(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 394 256 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
03.07.2024 Bulletin 2024/27

(21) Application number: **22861078.8**

(22) Date of filing: **02.08.2022**

(51) International Patent Classification (IPC):
F24C 7/02 *(2006.01)* ***F24C 7/06*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
H05B 3/265; F24C 7/02; F24C 7/06;
H05B 2203/032

(86) International application number:
PCT/JP2022/029595

(87) International publication number:
WO 2023/026787 (02.03.2023 Gazette 2023/09)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **27.08.2021 JP 2021138483**

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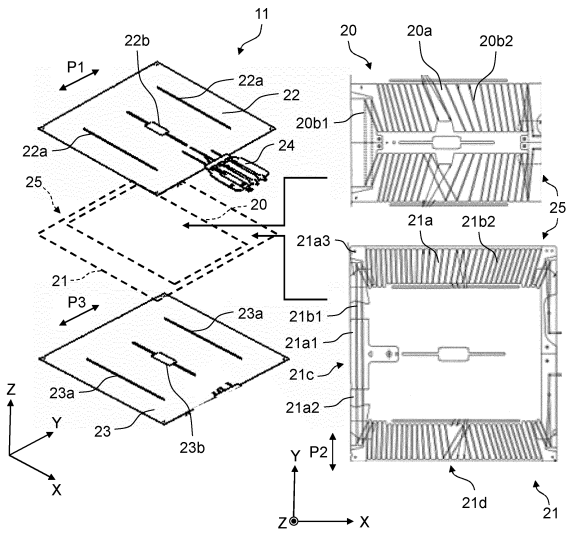
(54) **HEATING COOKER**

(57) A heating cooker includes a heating chamber for accommodating a heating target, and a planar heater. The planar heater is disposed above the heating chamber, and includes an inner heater and an outer heater surrounding the inner heater. The inner heater includes an inner mica and an inner wound heater wire. The outer heater includes a wide frame part, a narrow frame part, an outer mica disposed in each of the wide frame part and the narrow frame part, an outer wound heater wire arranged on the wide frame part, and an outer linear heater wire arranged on the narrow frame part. The narrow frame part includes at least one outer linear heater wire arranged in a longitudinal direction of the narrow frame part, and an upper mica that at least partially covers the at least one outer liner heater wire.

FIG. 6



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heating cooker that heats a cooking target, such as food, accommodated in a heating chamber, using a planar heater disposed on a ceiling of the heating chamber.

BACKGROUND ART

[0002] Conventionally, a heating section provided in a heating cooker, such as a microwave oven, is an infrared ray heater unit, a microwave heating unit, a steam heating unit, hot air circulation unit, and so on.

[0003] The infrared ray heater unit is configured to heat a heating target by radiation heat. The microwave heating unit is configured to heat a heating target by microwave. The steam heating unit is configured to heat a heating target by superheated steam. The hot air circulation unit is configured to heat a heating target by hot air supplied to inside a heating chamber.

[0004] Still more, in the heating cooker, there is a heating section configured to directly heat inside the heating chamber with a planar heater disposed on a ceiling of the heating chamber, (e.g., PTL 1 and PTL 2).

[0005] Furthermore, in the heating cooker, there is a heating section configured to heat the ceiling of the heating chamber with a planar heater disposed on a top surface of the ceiling to indirectly heat inside the heating chamber by the heated ceiling (e.g., PTL 3).

Citation List

Patent Literature

[0006]

PTL 1: Unexamined Japanese Patent Publication No. H3-103206
PTL 2: Unexamined Japanese Patent Publication No. 2010-54124
PTL 3: Unexamined Japanese Patent Publication No. 2017-161163

SUMMARY OF THE INVENTION

[0007] To increase a heating efficiency of above-described planar heater, a heater wire needs to be arranged substantially over entire periphery of the planar heater.

[0008] It is therefore an object of the present disclosure to prevent mutual contact of heater wires of the planar heater and improve the heating efficiency of the planar heater in a heating cooker equipped with the planar heater.

[0009] A heating cooker according to an exemplary embodiment of the present disclosure includes a heating chamber for accommodating a heating target, and a planar heater. The planar heater is disposed above the heating chamber, and includes an inner heater and an outer heater surrounding the inner heater.

[0010] The inner heater includes an inner mica and an inner wound heater wire. The outer heater includes a wide frame part, a narrow frame part, an outer mica disposed in each of the wide frame part and the narrow frame part, an outer wound heater wire arranged on the wide frame part, and an outer linear heater wire arranged on the narrow frame part.

[0011] The narrow frame part has at least one outer linear heater wire arranged in a longitudinal direction of the narrow frame part, and an upper mica that at least partially covers the at least one outer linear heater wire.

[0012] The heating cooker of the present disclosure is capable of preventing mutual contact of the heater wires of the planar heater and improving the heating efficiency of the planar heater.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

FIG. 1 is a perspective view illustrating an appearance of a heating cooker according to an exemplary embodiment of the present disclosure.
FIG. 2 is a perspective view of the heating cooker in a state a door is opened according to the exemplary embodiment.
FIG. 3 is a perspective view of the heating cooker in a state an outer cover is removed according to the exemplary embodiment.
FIG. 4 is an exploded perspective view of a planar heater unit in the heating cooker according to the exemplary embodiment.
FIG. 5 is a diagram illustrating a structure of an upper plate of the planar heater unit in the heating cooker according to the exemplary embodiment.
FIG. 6 is an schematic exploded view of the planar heater in the heating cooker according to the exemplary embodiment.
FIG. 7 is a plan view illustrating around an upper mica of an outer heater in the heating cooker according to the exemplary embodiment.
FIG. 8 is a plan view illustrating a narrow frame part that is a part of the outer heater in the heating cooker according to the exemplary embodiment.
FIG. 9 is a plan view of the planar heater in the heating cooker according to the exemplary embodiment.
FIG. 10 is a bottom view of the planar heater in the heating cooker according to the exemplary embodiment.
FIG. 11 is a circuit block diagram related to control of the heating cooker according to the exemplary embodiment.

DESCRIPTION OF EMBODIMENT

[0014] A heating cooker according to a first mode of the present disclosure includes a heating chamber for accommodating a heating target, and a planar heater. The planar heater is disposed above the heating chamber, and includes an inner heater and an outer heater surrounding the inner heater.

[0015] The inner heater includes an inner mica and an inner wound heater wire. The outer heater includes a wide frame part, a narrow frame part, an outer mica disposed in each of the wide frame part and the narrow frame part, an outer wound heater wire arranged on the wide frame part, and an outer linear heater wire arranged on the narrow frame part.

[0016] The narrow frame part includes at least one outer linear heater wire arranged in a longitudinal direction of the narrow frame part, and an upper mica that at least partially covers the at least one outer linear heater wire from above.

[0017] A heating cooker according to a second mode of the present disclosure further includes, in addition to the first mode, a lower mica that covers at least one outer linear heater wire from below. The at least one outer linear heater wire includes a plurality of outer linear heater wires. The plurality of outer linear heater wires are arranged separated from each other between the upper mica and the lower mica in the narrow frame part.

[0018] A cooking heater according to a third mode of the present disclosure further includes, in addition to the first and second modes, an inner linear heater wire in the inner heater. The plurality of outer linear heater wires are arranged substantially in parallel with and in the vicinity of the inner linear heater wire.

[0019] Heating cooker 100 according to the exemplary embodiment of the present disclosure will be described below with reference to accompanying drawings. An X axis, a Y axis, and a Z axis in the drawings are a horizontal direction (left-right direction), a depth direction (front-back direction), and a height direction (vertical direction) of heating cooker 100, respectively.

[0020] In the drawings, a front surface and a rear surface of heating cooker 100 correspond to the front and back of heating cooker 100, respectively. In other words, the front of heating cooker 100 is a negative direction on the Y axis and the back of heating cooker 100 is a positive direction on the Y axis.

[0021] In the drawings, left and right seen from the front of heating cooker 100 correspond to the left and right of heating cooker 100, respectively. In other words, the right side of heating cooker 100 is a positive direction on the X axis and the left side of heating cooker 100 is a negative direction on the X axis.

[0022] FIG. 1 is a perspective view illustrating an appearance of heating cooker 100. FIG. 2 is a perspective view of heating cooker 100 in a state a door is opened. As illustrated in FIG. 1 and FIG. 2, heating cooker 100 includes main body 1 having a front opening, heating chamber 4 provided inside main body 1, and door 2 covering the front opening of main body 1.

[0023] Handle 3 is provided on an upper end of door 2. When a user pulls handle 3, door 2 opens and the front opening of heating chamber 4 is exposed. After closing door 2, a heating target, such as food, accommodated inside heating chamber 4 is heated and cooked.

[0024] Setting section 5 is provided on the front of heating cooker 100. More specifically, setting section 5 is provided to the right of handle 2 on a front surface of main body 1. Setting section 5 includes a rotary switch for setting a range of cooking conditions, such as a cooking temperature and cooking time, and a display for displaying the range of cooking conditions and a heating status during heat-cooking.

[0025] Heating cooker 100 includes, as a heating section, planar heater 11 (FIG. 4) and a microwave heating unit (not illustrated).

[0026] The microwave heating unit is provided below a bottom of heating chamber 4. The microwave heating unit includes magnetron 28 (FIG. 11), a waveguide, and an antenna. Magnetron 28 is configured to generate microwave. The waveguide is configured to propagate the microwave from magnetron 28 to the antenna. The antenna is configured to radiate the microwave propagated by the waveguide into heating chamber 4.

[0027] The antenna can radiate microwave having directivity and circularly polarized microwave. Controller 7 described later (FIG. 11) rotates and stops this antenna to uniformly heat the heating target placed in heating chamber 4.

[0028] Heating cooker 100 may further include, as the heating section, a steam heating unit configured to heat the heating target by steam.

[0029] The steam heating unit includes a water tank and a boiler (both not illustrated) disposed inside main body 1. The boiler generates superheated steam by heating water from the water tank using a steam heater (FIG. 11) disposed inside the boiler. The steam heating unit is configured to heat the heating target in heating chamber 4 by spraying the superheated steam into heating chamber 4.

[0030] Heating cooker 100 may further includes, as the heating section, a hot air circulation unit configured to heat the heating target by circulating hot air inside heating chamber 4.

[0031] The hot air circulation unit includes rear heater 27 (FIG. 11), circulating fan (not illustrated), and circulating fan motor 29 (FIG. 11) disposed at the back of the rear surface of heating chamber 4. When the circulating fan motor operates, air circulates inside heating chamber 4 and in a space at the back of heating chamber 4. The hot air circulation unit is configured to heat the heating target in heating chamber 4 with hot air generated by heating the air with rear heater 27.

[0032] In these heating sections, one heating section is selected directly by the user or according to a cooking option selected by the user. After the user places the

heating target in heating chamber 4 and closes door 2, heating cooker 100 starts cooking when the user sets the heating section or cooking option via setting section 5 and presses a start button.

[0033] As illustrated in FIG. 2, heating cooker 100 accommodates detachable heat generating tray 6 inside heating chamber 4. More specifically, a plurality of rails (not illustrated) with different heights are provided on each of left and right side walls of heating chamber 4. Each of the plurality of rails provided on the left side wall has a same height as a corresponding rail of the plurality of rails provided on the right side wall. Therefore, a cooking tray such as heat generating tray 6 can be detachably placed in one of a plurality of heights in heating chamber 4 according to the purpose of use.

[0034] Heat generating tray 6 has a heat generating element (not illustrated) embedded in its placement surface. The heat generating element is configured with, for example, ferrite, and generates heat by absorbing the microwave when the microwave is radiated. Heat generating tray 6 heats the heating target placed on heat generating tray 6 using this heat.

[0035] The heat generating element may be other than ferrite. Still more, the heat generating element may be applied to a rear surface of heat generating tray 6. Heat generating tray 6 may be metal or ceramic as long as a principal material has good heat conductivity.

[0036] In the present exemplary embodiment, heat generating tray 6 is supported by a pair of rails provided on the left and right side walls of heating chamber 4. However, heat generating tray 6 may be suspended from a ceiling, or heat generating tray 6 may have a leg protruding downward and placed on a bottom surface of heating chamber 4.

[0037] In the microwave heating unit, the antenna is a rotary antenna having a waveguide structure in which the antenna is driven to rotate by a rotating mechanism (not illustrated) disposed below at a substantially center of the bottom surface of heating chamber 4. The antenna has microwave radiation directivity in a longitudinal direction of the waveguide structure and also has an opening provided in an upper part of the antenna to generate circularly polarized wave.

[0038] Heating cooker 100 of the present exemplary embodiment is configured to uniformly radiate the microwave in heating chamber 4 by rotating the antenna and also radiate the circularly polarized microwave to heat generating tray 6.

[0039] The bottom surface of heating chamber 4 is configured with a material that transmits the microwave from the antenna. The side walls, a rear wall, and the ceiling of heating chamber 4 are configured with steel or aluminum-plated steel sheet of stainless steel (SUS: steel use stainless).

[0040] Heating chamber 4 may be provided with a non-adhesive coating layer such as of fluoric resin or silicone resin. A coating layer suppresses adhesion of stains such as oil splashed during cooking and cooking waste, and also facilitates wiping off of stains adhered.

[0041] Furthermore, heating chamber 4 may be provided with, on each wall surface of heating chamber 4, a coating layer that has a self-cleaning function to decompose oil splashed during cooking and perform self-cleaning.

[0042] To provide the self-cleaning function to the coating layer, for example, a manganese oxide catalyst species that accelerates oxidation decomposition action is mixed in the coating layer. Still more, platinum that demonstrates a significant effect on oxidation decomposition action at low temperatures or palladium that has high activity in a mid to high temperature range may be added to the coating layer. Furthermore, cerium that has an adsorption action may be added,

Cooking heater 100 according to the present exemplary embodiment heats the heating target by planar heater unit 8 (FIG. 3) disposed above the ceiling of heating chamber 4, in addition to heating from below using heat generating tray 6.

[0043] FIG. 3 is a perspective view of heating cooker 100 in a state an outer cover is removed. As illustrated in FIG. 3, planar heater unit 8 is disposed above the ceiling of heating chamber 4 (FIG. 2).

[0044] Heating cooker 100 is provided with in-chamber temperature detector 9. In-chamber temperature detector 9 is, for example, a thermistor, and is disposed at an upper right corner of the rear wall of heating chamber 4 in order to detect the temperature inside heating chamber 4 (hereinafter referred to as an in-chamber temperature). Controller 7 (FIG. 11) described later receives in-chamber temperature information detected by in-chamber temperature detector 9 to perform a range of controls.

[0045] However, the structure of the present disclosure is not limited thereto. As long as the in-chamber temperature is detectable, in-chamber temperature detector 9 may be disposed in other places. For example, in-chamber temperature detector 9 may be disposed at any of the corners such as an upper left corner of the rear wall of heating chamber 4, or an upper front corner of the right wall or the left wall of heating chamber 4.

[Planar heater unit]

[0046] FIG. 4 is an exploded perspective view of planar heater unit 8. As illustrated in FIG. 4, planar heater unit 8 includes upper plate 10, planar heater 11, first heat insulator 13, retainer plate 14, insulating sheet 15, and heat shield 16 in this order from the bottom.

[0047] In other words, planar heater unit 8 has a stacking assembly structure. Therefore, all components of planar heater unit 8 can be easily replaced as required during maintenance. Planar heater unit 8 further includes heater temperature detector 18 disposed on retainer plate 14 in order to detect a temperature in a heating area directly heated by planar heater 11.

[0048] Insulating sheet 15 electrically insulates terminal section 24 and the like of planar heater 11 from other

components. Heat shield 16 blocks heat conduction from planar heater unit 8 to an outer cover of main body 1. Hereinafter, other components of planar heater unit 8 will be described.

[Upper plate of heating chamber]

[0049] FIG. 5 includes plan view (a), front view (b), and side view (c) to illustrate a structure of upper plate 10 in planar heater unit 8.

[0050] Upper plate 10 configures the ceiling of heating chamber 4. As illustrated in plan view (a) of FIG. 5, upper plate 10 includes heat generating area 10a having a substantially square shape in a plan view at the center of upper plate 10. Therefore, as illustrated in front view (b) and side view (c) of FIG. 5, heat generating area 10a has a three-dimensional curved shape protruding upward. In other words, heat generating area 10a is recessed from a surface on the side of heating chamber 4, i.e., a bottom surface. On the other hand, a top surface of heat generating area 10a is in close contact with planar heater 11.

[0051] Heating chamber 4 has a rectangular parallelepiped shape. Heat-generating area 10a covers substantially the entire ceiling of heating chamber 4. Planar heater 11 has a rectangular shape corresponding to a shape of the ceiling of heating chamber 4. Planar heater 11 covers the entire top surface of heat generating area 10a so as to achieve close contact with the top surface of heat generating area 10a. Therefore, almost the entire surface of upper plate 10 is heated by planar heater 11 and becomes a heat generating element.

[0052] As illustrated in plan view (a) of FIG. 5, heat generating area 10a has a plurality of honey-comb areas 10b each having a regular hexagonal shape (honeycomb shape). A boundary of two adjacent honey-comb areas 10b in heat generating area 10a is formed of a groove protruding toward heating chamber 4.

[0053] More precisely, the groove protruding toward heating chamber 4 is a groove formed between two parallel linear banks raised on the side of heating chamber 4. The plurality of honey-comb areas 10b has substantially the same area. Upper plate 10 is formed by press.

[0054] When planar heater 11 operates, heat generating area 10a expands. When planar heater 11 is turned off, heat generating area 10a contracts. However, the shape of honey-comb area 10b absorbs a stress in various directions generated by expansion or contraction.

[0055] When heat generating area 10a is heated by planar heater 11, it is difficult to uniformly heat entire heating area 10a, and uneven heat distribution occurs in heat generating area 10a. In this case, a stress caused by expansion or contraction in a certain portion of heat generating area 10a may have a stress level different from that of other portions of heat generating area 10a.

[0056] When upper plate 10 is flat, it is difficult for upper plate 10 to absorb the stress caused by expansion or contraction. Therefore, the ceiling of heating chamber 4 deforms unevenly, and a gap may occur between upper plate 10 and planar heater 11. When the gap is generated, heat from planar heater 11 is hardly transferred to upper plate 10.

[0057] In the present exemplary embodiment, upper plate 10 has the plurality of honey-comb areas 10b partitioned by grooves and formed on heat generating area 10a. This shape makes each of the plurality of honeycomb areas 10b to disperse and absorb the stress caused by expansion and contraction

[0058] As a result, an upper protruding curve shape of overall heat generating area 10a is gently raised without a large partial deformation. This structure enables heat generating area 10a to always maintain a state of close contact with planar heater 11, and thereby efficiently receiving heat from planar hater 11.

[0059] Note that heat generating area 10a of upper plate 10 has the plurality of honey-comb areas 10b. However, the present disclosure is not limited to this structure as long as heat generating area 10a has a plurality of areas that can disperse and absorb the stress caused by partial expansion and contraction. For example, heat generating area 10a may have a polygonal shape other than hexagon, such as triangle or square, or a shape formed of curved lines.

[0060] In the present exemplary embodiment, upper plate 10 is configured with steel or aluminum-plated sheet using stainless steel (SUS). A black film such as of silicone resin may be formed on both surfaces of upper plate 10. When the black film is formed on upper plate 10 on the side of planar heater, upper plate 10 can efficiently absorb heat from planar heater 11.

[0061] As described above, the coating layer having the cleaning function for automated cleaning by decomposing oil splashed by heating during cooking may be formed on the bottom surface of upper plate 10. Also on the left and right side walls and the rear wall of heating chamber 4, the coating layer having the self-cleaning function may be formed.

[Planar heater]

[0062] FIG. 6 is an exploded view schematically illustrating planar heater 11 to be mounted on heat generating area 10a of upper plate 10. As illustrated in FIG. 6, planar heater 11 includes inner heater 20, outer heater 21, upper insulator 22, and lower insulator 23.

[0063] Inner heater 20 and outer heater 21 are interposed between upper insulator 22 and lower insulator 23. Inner heater 20 and outer heater 21 are disposed such that side P2 of outer heater 21 overlaps with side P1 of upper insulator 22 and side P3 of lower insulator 23. Side P2 of outer heater 21 is a side on narrow frame part 21c (described later).

[0064] Inner heater 20 and outer heater 21 configure heater 25 that is a heat source of planar heater 11. Inner heater 20 and outer heater 21 are disposed on substantially a same plane such that outer heater 21 surrounds inner heater 20. Controller 7 (FIG. 11) described later

individually controls inner heater 20 and outer heater 21.

[0065] Inner heater 20 is substantially rectangular. Outer heater 21 is substantially square and surrounds inner heater 20. Therefore, outer heater 21 includes two narrow frame parts 21c and two wide frame parts 21d. Narrow frame parts 21c and wide frame parts 21d are configured with mica, which is an insulating plate, and a heater wire. A width (dimension in the X direction) of narrow frame part 21c is narrower than a width (dimension in the Y direction) of wide frame part 21d.

[0066] Inner heater 20 includes inner mica 20a, which is the insulating plate, inner linear heater wire 20b1, and inner wound heater wire 20b2. Inner wound heater wire 20b2 is formed by winding a heater wire around inner mica 20a and arranged on inner mica 20a. Inner linear heater wire 20b1 and inner wound heater wire 20b2 are connected in series and connected to terminal section 24.

[0067] Outer heater 21 includes outer mica 21a, which is the insulating plate, outer linear heater wire 21b1, and outer wound heater wire 21b2. Outer linear heater wire 21b1 is at least one (two in the present exemplary embodiment) substantially-linear heater wire arranged on outer mica 21a of narrow frame part 21c. Outer wound heater wire 21b2 is formed by winding a heater wire around outer mica 21a of wide frame part 21d and arranged on wide frame part 21d. Outer linear heater wire 21b1 and outer wound heater wire are connected in series and connected to terminal section 24.

[0068] Output power of a conventional planar heater is 650 W. Output power of planar heater 11 according to the present exemplary embodiment is 900 W, which is 1.6 times of the output power per unit area of the conventional planar heater.

[0069] In the present exemplary embodiment, inner heater 20 of planar heater 11 is, for example, operable with the output power of 3.0 W/cm^2. Inner heater 20 is configured with a strip of heater wire with a thickness of 0.10 mm. By winding the heater wire at high density to form inner heater 20 and outer heater 21, a temperature of upper plate 10 can be uniformly increased.

[0070] In narrow frame part 21c, two outer linear heater wires 21b1 are arranged such that two outer linear heater wires 21b 1 extend in a longitudinal direction of narrow frame part 21c. With this structure, heating chamber 4 can be uniformly heated from the center to the end. As a result, two pieces of bread can be uniformly toasted from the center to the end when, for example, two pieces of bread are placed side by side inside heating chamber 4.

[0071] Outer mica 21a includes upper mica 21a1 and lower mica 21a2 disposed in narrow frame part 21c, and corner mica 21a3 disposed at four corners of outer mica 21a. Outer mica 21a further includes two outer linear wires 21b1 arranged on lower mica 21a2. Outer linear heater wires 21b1 are interposed between lower mica 21a2 and upper mica 21a1 disposed near the center of narrow frame part 21c.

[0072] FIG. 7 is a plan view illustrating around upper mica 21a1 of outer heater 21 in heating cooker 100. As illustrated in FIG. 7, two notches 40 are provided in each of a front end and a rear end of upper mica 21a1. In other words, upper mica 21a1 has four notches 40 in total.

[0073] Two outer linear heater wires 21b1 are arranged below upper mica 21a1 and above lower mica 21a2. Outer linear heater wires 21b1 are inserted between respective two notches 40 at the front end of upper mica 21a1 and corresponding two notches 40 at the rear end of upper mica 21a1.

[0074] In this way, two outer linear heater wires 21b 1 are arranged separated from each other to prevent short-circuiting of two outer linear heater wires 21b 1.

[0075] The present disclosure is not limited to this structure. For example, two outer linear heater wires 21b1 may be separated from each other by a regulating rib provided in upper mica 21a1 and lower mica 21a2. Still more, two outer linear heater wires 21b1 may be bonded to upper mica 21a1 and lower mica 21a2 in a state separated from each other.

[0076] FIG. 8 is a plan view illustrating narrow frame part 21c that is a part of outer heater 21 in cooking heater 100. As illustrated in FIG. 8, narrow frame part 21c includes one portion Q1, two portions R, and two portions Q2 in the longitudinal direction of narrow frame part 21.

[0077] Portion Q1 is disposed at the center in the longitudinal direction of narrow frame part 21c. Two portions Q2 are disposed at respective ends of narrow frame part 21c in the longitudinal direction. One of two portions R is disposed between one of two portions Q2 and portion Q1. The other of two portions R is disposed between the other of two portions Q2 and portion Q1.

[0078] In portion Q1, outer linear heater wires 21b1 of outer heater 21 are arranged below upper mica 21a1 and above lower mica 21a2. In other words, in portion Q1, outer linear heater wires 21b1 are covered with upper mica 21a1 from above and covered with lower mica 21a2 from below.

[0079] Still more, in portions R, outer linear heater wires 21b 1 are arranged above lower mica 21a2 but not covered with upper mica 21a1.

[0080] Furthermore, in portions Q2, outer linear heater wires 21b1 are arranged below corner mica 21a3 and above lower mica 21a2. In other words, in portion Q2, outer linear heater wires 21b1 are covered with corner mica 21a3 from above and covered with lower mica 21a2 from below.

[0081] With this structure, two outer linear heater wires 21b 1 are separated from each other to prevent short-circuiting by contact of two outer linear heater wires 21b1. A similar effect can be achieved when outer heater 21 has one or three or more outer linear heater wires 21b1.

[0082] As illustrated in FIG. 6, inner linear heater wire 20b1 of inner heater 20 is at least one substantially-linear heater wire arranged substantially in parallel with and in the vicinity of outer linear heater wires 21b1 of outer heater 21. Since inner linear heater wire 20b1 is separated from outer linear heater wires 21b1, short-circuiting due

to contact of inner heater 20 and outer heater 21 can be prevented.

[0083] Since inner linear heater wire 20b1 is separated from outer linear heater wire 21b1 with an appropriate distance, a heating target such as bread can be efficiently and appropriately heated. A similar effect can be achieved when outer heater 21 has one or three or more outer heater wires 21b1.

[0084] As illustrated in FIG. 6, in planar heater 11, heater 25 including inner heater 20 and outer heater 21 is interposed between upper insulator 22 and lower insulator 23. This enables planar heater 11 to function as one heat source.

[0085] FIG. 9 is a plan view of planar heater 11 seen from the side of upper insulator 22. FIG. 10 is a bottom view of planar heater 11 seen from the side of lower insulator 23.

[0086] As illustrated in FIG. 9 and FIG. 10, upper insulator 22 has slit 22a in an area corresponding to an area where inner wound heater wire 20b2 and outer wound heater wire 21b2 face each other. Lower insulator 23 has slit 23a in an area corresponding to an area where inner wound heater wire 20b2 and outer wound heater wire 21b2 face each other.

[0087] Accordingly, in upper insulator 22, a heat transfer between an area heated by inner heater 20 and an area heated by outer heater 21 is blocked. In lower insulator 23, a heat transfer between the area heated by inner heater 20 and the area heated by outer heater 21 is blocked.

[0088] Slits 22a and 23a have the next effects. When inner heater 20 and outer heater 21 are operated, upper insulator 22 and lower insulator expand. However, slits 22a and 23a absorbs expansion of upper insulator 22 and lower insulator 23. Therefore, close contact between planar heater 11 and upper plate 10 can be maintained.

[0089] Opening 22b and opening 23b are respectively formed in upper insulator 22 and lower insulator 23. Aforementioned upper plate 10 of heating chamber 4 includes retainer plate locking part 10c (FIG. 5) that protrudes upward and is inserted into openings 22b and 23b.

[0090] Planar heater 11 includes terminal section 24 having a plurality of terminals. The terminals of terminal section 24 are connected to corresponding outer linear heater wires 21b 1 and outer wound heater wires 21b2. The terminals of terminal section 24 are connected to a power source controlled by controller 7 of heating cooker 100.

[First heat insulator]

[0091] As illustrated in FIG. 4, first heat insulator 13 in planar heater unit 8 is disposed above planar heater 11 such that first heat insulator 13 covers planar heater 11. First heat insulator 13 blocks upward heat from planar heater 11. First heat insulator 13 is formed of, for example, glass wool. First heat insulator 13 has a shape that can cover at least heat generating area 10a of upper plate 10, a substantially uniform thickness, and resilience in at least a thickness direction.

[0092] First heat insulator 13 has locking opening 13a and terminal opening 13c. Locking opening 13a is provided at the center of first heat insulator 13 and engages with retainer plate locking part 10c (FIG. 5). Terminal opening 13c is provided to pass the heater wires of planar heater 11 through, and is an opening formed in a portion of first heat insulator 13 located above terminal section 24.

[Retainer plate]

[0093] As illustrated in FIG. 4, retainer plate 14 in planar heater unit 8 includes curved area 14a having a curved surface same as heat generating area 10a formed on upper plate 10. Retainer plate 14 presses planar heater 11 onto heat generating area 10a of upper plate 10 via first heat insulator 13. As a result, the entire surface of planar heater 11 achieves close contact with heat generating area 10a without any gap.

[0094] Curved area 14a of retainer plate 14 has a three-dimensional curved shape protruding upward, same as that of heat generating area 10a of upper plate 10. In other words, curved area 14a is recessed from a surface on the side of heating chamber 4, i.e., bottom surface.

[0095] In the present exemplary embodiment, a horizontal curvature of curved area 14a is different from a vertical curvature of curved area 14a. More specifically, the horizontal curvature is smaller than the vertical curvature. However, the horizontal and vertical curvatures may be the same. Note that the horizontal direction and the vertical direction of curved area 14a are directions along the X axis and the Y axis, respectively.

[0096] As illustrated in FIG. 4, retainer plate 14 includes terminal fitting part 14b and heater temperature detector 18. Heater temperature detector 18 detects a temperature of an area directly heated by planar heater 11. Terminal fitting part 14b is an area where terminal section 24 of planar heater 11 is fitted.

[0097] Heater temperature detector 18 is disposed in a heating area (heating space) directly heated by planar heater 11. In the present exemplary embodiment, the heating area (heating space) is formed vertically above inner heater 20 of planar heater 11 so as to be heated directly by inner heater 20.

[Heating control]

[0098] Heating control using planar heater unit 8 will be described below.

[0099] Heater temperature detector 18 is disposed in the heating area (heating space) directly heated by inner heater 20 of planar heater 11 to detect a temperature in the heating area. Heater temperature detector 18 transmits a detected temperature to controller 7 (FIG. 11) as heater temperature information. Controller 7 controls the heating section according to a cooking option and the

like set by the user based on the heater temperature information and the in-chamber temperature information from in-chamber temperature detector 9.

[0100] In the conventional heating cooker, on and off control is performed on the planar heater in order to achieve a set temperature inside the chamber. Therefore, it is difficult to accurately control the in-chamber temperature, and time-consuming to reach the set temperature.

[0101] In the present exemplary embodiment, controller 7 performs temperature control for heat-cooking based on the heater temperature information and the in-chamber temperature information. In quick heating, in particular, controller 7 performs the temperature control for heat-cooking based on the heater temperature information indicating the temperature in the heating area heated by inner heater 20. The quick heating is an operation mode for rapidly increasing the in-chamber temperature of heating chamber 4 so that the in-chamber temperature reaches the set temperature in a short time.

[0102] As will be described later, a heater output of inner heater 20 can be adjusted to a desired value by setting input current to a desired value. After the in-chamber temperature reaches the set temperature, controller 7 controls the input current relative to inner heater 20 based on the in-chamber temperature information and the heater temperature information.

[0103] As a result, by the quick heating, heating cooker 100 can make the in-chamber temperature reach the set temperature quickly, and can also accurately maintain the in-chamber temperature at the set temperature.

[Heat-cooking]

[0104] FIG. 11 is a circuit block diagram related to the control of heating cooker 100. As illustrated in FIG. 11, heating cooker 100 includes controller 7, inner heater 20, outer heater 21, steam heater 26, rear heater 27, magnetron 28, and circulating fan motor 29. Controller 7 is configured to individually control inner heater 20, outer heater 21, steam heater 26, rear heater 27, magnetron 28 and circulating fan motor 29.

[0105] Heating cooker 100 further includes inverter circuit 33. Controller 7 causes inverter circuit 33 to drive magnetron 28.

[0106] Heating cooker 100 further includes triac 30 for controlling inner heater 20. Triac 30 is connected to inner heater 20, and can set input current to inner heater 20 in a stepless manner. Controller 7 causes triac 30 to set a desired value as the input current to inner heater 20.

[0107] Heating cooker 100 further includes relay 31 for controlling outer heater 21. Controller 7 performs on and off control on outer heater 21 by turning on and off relay 31. However, heating cooker 100 may further include a triac for outer heater 21, and controller 7 may cause this triac to change input power to outer heater 21 in a stepless manner.

[0108] Heating cooker 100 further includes relay 32 for controlling steam heater 26. Controller 7 performs on and off control on steam heater 26 by turning on and off relay 32.

[0109] In general, the heating cooker has predetermined rated power. Since heating cooker 100 includes a plurality of heating sections, controller 7 controls each heating section such that the total power consumption is always kept within the rated power. In particular, in the present exemplary embodiment, controller 7 performs distinctive control on planar heater unit 8.

[0110] As described above, planar heater unit 8 includes heater 25 including inner heater 20 and outer heater 21. The maximum heater output of inner heater 20 is, for example, 900 W, and the maximum heater output of outer heater 21 is, for example, 700 W. Accordingly, the maximum heater output of heater 25 is 1600 W. However, this value exceeds the rated power (1500 W) in general households.

[0111] In the present exemplary embodiment, triac 30 can set the heater output of inner heater 20 within a range from 300 W to 900 W in a stepless manner. Controller 7 sets the output power of inner heater 20 in the range from 300 W to 900 W in a stepless manner and performs the on and off control of 700 W on outer heater 21 such that the heater output of heater 25 does not exceed the rated power.

[0112] Hereinafter, specific heat-cooking by heating cooker 100 will be described.

[0113] When the heat-cooking is performed only using planar heater unit 8, controller 7 causes triac 30 to set the heater output of inner heater 20 to, for example, 700 W and turn on relay 30 of outer heater 21 having 700-W heater output. Accordingly, heating cooker 100 heats the heating target inside heating chamber 4 with 1400-W heater output in total.

[0114] When the heat-cooking is performed using planar heater unit 8 and the microwave heating unit, controller 7 operates inner heater 20 at, for example, the maximum heater output of 900 W and turns off outer heater 21. Accordingly, heating cooker 100 heats the heating target from above with 900-W heater output in total.

[0115] On the other hand, controller 7 sets power consumption such as by magnetron 28 to, for example, 450 W. When the microwave is radiated to heat generating tray 6 accommodated in heating chamber 4, heating cooker 100 heats the heating target from below using heat generating tray 6.

[0116] In another example, controller 7 may turn off outer heater 21 and operate inner heater 20 with 430-W heater output, and set power consumption such as by magnetron 28 to 550 W.

[0117] In this way, when planar heater unit 8 and the microwave heating unit are used for heat-cooking, heating cooker 100 performs desired heat-cooking while suppressing power consumption within the rated power.

INDUSTRIAL APPLICABILITY

[0118] As described above, the present disclosure is applicable to heating cookers equipped with a planar heater.

REFERENCE MARKS IN THE DRAWINGS

[0119]

1	main body
2	door
3	handle
4	heating chamber
5	setting section
6	heat generating tray
7	controller
8	planar heater unit
9	in-chamber temperature detector
10	upper plate
10a	heat generating area
10b	honey-comb area
10c	retainer plate locking part
11	planar heater
13	first heat insulator
13a	locking opening
13c	terminal opening
14	retainer plate
14a	curved area
14b	terminal fitting part
15	insulating sheet
16	heat shield
18	heater temperature detector
20	inner heater
20a	inner mica
20b 1	inner linear heater wire
20b2	inner wound heater wire
21	outer heater
21a	outer mica
21a1	upper mica
21a2	lower mica
21a3	corner mica
21b1	outer linear heater wire
21b2	outer wound heater wire
21c	narrow frame part
21d	wide frame part
22	upper insulator
22a	slit
22b	opening
23	lower insulator
23a	slit
23b	opening
24	terminal section
25	heater
26	steam heater
27	rear heater
28	magnetron
29	circulating fan motor
30	triac
31, 32	relay
33	inverter circuit
40	notch
100	cooking heater

Claims

1. A heating cooker comprising:

a heating chamber configured to accommodate a heating target; and

a planar heater disposed above the heating chamber, the planar heater including an inner heater and an outer heater surrounding the inner heater, wherein

the inner heater includes

an inner mica and

an inner wound heater wire,

the outer heater includes

a wide frame part,

a narrow frame part,

an outer mica disposed in each of the wide frame part and the narrow frame part,

an outer wound heater wire arranged on the wide frame part, and

an outer linear heater wire arranged on the narrow frame part, and

the narrow frame part includes

at least one outer linear heater wire arranged in a longitudinal direction of the narrow frame part and

an upper mica that at least partially covers the at least one outer linear heater wire from above.

2. The heating cooker of claim 1, further comprising a lower mica that covers the at least one outer linear heater wire from below, wherein

the at least one outer linear heater wire includes a plurality of outer linear heater wires, and

the plurality of outer linear heater wires are arranged between the upper mica and the lower mica in the narrow frame part, the plurality of outer linear heater wires being arranged separated from each other.

3. The heating cooker of claim 2, wherein

the inner heater further includes an inner linear heater wire, and

the plurality of outer linear heater wires are arranged substantially in parallel with and near the inner linear heater wire.

FIG. 1

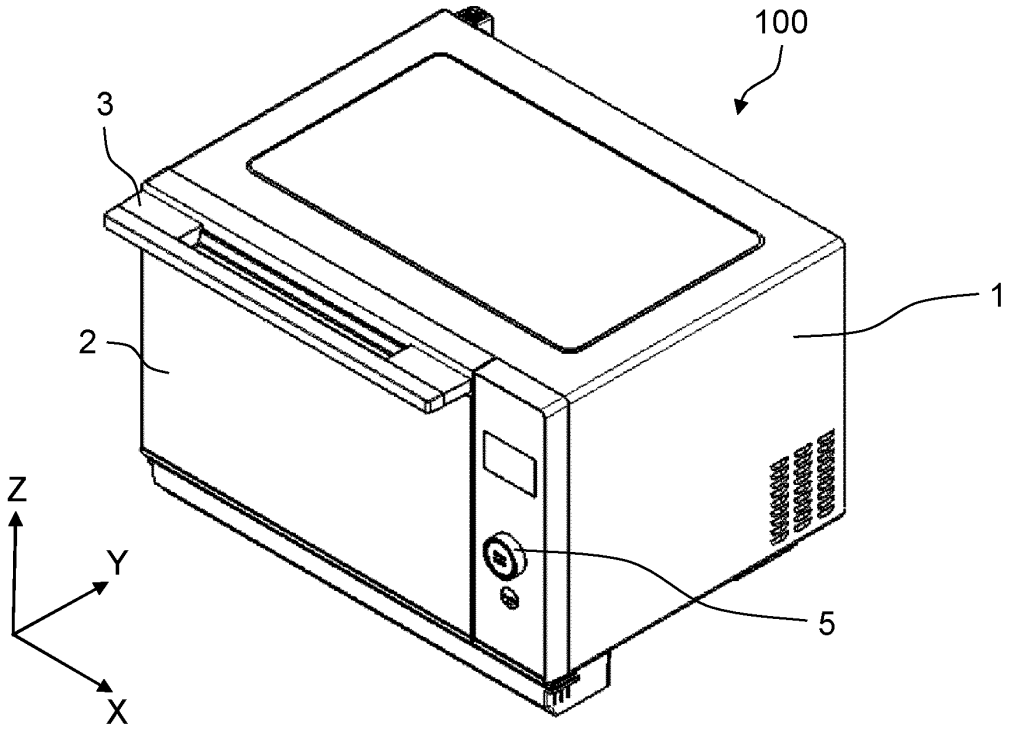


FIG. 2

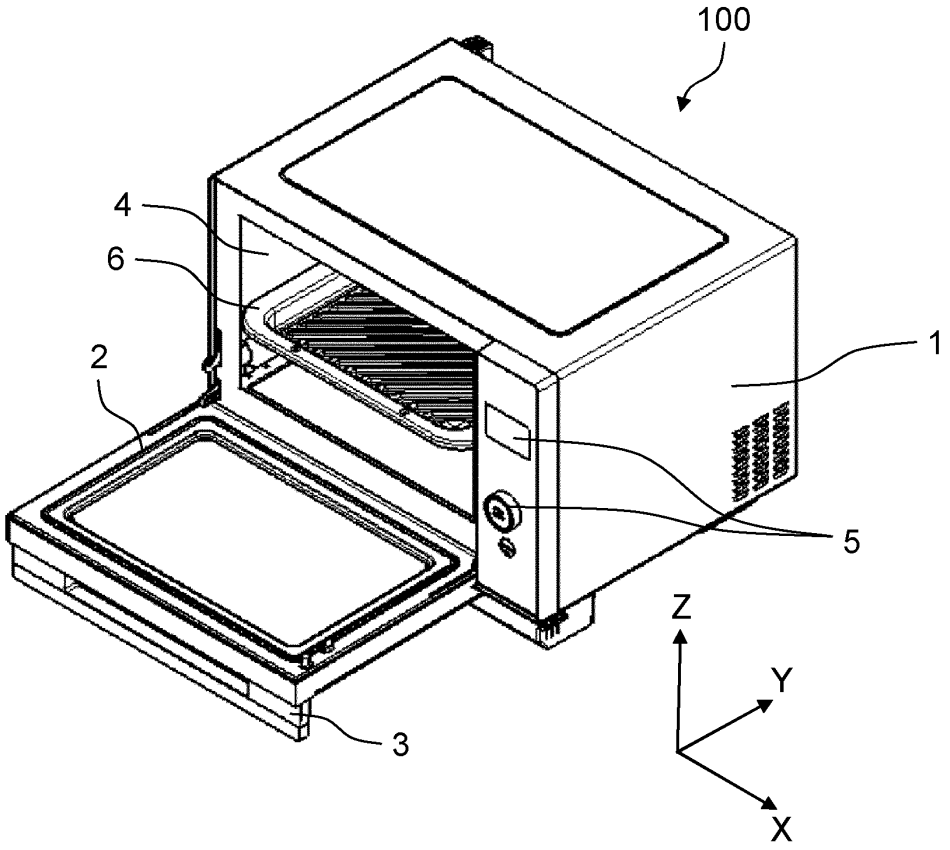


FIG. 3

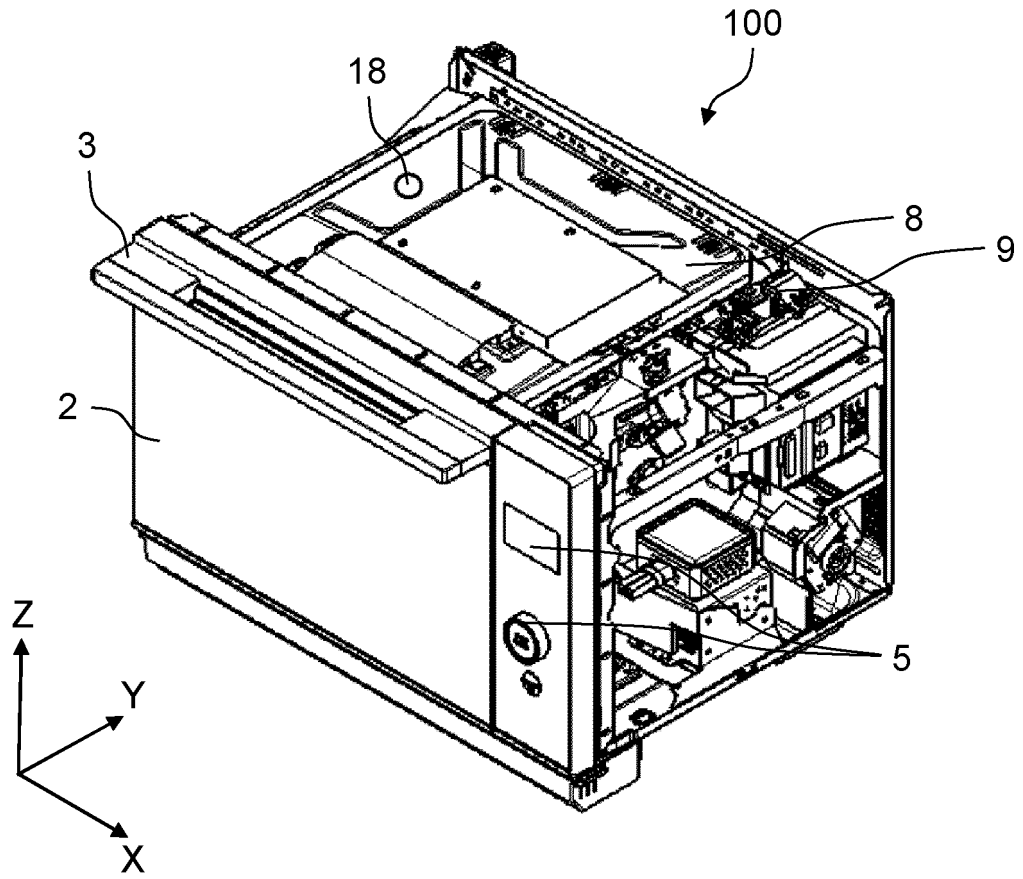


FIG. 4

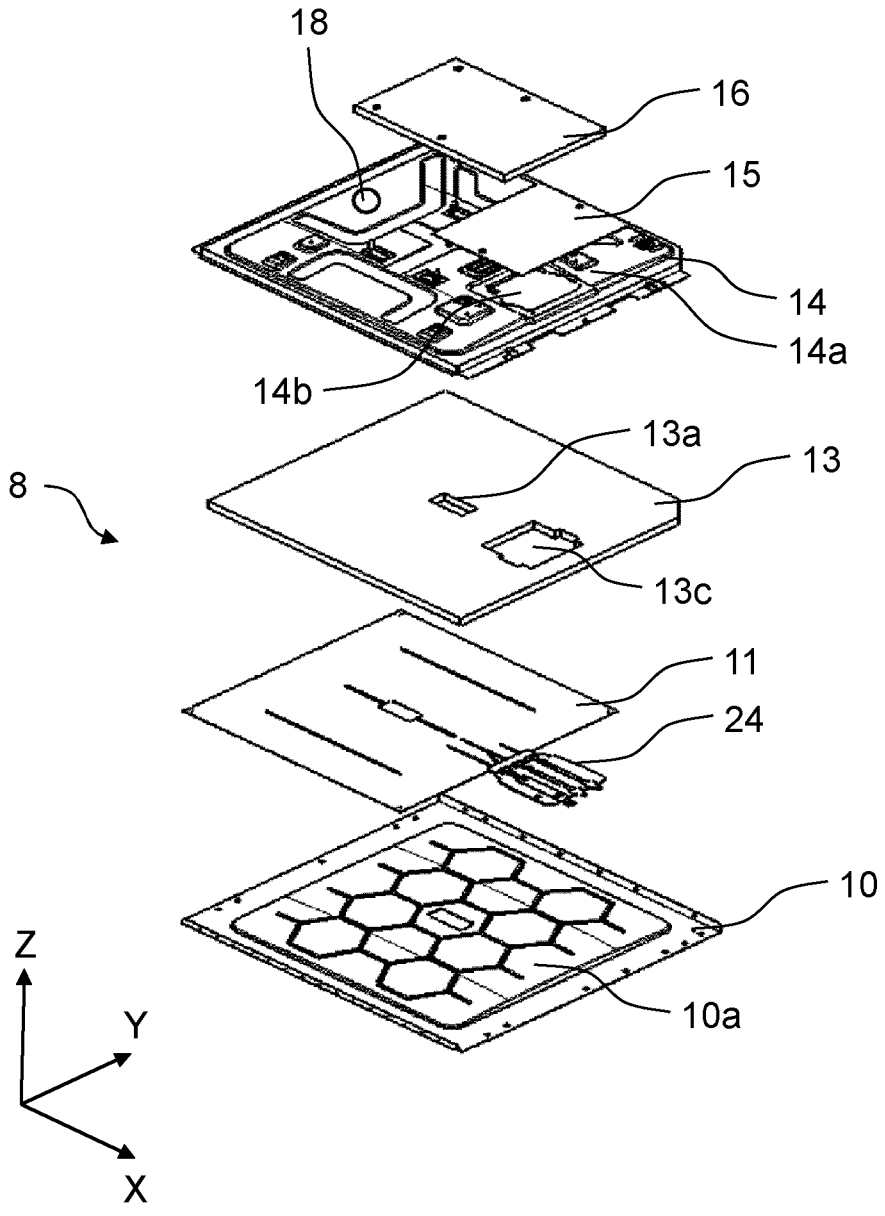


FIG. 5

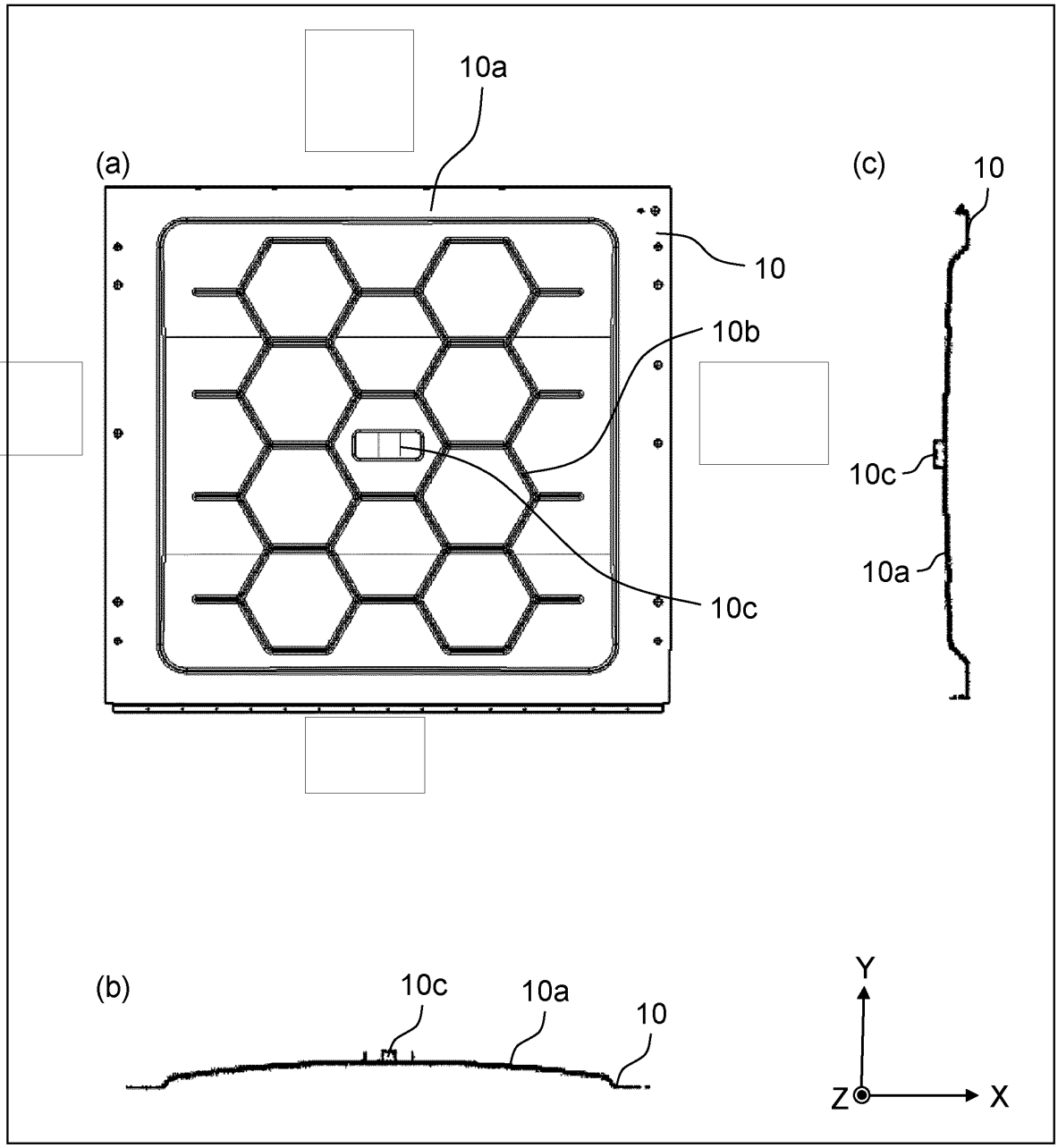


FIG. 6

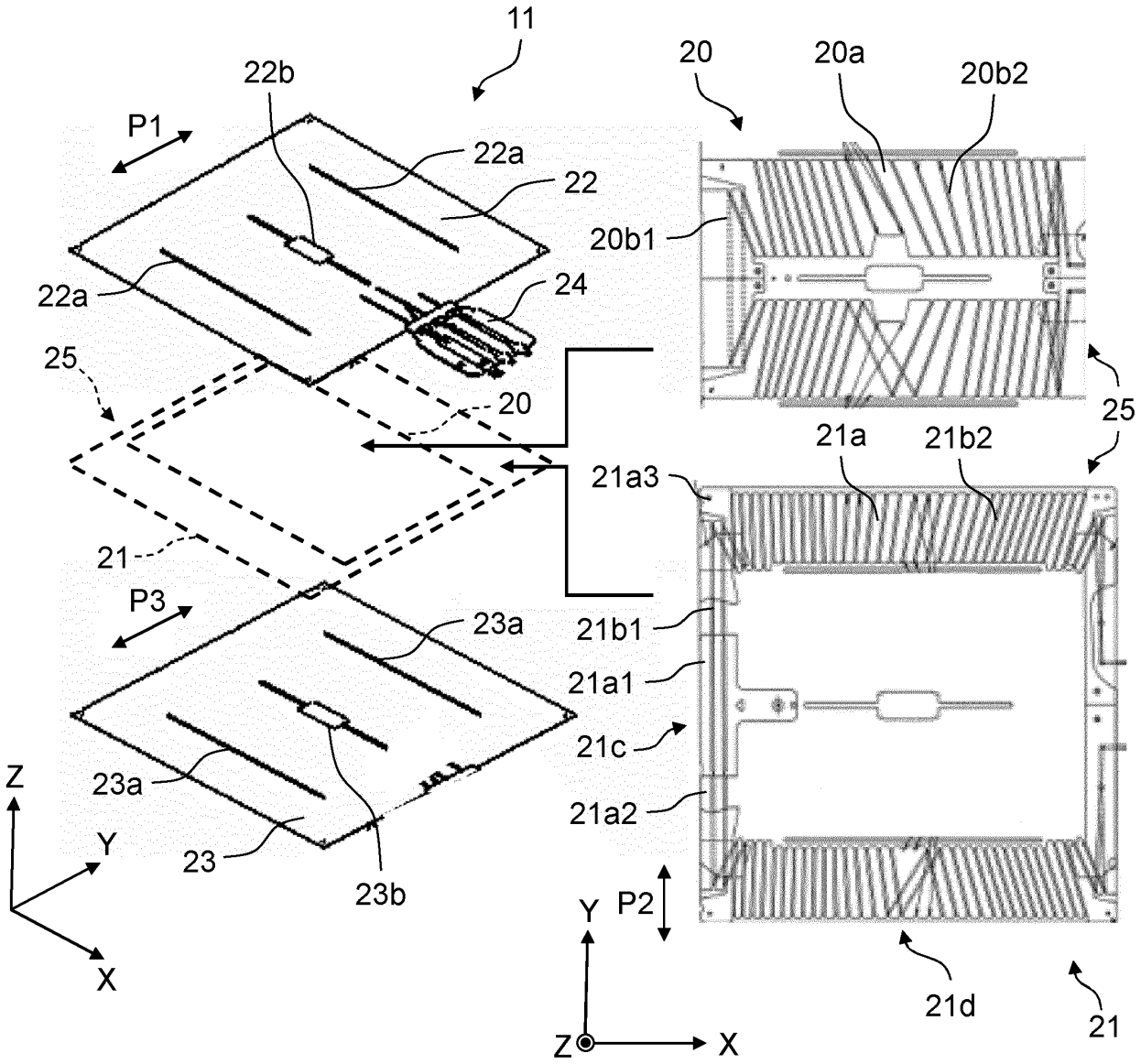

11
22b
P1
22a
22
22a
24
25
20
21
P3
23a
23a
23
23b
Z
Y
X
20
20a
20b2
20b1
25
21a
21b2
21a3
21b1
21a1
21c
21a2
Y
P2
Z
X
21d
21

FIG. 7

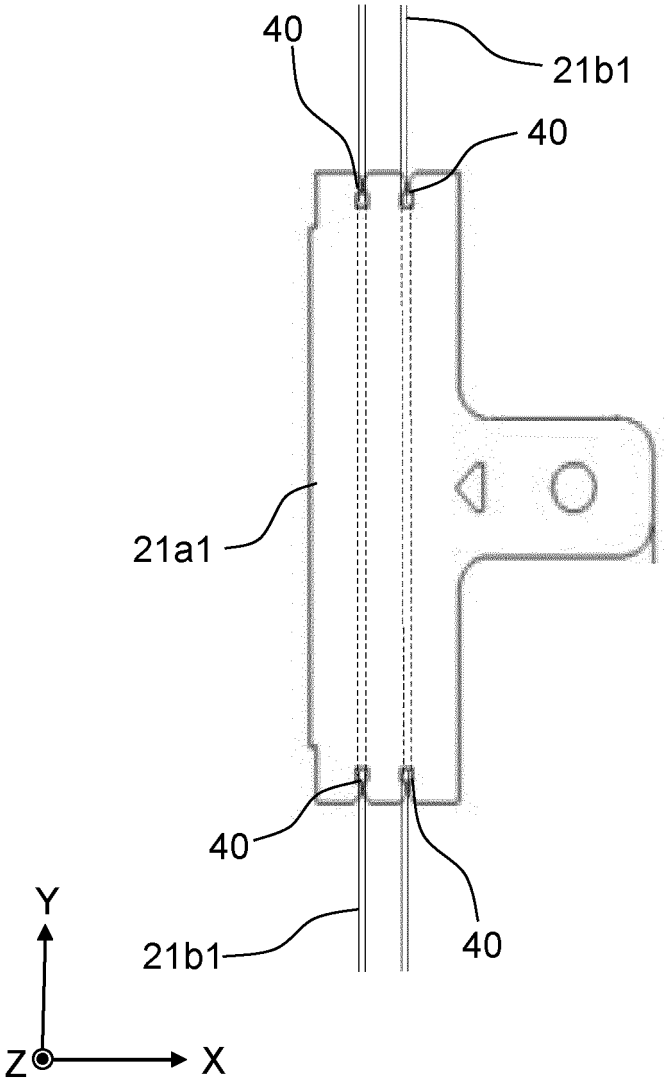


FIG. 8

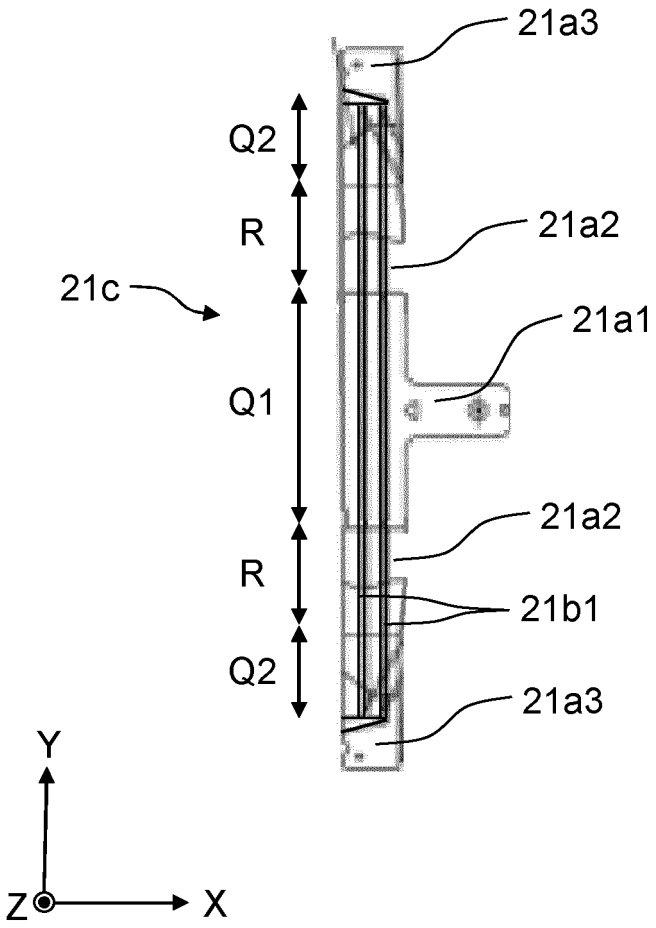


FIG. 9

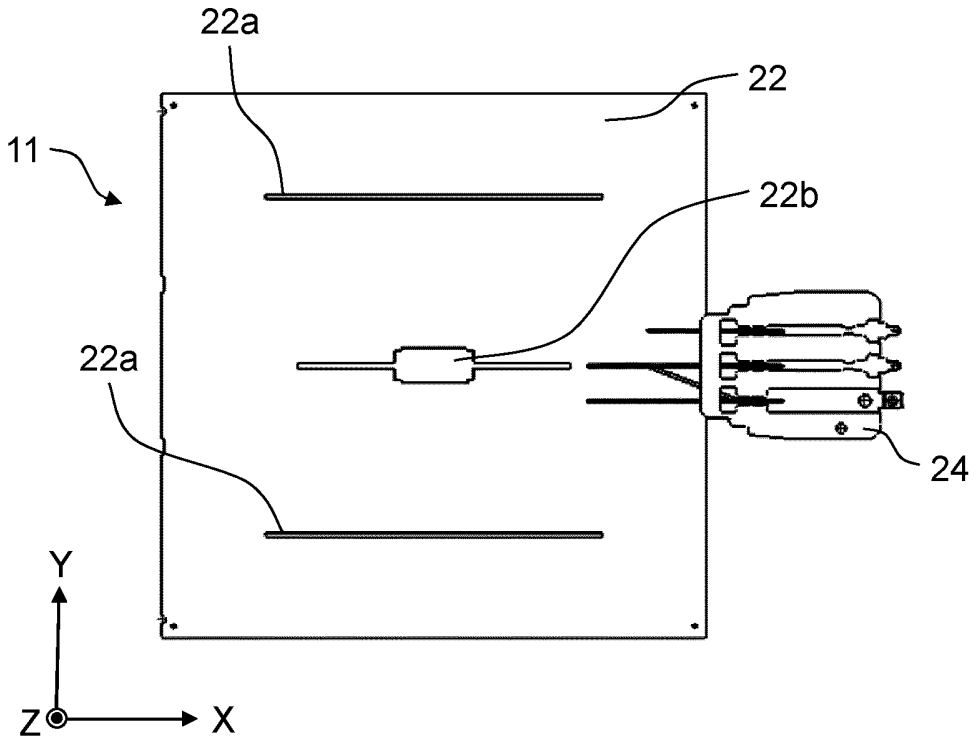


FIG. 10

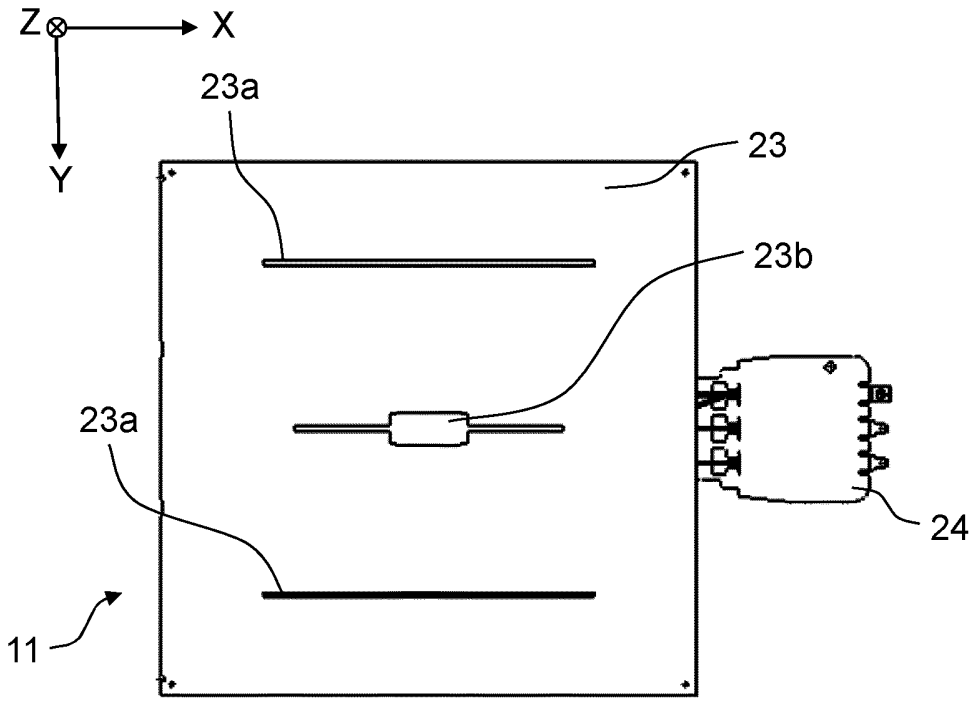
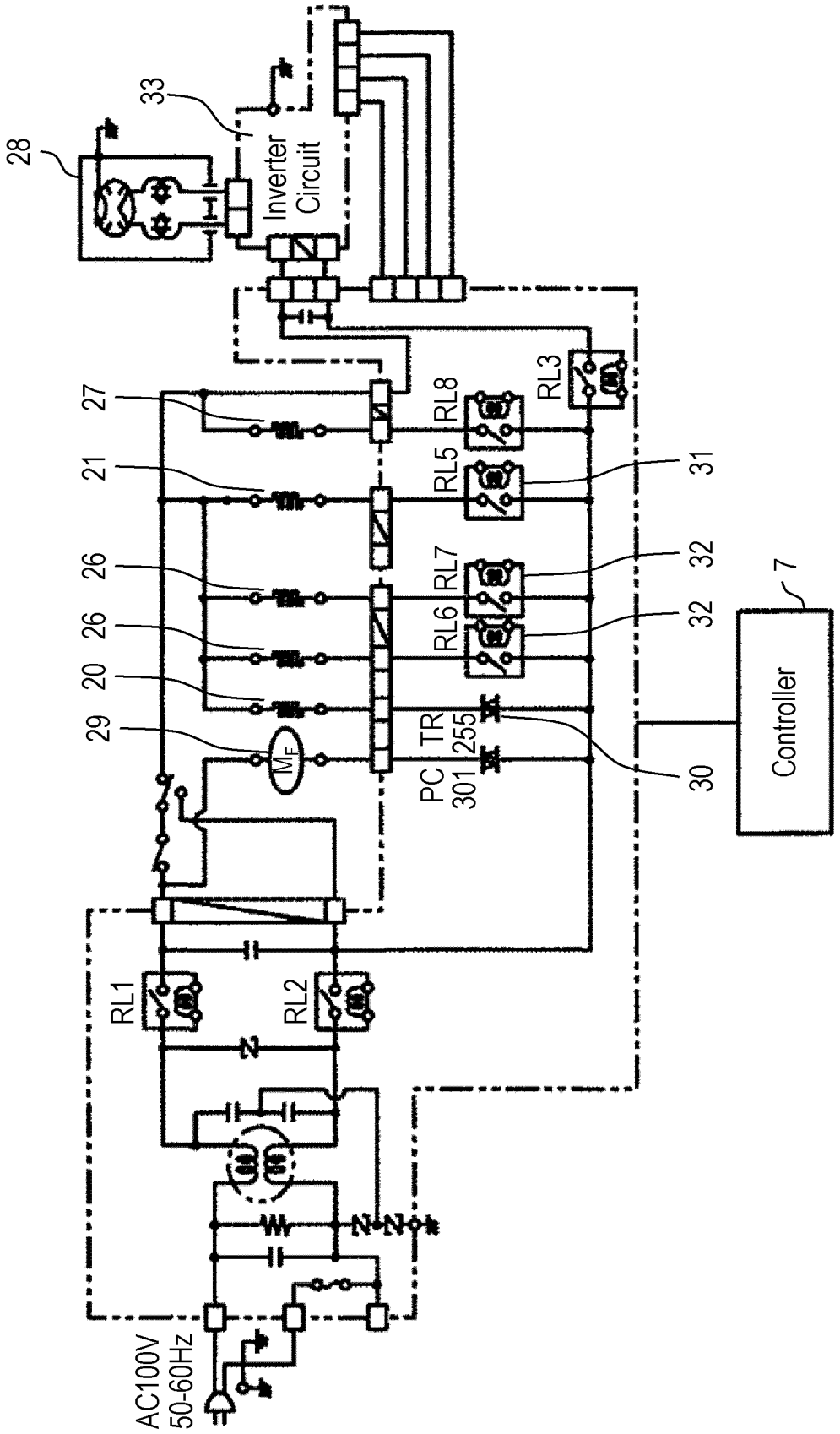


FIG. 11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Inverter Circuit
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21
26
26
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29
RL8
RL3
RL5
31
RL7
32
RL6
32
TR
255
PC
301
30
7
Controller
RL1
RL2
N
AC100V
50-60Hz

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/029595

A. CLASSIFICATION OF SUBJECT MATTER

F24C 7/02(2006.01)i; ***F24C 7/06***(2006.01)i
FI: F24C7/06 A; F24C7/02 531B

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)

F24C7/02; F24C7/06; H05B3/20

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2019-207077 A (PANASONIC IP MANAGEMENT CORP.) 05 December 2019 (2019-12-05) fig. 13	1-3
A	JP 2013-92303 A (MITSUBISHI ELECTRIC CORP.) 16 May 2013 (2013-05-16) fig. 4	1-3
A	JP 63-21115 Y2 (SASADA, Takuo) 10 June 1988 (1988-06-10) fig. 1-4	1-3

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

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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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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 September 2022	**20 September 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/029595

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2019-207077 A	05 December 2019	WO 2019/230186 A1	
JP 2013-92303 A	16 May 2013	(Family: none)	
JP 63-21115 Y2	10 June 1988	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H3103206 B **[0006]**
- JP 2010054124 A **[0006]**
- JP 2017161163 A **[0006]**