

Description

The invention relates to a heat cooking apparatus using radiant heat and microwave heat in combination, comprising: a heating chamber for accommodating food material to be heated therein and having its metal walls tightly connected with each other to form, together with a front door, a hermetically closed microwave-shielding heating chamber; the heating chamber having a microwave supply opening for introducing microwaves into the heating chamber; a resistance heater arranged near one of the metal walls of the heating chamber.

A cross-sectional view of such a conventional heat cooking apparatus is shown in Fig. 1, which illustrates a heating chamber 1 comprising an upper heater 2, a lower heater 3 and a pan 4 with food 5 to be heated and cooked. Furthermore, Fig. 1 shows a magnetron 6 which irradiates microwaves into the heating chamber 1 via waveguide 7 to heat the food 5; thus constituting a self-contained cooking range of the so-called compound type working with conventional radiant and microwave heat.

Fig. 2 is a perspective view of a conventional heater of a heat cooking apparatus, which has a structure of an upper heater 2 and lower heater 3 installed in the heating chamber 1. The disadvantage with this structure is that the effective capacity of the heating chamber is reduced because of the volume of the heater, so that heating of large-sized food can be a problem. In order to accommodate large-sized food, conventional heating chambers are made larger because of the heater, consequently, the external dimension of a conventional heating apparatus has to be made larger requiring a larger space for it to be placed.

Moreover, this kind of heater configuration makes it difficult to clean inside parts of the heating chamber, e.g. scattered food on the heating chamber wall surfaces, which also causes this type of conventional heat cooking apparatus to be inconvenient to use.

A conventional-type rod heater makes it difficult to perform uniform heating because the heater applies heat only to the limited area so that the food is thus scorched in the pattern of the heater.

From US-A-44 55 319 a long wavelength counter top radiation oven is known in which the top and bottom surfaces of the oven cavity are formed by metal radiator panels each heated by an electric resistance heating element. This oven is particularly designed for baking, broiling, roasting and other cooking operations, and the long wavelength radiation cooking provides a more even cooking with greater retention of moisture and nutrients. The panels of the oven cavity are coated with ceramic surfaces to give a good surface emissivity to enhance the thermal efficiency of the oven. The metal radiator panels are either made as cast aluminum plates with an embedded heating element, or in the form of a sandwich construction

having the coating on one side of a steel substrate, and ceramic insulation, heating elements and other layers in combination. These metal radiator panels are placed as upper walls or lower walls, together with separate sidewalls and a backwall to form the oven cavity.

It is an object of the present invention to provide a heat cooking apparatus using radiant heat and microwave heat in combination, which offers a large volume heating chamber, is easy to clean and to mount, and provides high-performance heat cooking together with uniform heat distribution.

According to the invention, the heat cooking apparatus is structured as defined in claim 1.

The heat cooking apparatus according to the invention has the advantage that the heating chamber can be constructed from tightly connected metal walls in order to provide effective microwave-shielding, which would normally not be necessary with conventional cooking apparatus' using resistance heaters as for instance disclosed in US-A-44 55 319.

Preferable embodiments are disclosed in the dependent claims.

These and other features of the present invention will become apparent from the following description taken in conjunction with preferred embodiments thereof with reference to the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a conventional type heat cooking apparatus, as already referred above;

Fig. 2 is a perspective view of the heater for use in the heat cooking apparatus of Fig. 1;

Fig. 3 is a perspective view of a heat cooking apparatus according to one embodiment of this invention;

Fig. 4 is a cross-sectional view of the heat cooking apparatus of Fig. 3;

Fig. 5 is a disassembly perspective view showing compounds of heater portion of the heat cooking apparatus of Fig. 4;

Fig. 6 is a cross-sectional view, on an enlarged scale, showing the heater portion of Fig. 5; and Fig. 7 to Fig. 9 are respectively cross-sectional views, similar to Fig. 6, each showing heater structures of other embodiments of this invention.

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

The heat cooking apparatus according to one preferred embodiment of this invention is shown with Figs. 3 to 6, which will be described in detail hereinafter.

In Fig. 3, a door 12, which can be freely opened and closed, is installed in the front part of a heat cooking apparatus housing 11 having an operation panel

13, a display board 14 is installed in the panel 13 to display the timetable for heating, and an operation key 15 is provided on the operation panel, the door 12 being used for placing food material in a heating chamber 16 provided in the housing 11. In Fig. 4, an upper heater 18 is attached to the outside surface of upper wall 17 of the heating chamber 16, and a lower heater 20 is attached to the outside surface of lower wall 19. A magnetron 21 is provided with an oscillator, which irradiates microwaves to food material 24a on a pan 24 in the heating chamber 16 through an opening 23 via waveguide 22, and heat insulators 25 and 26 serve as shields for the housing 11 against heat from the heater.

In Fig. 5 and Fig. 6, a spool 28, composed of a heat-proof insulator such as mica, is coiled flatly by a heating element 29, which is connected to a lead wire 30 and insulated by an insulator 31.

Insulators 32, composed of a heat-proof insulator such as mica, are installed at the upper and lower surface of spool 28, and, thus, heating elements 29 are held between insulating sheets 32. The upper surface or the upper most insulating sheet 32 contacts with metal keep-plate 33 which is fixed to a heating chamber body 35 by a screw 34. The surface of the heating chamber wall 36 facing the heating element 29 is made of a metal plate such as steel, and its inside surface is coated with non-metallic layer 37, which is formed by coating with a non-metallic and high-performance heat-resistance material such as heat-resistant paint, heat-resistant enamel, or ceramic paint. Non-metallic layer 37 should be formed at least at the inside surface of heating chamber, though, if it is formed on both surfaces of the wall, the heat-proof effectiveness is greatly enhanced. The preferable colors for the non-metallic layer 37 are black, dark gray, dark blue and dark brown, since these colors make the surface emissivity effective. A heat insulator 38 is provided to prevent the heat loss from the heating element.

Fig. 7 shows the cross-sectional view of a portion of a heat cooking apparatus according to another embodiment of this invention, in which the inner surface of heating chamber wall 36 is coated with non-metallic layer 37 and the outer surface with an aluminum layer 39.

Fig. 8 shows the cross-sectional view of a portion of heat cooking apparatus according to a further embodiment of this invention, in which both surfaces of the heating chamber wall 36 are coated with an aluminum layer 39, and the inside surface of the heating chamber is coated with a layer capable of decomposing material by means of catalytic action or a non-metallic self-cleaning layer 40, which can be formed directly on the heating chamber wall surface without forming an aluminum layer 39, having the ability to clean dirt by burning at high temperature, while the color of this self-cleaning layer is preferably black.

The heat of heating element 29 travels through insulating sheet 32 to heating chamber wall 36, and, then, travels through aluminum layer 39, and non-metallic self-cleaning layer 40 respectively, resulting in that the food material is heated by heat-radiation from the heating chamber inner-surface into the heating chamber.

Fig. 9 shows the cross-sectional view of a portion of heat cooking apparatus, according to a still further embodiment of this invention, in which the heating element 42 is nipped by heat-proof insulator 43 to form a flat heater at the upper part of the upper-wall surface of the heating chamber, and the inside surface of the upper-wall of the heating chamber is coated with a non-metallic layer 44. The upper-wall surface 41 of the heating chamber is constructed to form a U-shape on the side of non-metallic layer 44, so that upon energizing the heating element 42 the raised heater temperature increases the U-shape of the upper-wall surface of heating chamber as well as the elongation of the upper side of the upper-wall surface 41 of the heating chamber, so that a keep-plate 45 presses the heater more firmly so as to exert improved heat conduction and less heat deformation of the upper-wall surface 41 of heating chamber regulated by the keep-plate 45, and, accordingly, the stress applied to non-metallic layer 44 becomes smaller, resulting in enhanced durability.

The heat cooking apparatus of this invention described above has the following advantages:

- (1) The heating element is flatly installed to uniformly conduct heat to the heating chamber, thus the food material can be heated uniformly. In addition, the whole heating chamber wall surface serves as a heat-conducting surface to exert a great quantity of heat conduction, and, consequently, effective heat application is possible even if the heating element is located outside the heating chamber. Heat from the heating element is conducted to the wall surface of heating chamber via an insulator, and the inside wall surface of heating chamber is coated with non-metallic layer to perform non-metallic radiation on its surface whose emissivity is 0.5 or over, which is far higher than that of the metallic surface, whereby the heat from the heating chamber can be effectively irradiated to the food material. Heat rays, which have relatively long wavelength as far as infrared rays and are easily absorbed by the food material, are irradiated from the heating chamber wall surface, so that high-performance heating efficiency can be obtained as a result of this point.
- (2) The above-mentioned heating efficiency can be enhanced by coating the inside surface of heating chamber with a non-metallic layer and the outside surface with an aluminum layer whereby the heat of heating element, conducted to aluminum layer via an insulating sheet is uni-

formly conducted to the total whole surface through the aluminum layer. The heat conduction from aluminum layer to the metal plate, comprising the heating chamber wall surface, is performed through the total surface of the metal plate, therefore, the greater the heat conduction area, the better the heat conduction becomes; thus, heating efficiency can be enhanced by the synergetic effect of non-metallic irradiation and blackbody irradiation.

(3) As heat conduction is excellent, the heat of heating element can be efficiently transmitted to heat the wall surface of heating chamber, so that, even if the heating element is installed outside the heating chamber, it can effectively perform heat application, and as a result of this invention, the heating efficiency and energy-saving are improved as compared with conventional types of ovens

(4) Compared with a conventional type whose heater is installed inside the heating chamber, the heating chamber of this invention becomes spacious and free from protruding portions, which makes it very easier to clean and operate, even if the food material is scattered around the heating chamber wall.

(5) The effective spacious capacity of the heating chamber increases for the space occupied by the heater making it possible to cook large food material, and if the heating chamber capacity is the same, this invention can make the external shape of the apparatus smaller than that of the conventional type and thus can provide a compact and easy-to-use heat cooking apparatus.

(6) Heat from the heating element is uniformly conducted to the total internal space of the heating chamber through the metal plate of the wall surface of heating chamber or the aluminum layer, whereby uniform heating and cooking become possible.

(7) The irradiation effect can be enhanced by synergetic effect of non-metallic irradiation and blackbody irradiation by making the inside wall of heating chamber a dark color, thus, dirt is hard to see, and furthermore if the self-cleaning layer is added, dirt is self-purified which keeps the heating chamber constantly clean and makes it hygienic, unnecessary to clean, and still more, easy to use. As the heating element heats the total wall surface of heating chamber, the total self-cleaning layer uniformly becomes very hot to make catalytic effect and purification effect extremely efficient.

(8) The non-metallic, aluminum and self-cleaning layers are formed to exert excellent corrosion resistance, high-performance, durability and sturdiness of the heat cooking apparatus. Moreover, a steel plate can be used for the material of metal

plate, and, thus, materials cost is lower than that for materials such as stainless steel. Furthermore, workability is made easier, and an economical system is achievable.

(9) The heating chamber wall surface, in which the flat heater is installed, is formed in U-shape so as to curve to the flat heater direction when heated, and as a result of this process, it firmly presses the flat heater, resulting in that the heat conduction is further improved.

Claims

1. A heat cooking apparatus using electric resistance heat and microwave heat in combination, comprising:
a heating chamber (16) for accommodating food material (24a) to be heated therein and having its metal walls tightly connected with each other to form, together with a front door (12), a hermetically closed microwave-shielding heating chamber (16);
the heating chamber (16) having a microwave supply opening (23) for introducing microwaves into the heating chamber;
a flat heater unit (18) releasably mounted as a separate unit outside one metal wall (17, 36, 41) of the heating chamber (16) and covering substantially the whole outside surface of this metal wall, the flat heater unit having a resistance heater (29) separated from said one metal wall (17, 36, 41) by a heat-resistant electric insulator (32); and
a non-metallic highly heat emissive layer (37, 40, 44) coated on the inner surface of said one metal wall (17, 36, 41) of the heating chamber (16).
2. A heat cooking apparatus as claimed in claim 1, further comprising an aluminium layer (39) between said heater unit (18) and said one metal wall (36) of the heating chamber (16).
3. A heat cooking apparatus as claimed in claim 1, wherein said non-metallic layer (40) is a self-cleaning material.
4. A heat cooking apparatus as claimed in claim 1, wherein the surface of said one metal wall (17, 41) is concave.
5. A heat cooking apparatus as claimed in claim 1, wherein said non-metallic layer (37, 40, 44) is black in color.



formly conducted to the total whole surface through the aluminum layer. The heat conduction from aluminum layer to the metal plate, comprising the heating chamber wall surface, is performed through the total surface of the metal plate, therefore, the greater the heat conduction area, the better the heat conduction becomes; thus, heating efficiency can be enhanced by the synergetic effect of non-metallic irradiation and blackbody irradiation.

(3) As heat conduction is excellent, the heat of heating element can be efficiently transmitted to heat the wall surface of heating chamber, so that, even if the heating element is installed outside the heating chamber, it can effectively perform heat application, and as a result of this invention, the heating efficiency and energy-saving are improved as compared with conventional types of ovens

(4) Compared with a conventional type whose heater is installed inside the heating chamber, the heating chamber of this invention becomes spacious and free from protruding portions, which makes it very easier to clean and operate, even if the food material is scattered around the heating chamber wall.

(5) The effective spacious capacity of the heating chamber increases for the space occupied by the heater making it possible to cook large food material, and if the heating chamber capacity is the same, this invention can make the external shape of the apparatus smaller than that of the conventional type and thus can provide a compact and easy-to-use heat cooking apparatus.

(6) Heat from the heating element is uniformly conducted to the total internal space of the heating chamber through the metal plate of the wall surface of heating chamber or the aluminum layer, whereby uniform heating and cooking become possible.

(7) The irradiation effect can be enhanced by synergetic effect of non-metallic irradiation and blackbody irradiation by making the inside wall of heating chamber a dark color, thus, dirt is hard to see, and furthermore if the self-cleaning layer is added, dirt is self-purified which keeps the heating chamber constantly clean and makes it hygienic, unnecessary to clean, and still more, easy to use. As the heating element heats the total wall surface of heating chamber, the total self-cleaning layer uniformly becomes very hot to make catalytic effect and purification effect extremely efficient.

(8) The non-metallic, aluminum and self-cleaning layers are formed to exert excellent corrosion resistance, high-performance, durability and sturdiness of the heat cooking apparatus. Moreover, a steel plate can be used for the material of metal

plate, and, thus, materials cost is lower than that for materials such as stainless steel. Furthermore, workability is made easier, and an economical system is achievable.

(9) The heating chamber wall surface, in which the flat heater is installed, is formed in U-shape so as to curve to the flat heater direction when heated, and as a result of this process, it firmly presses the flat heater, resulting in that the heat conduction is further improved.

Claims

1. A heat cooking apparatus using electric resistance heat and microwave heat in combination, comprising:
a heating chamber (16) for accomodating food material (24a) to be heated therein and having its metal walls tightly connected with each other to form, together with a front door (12), a hermetically closed microwave-shielding heating chamber (16);
the heating chamber (16) having a microwave supply opening (23) for introducing microwaves into the heating chamber;
a flat heater unit (18) releasably mounted as a separate unit outside one metal wall (17, 36, 41) of the heating chamber (16) and covering substantially the whole outside surface of this metal wall, the flat heater unit having a resistance heater (29) separated from said one metal wall (17, 36, 41) by a heat-resistant electric insulator (32); and
a non-metallic highly heat emissive layer (37, 40, 44) coated on the inner surface of said one metal wall (17, 36, 41) of the heating chamber (16).
2. A heat cooking apparatus as claimed in claim 1, further comprising an aluminium layer (39) between said heater unit (18) and said one metal wall (36) of the heating chamber (16).
3. A heat cooking apparatus as claimed in claim 1, wherein said non-metallic layer (40) is a self-cleaning material.
4. A heat cooking apparatus as claimed in claim 1, wherein the surface of said one metal wall (17, 41) is concave.
5. A heat cooking apparatus as claimed in claim 1, wherein said non-metallic layer (37, 40, 44) is black in color.



Patentansprüche

1. Heizkochvorrichtung, die eine elektrische Widerstandsheizung und in Kombination damit eine Mikrowellenheizung hat, und enthält:
eine Heizkammer (16) zum Unterbringen von zu erwärmenden Nahrungsmitteln (24a) und dessen Metallwände eng miteinander verbunden sind, um zusammen mit einer Vordertür (12) eine hermetisch abgeschlossene, Mikrowellen abschirmende Heizkammer (16) zu bilden;
die Heizkammer (16) weist eine Mikrowelleneintrittsöffnung (23) zum Einführen der Mikrowellen in die Heizkammer auf;
eine flache Heizgeräteeinheit (18), die lösbar als separate Einheit außerhalb einer Metallwand (17, 36, 41) der Heizkammer (16) befestigt ist und im wesentlichen die gesamte Außenfläche dieser Metallwand bedeckt, wobei die flache Heizgeräteeinheit einen Widerstandsheizkörper (29) hat, der von der einen Metallwand (17, 36, 41) durch einen hitzefesten elektrischen Isolator (32) getrennt ist;
und eine nichtmetallische, stark wärmeausstrahlende Schicht (37, 40, 44), die die Innenfläche der einen Metallwand (17, 36, 41) der Heizkammer (16) bedeckt.
2. Eine Heizkochvorrichtung nach Anspruch 1, die weiter eine Aluminiumschicht (39) zwischen der Heizgeräteeinheit (18) und der einen Metallwand (36) der Heizkammer (16) enthält.
3. Heizkochvorrichtung nach Anspruch 1, bei der die nicht metallische Schicht (40) ein selbstreinigendes Material ist.
4. Eine Heizkochvorrichtung nach Anspruch 1, bei der die Oberfläche der einen Metallwand (17, 41) konkav ist.
5. Eine Heizkochvorrichtung nach Anspruch 1, bei der die nicht metallische Schicht (37, 40, 44) eine schwarze Farbe hat.

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ouverture d'alimentation en micro-ondes (23) pour introduire des micro-ondes dans la chambre de chauffage;

une unité à élément chauffant plat (18) montée de manière amovible sous forme d'une unité séparée à l'extérieur d'une paroi métallique (17, 36, 41) de la chambre de chauffage (16) et recouvrant pratiquement l'ensemble de la surface extérieure de cette paroi métallique, l'unité à élément chauffant plat comportant un élément chauffant par résistance (29) séparé de ladite paroi métallique (17, 36, 41) par un isolant électrique résistant à la chaleur (32); et une couche non métallique hautement émissive de chaleur (37, 40, 44) appliquée sur la surface intérieure de ladite paroi métallique (17, 36, 41) de la chambre de chauffage (16).

2. Appareil de cuisson selon la revendication 1, comportant en outre une couche d'aluminium (39) entre ladite unité à élément chauffant (18) et ladite paroi métallique (36) de la chambre de chauffage (16).

3. Appareil de cuisson selon la revendication 1, dans lequel ladite couche non métallique (40) est en matériau auto-nettoyant.

4. Appareil de cuisson selon la revendication 1, dans lequel la surface de ladite paroi métallique (17, 41) est concave.

5. Appareil de cuisson selon la revendication 1, dans lequel ladite couche non métallique (37, 40, 44) est de couleur noire.

Revendications

1. Appareil de cuisson utilisant le chauffage électrique par résistance et le chauffage par micro-onde en combinaison, comportant :
une chambre de chauffage (16) pour recevoir l'aliment (24a) qui doit y être chauffé et ayant ses parois métalliques reliées les unes aux autres de manière étanche afin de former, avec la porte avant (12), une chambre de chauffage (16) fermée hermétiquement, protégée contre les micro-ondes; la chambre de chauffage (16) ayant une

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