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②④ **Combination convection and microwave oven.**

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Description

The present invention relates to a combination oven, particularly for domestic use, in which the heating and cooking of foods is carried out with the aid of conventional gas or electric heating means or by means of microwaves. For achieving a more homogenous heat distribution in the oven cavity, the oven is provided with a motor-driven fan effective to agitate the air within the oven cavity during operation of the oven.

Combination convection and microwave ovens present the problem of suitably positioning the elements for microwave generation and diffusion so as to ensure proper operation of the oven in both of its operating modes. According to one solution, the microwave generator is disposed outside and on top of the oven cavity, and the microwaves are radiated into the oven cavity through the top wall thereof (FR—A—21 04 482).

In this case the conventional heating elements have to be of a particular configuration and require special shielding, while the components of the microwave system require extensive provisions for ventilation and insulation. This leads to increased difficulties and costs in designing and manufacturing an oven of this type while reducing the efficiency thereof in the conventional cooking mode, as the increased ventilation carries away a substantial portion of the generated heat.

According to another known solution, the microwave generator is located below the oven cavity, while the microwaves are radiated into the oven cavity through the top wall thereof. In this case the temperature problems are somewhat mitigated, but the efficiency is reduced in the microwave cooking mode due to increased losses resulting from the increased length of the waveguide conduit and the low quality thereof.

If finally the microwave generator is located below the oven cavity and the microwaves are radiated thereinto through the bottom wall thereof, the foods to be cooked are partially shielded from the microwaves by the vessels containing them (EP—A—23 827). In this case there arise additional problems with regard to cleaning the oven, as grease and other contaminations tend to accumulate on the bottom wall of the oven cavity, particularly in the conventional cooking mode.

It is therefore an object of the present invention to provide a combination convection and microwave oven in which the two cooking modes are effectively integrated so as to obtain optimum efficiency ratings, and in which all problems related to the heating of components, to the reduction of energy losses as achieved by the employ of a short waveguide conduit, and to the cleaning and mounting particularly of the conventional heating elements interiorly of the oven cavity are effectively solved.

This object is attained according to the invention by a combination convection and microwave oven comprising: an oven cavity having disposed

therein conventional heater elements and a fan driven by an electric motor located outside said cavity, and a microwave generator disposed in a rear portion of said oven below said oven cavity and connected thereto through a waveguide conduit. According to the invention, an oven of this type is characterized in that the end portion of the shaft of said motor driving said fan projects into the oven cavity and forms a rotating antenna for radiating microwaves, said shaft being mounted in a support of an insulating material permeable to microwaves and extending through said waveguide conduit disposed at the rear of the rear wall of the oven cavity.

These and other characteristics of the invention will become more clearly evident from the following description of exemplary embodiments with reference to the accompanying drawing, the only figure of which shows a diagrammatical cross-sectional view of a combination oven according to a preferred embodiment of the invention.

The oven according to the invention comprises a housing 19 enclosing an oven cavity 17 surrounded by an insulating jacket 7 and provided with a door 18.

Door 18 is of the conventional double glass window type including seals for preventing the escape of microwaves and provided with a handle 16. An opening of handle 16 communicates with an open space 15 between the door and the forward edge of the oven cavity, and with a conduit 8 disposed above the oven cavity and connected to a fan 19. Located above the oven cavity 17 is a control panel 20. The air aspirated by fan 9 is thus effective to cool control panel 20 and handle 16 and ensures the extraction of the humidity resulting from the cooking of foods within oven cavity 17.

The lower portion of housing 19 is formed with a seat for mounting a microwave generator 3 and a transformer 4 associated therewith adjacent a rear portion of the oven. A blower fan 2 accommodated by the same seat aspirates air through a front opening 1 and expels it at the back of the oven, thereby cooling the microwave generator and other components located at the rear portion of the oven as will be described.

The microwaves generated by generator 3 are conducted along a waveguide conduit 5 secured to the rear wall of oven cavity 17 and extending over a limited length to about half the height of the oven cavity.

Interiorly of oven cavity 17 and about at the center of its rear wall there is mounted a fan 11 the metal shaft 12 of which extends through waveguide 5 to be driven by an electric motor 6 supported by the rear wall of the oven. A support 12 of an insulating material permeable to microwaves surrounds shaft 12 over a part of its length within waveguide conduit 5 so as to avoid any radiation losses. Within oven cavity 17 fan 11 is surrounded by conventional heater elements 10, for instance electric resistance heater elements, while an electric resistance grill rod 14 is mounted in the upper portion of cavity 17.

Fixedly secured in front of fan 11 and heater elements 10 is a panel 13 made of heat resistant material permeable to microwaves, for instance of a vitreous ceramic material, provided with central openings permitting air to be circulated within oven cavity 17 by the action of fan 11, such air being aspirated through said central openings and expelled in radial directions from behind panel 13.

The panel 13 is preferably detachable for facilitating cleaning and maintenance operations.

Motor 6 of fan 11 is adapted to operate at two different speeds, while the shaft 12 of fan 11 projects into the oven cavity for a length corresponding to one quarter of the wavelength of the microwave radiation generated by generator 3.

As fan 11 is driven at low speed, its shaft 12 functions as a microwave radiating antenna, while fan 11 is effective to evenly distribute the radiation throughout oven cavity 17. In the conventional cooking mode, fan 11 is driven at higher speed, so that the oven functions as a convection oven.

It is finally also possible to simultaneously carry out the cooking process by the conventional convection method and by the microwave method by alternately driving fan 11 at its low and high speeds, so as to obtain the desired results in an economical manner without prejudice to the reliability of the oven's components.

The present invention thus effectively provides a structural and functional integration of the conventional cooking system with the microwave cooking system with optimum technical and economical results.

The described construction may of course be modified in various manners without leaving the scope of the present invention. The fan 2 for cooling the microwave generating components may thus be mounted at a different location as dictated by the space available within housing 19. Further the electric resistance grill rod 14 may be fixedly or detachably mounted within the oven cavity 17.

Of particular importance is the location of the microwave generator in the lower rear portion of housing 19, and the emission of the microwaves into the oven cavity 17 through the rear wall thereof, the fan 11 used for circulating the air within oven cavity 17 and the end portion of fan shaft 12 forming the means for radiating the microwaves into the oven cavity.

Claims

1. A combination convection and microwave oven, comprising: an oven cavity (17) having disposed therein conventional heater elements (14) and a fan (11) driven by an electric motor (6) located outside said cavity (17), and a microwave generator (3) disposed in a rear portion of said oven below said oven cavity (17) and connected thereto through a waveguide conduit (5), characterized in that the end portion of the shaft (12) of said motor (6) driving said fan (11) projects into

said oven cavity (17) and forms a rotating antenna for radiating microwaves, said shaft (12) being mounted in a support (21) of an insulating material permeable to microwaves and extending through said waveguide conduit (5) disposed to the rear of the rear wall of said oven cavity (17).

2. A combination oven according to claim 1, characterized in that said motor (6) is adapted to operate at two different speeds and in that the shaft (12) of said fan (11) extends into the interior of said oven cavity (17) so as to function as a rotating antenna for the diffusion of microwaves.

3. A combination oven according to claim 1, characterized in that said fan (11) is surrounded by a conventional heater element (10), for instance an electric resistance heater element, said fan (11) and said heater element (10) being protected by a panel (13) formed of a heat-resistant material permeable to microwaves and provided with central openings.

Patentansprüche

1. Kombiniertes Konvektions- und Mikrowellenofen, enthaltend eine Ofenkammer (17), in der konventionelle Heizelemente (14) und ein Ventilator (11) angeordnet sind, der von einem Elektromotor (6) angetrieben wird, der außerhalb der genannten Kammer (17) angeordnet ist, und einen Mikrowellengenerator (3), der im rückwärtigen Abschnitt des Ofens unterhalb der Ofenkammer (17) angeordnet ist und mit dieser über eine Wellenleitung (5) verbunden ist, dadurch gekennzeichnet, daß der Endabschnitt der Welle (12) des genannten Motors (6), der den Ventilator (11) antreibt, in die Ofenkammer (17) vorsteht und eine rotierende Antenne zur Abstrahlung von Mikrowellen bildet, wobei die Welle (12) in einem Halter (21) aus isolierendem Material gelagert ist, das für Mikrowellen durchlässig ist und der sich durch die Wellenleitung (5) erstreckt, die an der Rückseite der Rückwand der Ofenkammer (17) angeordnet ist.

2. Kombiniertes Ofen nach Anspruch 1, dadurch gekennzeichnet, daß der genannte Motor (6) dazu eingerichtet ist, mit zwei unterschiedlichen Geschwindigkeiten zu arbeiten, und daß die Welle (12) des genannten Ventilators (11) sich in das Innere der Ofenkammer (17) erstreckt, um als eine rotierende Antenne für die Verteilung von Mikrowellen zu wirken.

3. Kombiniertes Ofen nach Anspruch 1, dadurch gekennzeichnet, daß der Ventilator (11) von einem konventionellen Heizelement (10), beispielsweise einem elektrischen Widerstandsheizelement, umgeben ist, und daß der Ventilator (11) und das genannte Heizelement (10) von einer Tafel (13) aus einem wärmebeständigen Material geschützt sind, das für Mikrowellen durchlässig ist und mit zentralen Öffnungen versehen ist.

Revendications

1. Four combiné à convection et micro-ondes, comprenant: une cavité de four (17) à l'intérieur

de laquelle sont disposés des éléments chauffants conventionnels (14) et un ventilateur (11) entraîné par un moteur électrique (6) disposé à l'extérieur de la cavité (17), et un générateur de micro-ondes (3) disposé dans une portion arrière du four en-dessous de la cavité du four (17) et raccordé à celle-ci par un conduit de guide d'ondes (5), caractérisé en ce que la portion terminale de l'arbre (12) du moteur (6) entraînant le ventilateur (11) se projette dans la cavité du four (17) et forme une antenne rotative pour le rayonnement des micro-ondes, cet arbre (12) étant monté dans un support (21) en un matériau isolant perméable aux micro-ondes et s'étendant à travers le conduit de guide d'ondes (5) disposé sur l'arrière de la paroi postérieure de la cavité du four (17).

2. Four combiné selon la revendication 1, caractérisé en ce que le moteur (6) est adapté pour fonctionner à deux vitesses différentes et en ce que l'arbre (12) du ventilateur (11) s'étend dans l'intérieur de la cavité de four (17) de façon à fonctionner en tant qu'antenne rotative pour la diffusion des micro-ondes.

3. Four combiné selon la revendication 1, caractérisé en ce que le ventilateur (11) est entouré par un élément chauffant conventionnel (10), par exemple un élément chauffant à résistance électrique, le ventilateur (11) et cet élément chauffant (10) étant protégés par un panneau (13) en un matériau résistant à la chaleur, perméable aux micro-ondes et pourvu d'ouvertures centrales.

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