in the form of the inner pan 802 and the agitator 804. In some embodiments the inner pan 802 of the foodstuff receptacle of Figure 14 may have a different diameter to that of the inner pan 204 of the foodstuff receptacle 200 of Figure 5. This may allow for a nested arrangement of inner pans within the outer pan 202 for storage. In use the foodstuff preparation device 100 may sense which inner pan is received within the outer  
25 pan 202, or may be provided with such information via a user input, for example.

The inner pan 802 comprises a generally circular base portion 806, and a sidewall 808 extending upwardly from the base portion 806 to define a receiving space 810. The base portion 806 is hollow in form, and houses a magnetic assembly 812 of the agitator  
30 804.

The agitator 804 comprises a magnetic assembly 812, and a plurality of chopping blades 814 fixedly attached to the magnetic assembly 812. The agitator 804 as shown in Figure 14 has the magnetic assembly 812 housed in the base portion 806 of the inner pan 802, and the plurality of chopping blades 814 housed in the receiving space 810, with the plurality of chopping blades 814 connected to the magnetic assembly by a connector portion 816. It will, however, be appreciated that in other embodiments the magnetic assembly 812 may comprise a housing that enables both the magnetic assembly 812 and the plurality of chopping blades 814 to be located within the receiving space 810.

The magnetic assembly 812 comprises an annular array of bar magnets 818, as shown schematically in Figure 15. The connection portion 816 is a rigid connection, and may comprise a shaft held within a bearing assembly.

In use, the foodstuff receptacle 800 is placed on the foodstuff preparation device 100 of Figure 2 such that the bar magnets 818 of the agitator 804 overlie the poles 126 of the first pair of poles of each magnetic core 106.

The coils 108 are energised by the energisation device 110 such that magnetic flux circuits, ie magnetic fields, are generated at the poles 126 of the first pair of poles of each of the magnetic cores 106. In the present embodiment, the magnetic fields produced at the first pairs of poles 126 is a varying, ie alternating, magnetic field that interacts with the bar magnets 818 of the agitator 804 to drive rotation of the agitator 804, and hence rotation of the plurality of chopping blades 814 within the receiving space 810. This allows for foodstuffs, for example vegetables or the like, to be chopped when placed in the receiving space 810 of the foodstuff receptacle 800.

Here the poles 126 of the first pairs of poles of the magnetic field generator 104 are used to provide rotational functionality, compared to the use of the poles 130 of the second pairs of poles of the magnetic field generator to provide rotational functionality with the foodstuff receptacle of Figure 5. The poles 126 of the first pairs of poles are

located at a greater radius than poles 130 of the second pairs of poles 130, and hence may provide greater torque, which may be beneficial when using chopping blades 814.

As shown schematically in Figure 15, the foodstuff receptacle 800 may also be provided with a salient magnetic assembly 820, which may also be a susceptor material, which interlocks with the salient magnetic assembly defined by the magnetic cores 106 of the magnetic field generator 104, for example with the poles 130 of the second pairs 130 of poles, to prevent rotation of the foodstuff receptacle 800 relative to the foodstuff preparation device 100 in a similar manner to that previously described in relation to the foodstuff receptacle 200 of Figure 5 above.

A further alternative embodiment of a foodstuff receptacle 900 for use with the magnetic field generator 104 of Figure 2 is shown schematically in cross-section in Figure 16. Here the foodstuff receptacle 900 takes the form of a blender jug.

The foodstuff receptacle 900 comprises a cylindrical base portion 902, a sidewall 904 extending upwardly from the base portion 902 to define a receiving space 906, a handle 908, a lip 910, an agitator 912, and a salient magnetic assembly 914. The lip 910 enables contents of the foodstuff receptacle 900 to be poured from the receiving space 906, whilst the handle 908 is shaped such that it can be grasped by a user. Here the base portion 902, the sidewall 904, the handle 908 and the lip 910 may be formed from a thermally insulating material, for example a plastic, as part of a single or multi-step moulding process.

The agitator 912 of the foodstuff receptacle 900 of Figure 16 has substantially the same form as the agitator 804 of the foodstuff receptacle 800 of Figure 14, and in particular comprises an annular array of bar magnets, as shown schematically in the embodiment of Figure 15. The base portion 902 is hollow in nature, and houses a magnetic assembly 916 of the agitator 912, including the bar magnets, whilst chopping blades 918 of the agitator 912 are located in the receiving space 906. The salient magnetic assembly 914

has substantially the same structure as the salient magnetic assembly 820 depicted in Figure 15, and is embedded in a lower wall of the base portion 902.

In use, the foodstuff receptacle 900 is placed on the foodstuff preparation device 100 of Figure 2 such that the bar magnets of the agitator 912 overlie the poles 126 of the first pair of poles of each magnetic core 106, and the salient magnetic assembly 914 overlies the poles 130 of the second pair of poles of each magnetic core 106.

The coils 108 are energised by the energisation device 110 such that magnetic flux circuits, ie magnetic fields, are generated at the poles 126 of the first pair of poles of each of the magnetic cores 106. In the present embodiment, the magnetic fields produced at the first pairs of poles 126 are varying, ie alternating, magnetic fields that interacts with the bar magnets of the agitator 912 to drive rotation of the agitator 912, and hence rotation of the chopping blades 918 within the receiving space 906. This allows for foodstuffs, for example vegetables or fruit or the like, to be chopped when placed in the receiving space 906 of the foodstuff receptacle 900. The salient magnetic assembly 914 interacts with magnetic flux circuits, ie magnetic fields, generated at the poles 130 of the second pair of poles of each of the magnetic cores 106 to lock the foodstuff receptacle 900 to the contact surface 102 of the foodstuff preparation device 100, for example such that rotation of the foodstuff receptacle 900 relative to the contact surface 902 is inhibited.

In some embodiments, the foodstuff receptacle 900 may be provided with a gear arrangement linking the magnets of the agitator 912 to the plurality of chopping blades 918. This may provide a further torque increase whilst reducing speed.

A further alternative embodiment of a foodstuff receptacle 1000 for use with the magnetic field generator 104 of Figure 2 is shown schematically in Figures 17 and 18.

The foodstuff receptacle 1000 comprises a generally circular base 1002, and a sidewall 1004 extending upwardly from the base 1002 to define a receiving space for receiving

foodstuffs. A plurality of filaments 1006 of ferrous material, for example long and thin strips of ferrous material, are applied to the base 1002 and the sidewall 1004. In particular, each filament 1006 is a continuous filament that extends along the base 1002 and up the sidewall 1004. The plurality of filaments 1006 define both a susceptor and a number of poles P1-P12 of a salient magnetic assembly on the base 1002.

The continuous nature of the filaments 1006 can be seen when considering, for example, the filament that defines both pole P1 and pole P9. In particular, the filament 1006 extends from an upper region of the sidewall 1004 to the base 1002 at pole P1, extends across the base 1002 from pole P1 to pole P9, and extends from pole P9 along the sidewall 1004 to the upper region of the sidewall 1004. As shown, the plurality of filaments 1006 extend up substantially the entirety of the height of the sidewall 1004. The location of the plurality of filaments 1006 along the base 1002 is such that a circular region 1008 is located centrally on the base 1002. This circular region 1008 is formed of a non-susceptor material, for example a non-ferrous material that allows the passage therethrough of a magnetic field generated by the magnetic field generator 104. An agitator, for example the agitator 210 of the embodiment of Figure 5, may be placed in the receiving space above the circular region 1008 in use.

In use, the foodstuff receptacle 1000 is placed on the foodstuff preparation device 100 of Figure 2, for example with the corresponding salient magnetic assemblies interacting to guide the foodstuff receptacle 1000 into position on the contact surface 102 of the foodstuff preparation device 100. The foodstuff receptacle 1000 is positioned on the contact surface 102 such that the susceptor defined by the plurality of filaments 1006 overlies the poles 126 of the first pair of poles of each magnetic core 106, and the circular region 1008 of the foodstuff receptacle 1000, and the agitator 210, overlie the poles 130 of the second pair of poles of each magnetic core 106.

The coils 108 are energised by the energisation device 110 such that first and second magnetic flux circuits, ie first and second magnetic fields, are generated at the poles 126 of the first pair of poles and the poles 130 of the second pair of poles of each of the

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magnetic cores 106. As mentioned above, due to the different reluctances of the first and second magnetic flux circuits, and the frequency of energisation of the coils 108, the magnetic fields generated at the first pairs of poles 126 and the second pairs of poles 130 may have different characteristics. In the present embodiment, the magnetic field produced at the first pairs of poles 126 is a first varying, ie alternating, magnetic field that interacts with the plurality of filaments 1006 such that eddy currents are generated within the plurality of filaments 1006, and the receiving space is heated. The magnetic field produced at the second pairs of poles 130 is a second varying, ie alternating, magnetic field that interacts with the bar magnets 242 of an agitator, if present, such that the agitator is rotated within the receiving space 226. In such a manner the agitator may be used to stir foodstuffs received within the receiving space.

As the plurality of filaments 1006 extend both along the base 1002 and up the sidewall 1004, a better heat distribution may be achieved within the receiving space compared to, for example, an arrangement in which a susceptor does not extend up the sidewall 1004. For example, heat may be conducted up the sidewall 1004 in view of the plurality of filaments 1006. As the plurality of filaments 1006 are relatively thin, a thickness of the base 1002 may be reduced, which may aid interaction with magnetic fields generated by the magnetic field generator 104, for example by bringing the agitator 210 closer to the magnetic field generator.

Although not shown here, it will be appreciated that a layer of thermally insulating material may be provided on the base 1002 and/or the sidewall 1004 to improve thermal efficiency and/or increase user safety.

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In each embodiment of the magnetic field generators previously described, single annular arrangements of coils and magnetic cores have been described, for example corresponding to a single ring of an induction hob. Induction hobs typically comprise more than a single ring, and it will be recognised that the embodiments of magnetic field generators previously can be extended to provide a foodstuff preparation device 100 having a multi-ring structure.

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An example of such a multi-ring structure 1100 is shown schematically in Figure 19.

5 Here four magnetic field generators 104 as per the embodiment of Figure 2 are located as outer rings 1102. An inner ring 1104 comprises an array of C-shaped magnetic cores 1106, with the array also sharing a coil 108, coreback 114, and a first pair of poles 126 of each of the outer rings 1102. Each C-shaped magnetic core 1106 comprises a coreback, and a plurality of poles 1108 extending upwardly from the coreback, for example in a direction toward the contact surface 102 of the foodstuff preparation  
10 device 100 (out of the page in Figure 19). Each coreback of the C-shaped magnetic cores 1106 is wound with a respective coil 1110. In use the coils 1110 of the C-shaped magnetic cores 1106 and the coils 108 of the shared magnetic cores 106 of the outer rings 1102 can be energised depending on a foodstuff receptacle received on the contact surface of the foodstuff preparation device 100 to provide any of the heating, rotation or  
15 locking functionality previously described.

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20 Phase shifting of PWM can also be applied to the operation of the multi-ring structure 1100 of Figure 19 when multiple rings operate concurrently. Each of these rings can be operating at the same or a different PWM duty cycle (also burst mode control applies) depending on the heating requirement. The interactions of these four rings can be correctly controlled to avoid periodic random combinations of coil currents that produce short term high values of mains input current.

25 Whilst several embodiments of foodstuff receptacles are described herein as having an outer pan, it will be appreciated that the outer pan is an optional feature that may provide increased safety or thermal efficiency, but that the inner pans may be used in isolation if desired.

Claims

1. A foodstuff receptacle for use with a foodstuff preparation device, the foodstuff receptacle comprising a receiving space for receiving foodstuffs, a liquid reservoir for receiving liquid, a susceptor for heating liquid within the liquid reservoir, and an agitator within the liquid reservoir, the susceptor configured to interact with a first magnetic field of the foodstuff preparation device to heat liquid within the liquid reservoir, and the agitator configured to interact with a second magnetic field of the foodstuff preparation device such that the agitator is movable within the liquid reservoir to displace liquid from the liquid reservoir to the receiving space; and wherein the foodstuff receptacle comprises a first salient magnetic assembly configured to interact with a second salient magnetic assembly of a foodstuff preparation device when the foodstuff receptacle is placed on the foodstuff preparation device to inhibit motion of the foodstuff receptacle relative to the foodstuff preparation device.

2. A foodstuff receptacle as claimed in Claim 1, wherein the foodstuff receptacle comprises a base and a sidewall defining the liquid reservoir, the susceptor is located in the base and the base comprises a non-susceptor portion aligned with the agitator.

3. A foodstuff receptacle as claimed in Claim 2, wherein the susceptor and the non-susceptor portion are concentrically arranged within the base.

4. A foodstuff receptacle as claimed in Claim 2 or Claim 3, wherein the non-susceptor portion is arranged centrally on the base, and the susceptor extends annularly about the non-susceptor portion.

5. A foodstuff receptacle as claimed in Claim 2 or Claim 3, wherein the susceptor is arranged centrally on the base, and the non-susceptor portion extends annularly about the susceptor.

6. A foodstuff receptacle as claimed in Claim 1, wherein the first salient magnetic assembly comprises an annular ring with a plurality of protrusions extending from the annular ring.

5 7. A foodstuff receptacle as claimed in any preceding claim, wherein the susceptor defines the first salient magnetic assembly.

8. A foodstuff receptacle as claimed in any preceding claim, wherein the agitator is removable from the foodstuff receptacle.

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9. A foodstuff receptacle as claimed in any preceding claim, wherein the foodstuff receptacle comprises a retention surface at least partially defining the receiving space, the retention surface disposed above the liquid reservoir.

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10. A foodstuff receptacle as claimed in Claim 9, wherein the retention surface comprises a plurality of apertures that allow fluid communication between the liquid reservoir and the receiving space.

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11. A foodstuff receptacle as claimed in any preceding claim, wherein the susceptor comprises a plurality of continuous filaments extending along the base and up the sidewall.

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12. A foodstuff receptacle as claimed in any preceding claim, wherein the foodstuff receptacle comprises a thermally insulating layer disposed on the base and the sidewall.

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13. A foodstuff preparation system comprising a foodstuff preparation device and a foodstuff receptacle as claimed in any preceding claim, wherein the foodstuff preparation device comprises a magnetic field generator configured to generate the first and second magnetic fields.

14. A foodstuff preparation system as claimed in Claim 13, wherein the magnetic field generator comprises a magnetic core structure, a coil wrapped around the magnetic core structure, and an energisation device configured to energise the coil, the magnetic core structure comprises a first pole pair configured to interact with the susceptor of the foodstuff receptacle to define a first magnetic flux path, and the magnetic core structure comprises a second pole pair configured to interact with the agitator of the foodstuff receptacle to define a second magnetic flux path.

15. A foodstuff preparation system as claimed in Claim 14, wherein the magnetic field generator comprises a plurality of first pole pairs configured to interact with the susceptor of the foodstuff receptacle to define respective first magnetic flux paths, and a plurality of second pole pairs configured to interact with the agitator of the foodstuff receptacle to define respective second magnetic flux paths, the first and second pole pairs being annularly arranged.

16. A foodstuff preparation system as claimed in any of Claims 13 to 15, wherein the magnetic field generator defines a salient magnetic assembly.