METHOD OF MICROWAVE BAKING

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ABSTRACT

Methods of using, in a microwave oven, a baking chamber, heated by microwave absorptive material, which includes monitoring the temperature of said baking chamber, barbecuing meat within said baking chamber and, after use, the self-cleaning of said baking chamber.

7 Claims, 2 Drawing Figures
METHOD OF MICROWAVE BAKING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of parent applications Ser. No. 470,809, filed July 9, 1965; and Ser. No. 483,144, filed Aug. 27, 1965, both abandoned in favor of Ser. No. 704,389, filed Feb. 9, 1968, now U.S. Pat. No. 3,701,872 and this application is a division of Ser. No. 193,940, filed Oct. 29, 1971, now U.S. Pat. No. 3,731,037.

BACKGROUND OF THE INVENTION

This invention provides a method of cooking in a microwave oven to fry, bake, broil, brown and barbecue. Various systems are in use to accomplish this purpose, for example, a conventional gas or electric oven to which a microwave heating feature has been appended, but none, completely microwave powered, that are satisfactory.

Structures which enable a microwave oven to fry, bake, broil, brown and barbecue are described in my copending application, U.S. Ser. No. 704,389, now U.S. Pat. No. 3,701,872. Said application concerns heat insulating structures which contain and direct heat released from microwave lossy material onto a workload and include the use of heat conducting material to better accomplish even, efficient heating. My U.S. Pat. No. 3,469,053, Microwave Kiln, describes a dry-heat, oven structure which can be an integral or removable part of a microwave oven. My U.S. Pat. No. 3,585,258, Method of Firing Ceramic Articles Utilizing Microwave Energy, describes methods of heating in a microwave oven. My U.S. Pat. No. 3,539,751, Insulating Implement for Use in a Microwave Oven, describes improved ways of containing and directing the heat evolved from microwave irradiation of lossy material. This invention describes novel combinations of my said U.S. Pat. application Ser. No. 704,389, now U.S. Pat. No. 3,701,872 and U.S. Pat. Nos. 3,469,053, 3,585,258 and 3,539,751 and new improvements.

One object of this invention is to provide a method for a microwave oven which will fry, bake, broil, brown and/or barbecue food.

Another object of this invention is to provide a new method of combining an infra red oven and a microwave oven.

Another object of this invention is to describe methods of cooking meat in metal containers in a microwave oven to provide rare and medium rare cooked portions.

SUMMARY OF THE INVENTION

This invention concerns an improved microwave heating method using a member which can be an integral or removable member of a microwave oven. Said member being a heat-insulating structure containing a work chamber therein. Said heat-insulating structure designed to confine and allow for a build up of heat energy. Said work chamber contains a microwave lossy material capable of, on exposure to microwave energy, producing a hot dry heat. A foodstuff in a container placed within said chamber heats from the direct action of microwave radiation and from heat transfer into the container from said microwave lossy material.

FIG. 1 is a cut-away, side view of the invention for use in a work chamber of a microwave oven.

FIG. 2 is a cross section view of invention taken along line 2—2 of FIG. 1.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGS. 1 and 2 in the drawing, there is depicted a cut-away, side view and a cross section view of a heat insulating box 1, containing a work chamber 2, resting on a floor or shelf 13 in an oven chamber (not shown) of a microwave oven (not shown). The heat insulating walls 3 of work chamber 2 are lined with a microwave lossy lining 4. Heat insulating walls 3's insulating capabilities can be further enhanced by means described more fully in my U.S. Pat. No. 3,539,751. Illustrated are a planned pattern of holes 8—8 drilled in heat insulating walls 3 and sealed by seals 9—9 to lower mass of walls 3. Fired insulating refractory material as manufactured by General Refractories Company for their insulating fire brick, for example GR—25, is satisfactory.

The microwave lossy lining 4 can be made of many suitable materials constituted to withstand the temperature shock and repeated heat recycling associated with normal oven usage. I find General Refractories Company's Briikol A made lossy by the addition of ferrite and carbon materials suitable. This material is a brick mortar which adheres to the insulating firebrick material. It is advisable to fire the assembled kiln before its initial use. Other suitable materials for lining 4 include quartz or glass ceramic made lossy by the inclusion of pockets of electrically arcing particles, as described in my copending application Ser. No. 704,389, or a lining of lossy glass ceramic or ferrite. Preferred is a lossy material that also permits the passage of microwave energy therethrough while heating to a high temperature. Lining 4 need not be smooth for a rough lining presents a larger surface area. Many materials classified as "low loss" when heated to a high temperature become lossy along with lossy lining 4, and when all is hot and lossy, microwave power expends itself principally in the sensor lining 4 and work chamber 2 contents. The outer surface of heat insulating walls 3 should be kept in their characteristic low loss state by radiating heat to the cool oven chamber walls 13 and kept cool from air normally circulated in a conventional microwave oven's chamber.

It is preferred to make the roof lining 10 lossier than floor lining 11. One way to accomplish this is to build into roof lining 10 pockets of microwave lossy arcing material, as ferrite particles, more fully described in my copending application, U.S. Ser. No. 704,389. In operation, roof lining 10 heats to a higher temperature than the floor lining 11 and browns the top of the foodstuff 6 principally by radiant heat transfer.
Work chamber 2 (with section 5 in place) is a closed cavity. By its nature heat energy in a closed, heat-insulated cavity must equalize and become homogene-ous. Heat is transferred amongst all parts of work chamber 2, lining 4, foodstuff 6 and container 7 not only by conducted, convected and radiant heat transfer, but by heat transfer of water vapour condensing on colder sections and evaporating from hotter sections. When floor lining 10 is constructed of a porous mate-rial, as ceramic refractory mortar, water condensing on the outer sides of container 11 drips off and is absorbed and, by capillary action, dispersed in floor lining 11 where it presents a large volume to the microwave energy, and, because of direct microwave heating and heating by the lossy material of floor lining 11, it speedily evaporates and condenses ultimately on the cooler sections of the workload. This results in more juices and gravies, no need for basting and easier cleaning containers. Very little water is observed lost from foodstuff 6 until it approaches temperatures hotter than are required for eating. In fact, the escape of observable steam (note that section 5 does not form a vapour tight joint) generally signals either too rapid heating or that the food is properly heated and can be removed.

I prefer to equip my microwave kiln with a 500°-500°F metal thermometer, as Weston Model 2261 or Model 2292, arranged as to be viewed through a window in a microwave oven door (not shown) so that the cooking process can be temperature monitored.

The methods of using a microwave kiln for cooking are as varied as the type of meals one can cook. One representative method is to expose foodstuff in kiln to microwave energy for a fixed period of time and then allow a resting time before kiln is opened. Food can be cooked for a short time to start the cooking process and then removed from the oven in the still unopened kiln for transporting to a remote eating area while the food continues to cook from the heat stored in lining 4, and, when the temperature of the work chamber 2 and its contents finally equalizes insulating walls 3 continue to hold food hot, as in a thermos bottle, for extended periods of time. New skills must be learned and practiced to capitalize fully on the usefulness of this microwave kiln. It must be kept in mind that air temperature in work chamber 2 and radiant heat temperature striking the food are both independent and effective. For example, thermometer 12 may be reading 120°F air temperature while the food is burning from radiant heat energy.

In another representative method of operation, a remov-able microwave kiln 1 is inserted into a microwave oven's cavity (not shown) with a frozen TV dinner, foodstuff 6 in its aluminum container 7, in kiln's work chamber 2. The oven is energized. Since the food is frozen, it is less lossy than when defrosted. Hence, initially more microwave energy is available to heat up lining 4 and crust the surface of foodstuff 6. Thermometer 12 indicates the air temperature of work chamber 2 and signals when to stop cooking and remove cooked foodstuff 6 in its heated container 7. A second TV dinner cooked immediately in the instant preheated work chamber 2 takes only slightly less time to cook because foodstuff 6 represents the real load to the microwave oven, and its mass and the microwave power level determines the length of time for cooking. The utility of the kiln is to cook a foodstuff to a desirable internal and external temperature, and not, whether lossy lining 4 reaches 500° or 1,500°F. The kiln's job is to increase efficiency while affecting the flavor, color, and crust while microwave energy defrosts and cooks. Thermom-eter 12 helps determine when cooking is completed when exact measurements, size and composition of foodstuff 6 is not known. If conditions are fixed as in industrial cooking or repeat cooking of the same manu-facturer's identical TV dinners, a simple conventional timer (not shown) can be employed. I prefer a combi-nation of timer and thermometer.

In a second representative example of operation, either with or without empty container 7 as desired, micro-wave kiln 1 is heated to a predetermined temperature without foodstuff 6 in work chamber 2. At the pre-determined temperature, say 500°F, (generally hotter than would be proper for gas or electric ovens because microwaves speed, in deep cooking and defrosting, leaves less time for surface browning) foodstuff 6 is intro-duced into hot work chamber 2. If empty container 7 was included in the preheating and it is of sufficient mass, foodstuff 6 is seared when it first contacts hot container 7, and thenceforth, microwave energy and heat energy stored in lining 4 finishes the cooking and browning.

The selection of material for container 11 can be used to vary the results. For instance, it is easier to cook a hamburger well done, in a glass ceramic con-tainer 7 than in an aluminum container 7. Non lossy glass ceramic tends to become lossy as it heats and it retains its heat longer to keep food hotter longer on subsequent service. An aluminum pan is generally manu-factured with less mass than a comparable glass ceram-ic pan so has less thermal capacity. Aluminum is a good heat conductor, and heat, which its outer surfaces (acting as heat absorbent fins) collect from the hot work chamber 2, is readily transferred to cooler foodstuff 6. It is easier to cook a hamburger rare or medium in an aluminum container 7. Aluminum collects more grasy as it shields the grasy from direct microwave ac-tion. I prefer to cook my hamburgers in small 4 inch aluminum foil pie dishes, but it must be understood that while aluminum may slightly favor glass ceramic for rare hamburgers, it is relatively easy to also cook hamburgers rare in glass ceramic (e.g., glass ceramics larger mass takes longer to heat and oven would have to be preheated).

Aluminum, representative of other non-magnetic metals, can be additionally used as follows: I have dis-covered that a mixture of two microwave lossy materi-als, one which is lossy because of its electrical proper-ties, as carbon, mixed with a second material which is principally lossy because of its magnetic properties, as ferrite, with or without a refractory mortar binder, and spread out as a thin floor lining 11, draws power more evenly from both the electric and magnetic fields and results in better loading with less spot heating. Said bet-ter loading and evener heating is advantageous when kiln is preheated empty. And, when aluminum con-tainer 7 subsequently rests on said preheated mixture, the electrical material is not lossy in juxtaposition as the electric field is at a minimum close to metal. The magnetic field and the heating of the magnetic material is at maximum close to the aluminum surface. This rule I find true if microwave energy can also approach the upper side of container 7. The heat conducting proper-ties of aluminum and the relatively cool container 7 and foodstuff 6 operate together to keep the magnetic
material below its Curie point. The other sections of floor lining 11, not covered by aluminum container 7, remain lossy in response to both the electric and magnetic field and readily evaporate and recycle condensed water dripping off the outside of aluminum container 7. Note that, in this case, proximity with aluminum container 7 "turns off" some of the lossiness of floor lining 11 and so effectively makes more microwave energy available for roof lining 10 and foodstuff. To make the roof lining 10 hotter use shiny aluminum rather than glass ceramic.

Food shielded from microwave energy by being placed in a closed-to-microwave-energy metal container can be baked in a heated kiln. More than one container 7 can be used simultaneously, and each can be of different material. One metal container can hold a second. Container 7 may be made of lossy material and foodstuff 6 may be non lossy. Crusted frozen baked products can be defrosted directly without container 7.

Meat can be barbecued in work chamber 2 by heating lining 4 hot enough to ignite fat. Barbecuing can take place with either section 5 off, in which case flames will issue, or, can be operated with section 5 in place where lacking oxygen slow combustion takes place. When barbecuing with section 5 in place, care must be exercised opening work chamber 2, if flames shoot out, replace section 5 until work chamber 2 cools below ignition point. In either case means for venting (not shown) products of combustion must be employed.

Work chamber 2 is self cleaning in the manner of typical self cleaning ovens that are heated empty to such temperature as will burn off accumulated mess and splatter.

The top temperature work chamber 2 can reach is fixed by the thickness and material of heat insulating walls 3 multiplied times the highest power level of the microwave oven's generator.

Although this invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention, as a disposable, one time kiln to heat a foodstuff 6 in an aluminum container 7 where walls 3 are polyurethane foam and lossy floor lining 11 is water.

I claim:

1. A method of baking a foodstuff in a microwave oven which includes the steps of:
   - locating within said microwave oven a baking chamber defined by a first microwave-permeable, heat-insulating material and heated by a second microwave-absorptive material, exposing to microwave energy said baking chamber for a predetermined time while said microwave-absorptive material absorbs and converts said microwave energy to heat energy which heat energy heats said baking chamber, and subsequently placing said foodstuff into said heated baking chamber for a predetermined time to bake said foodstuff.
   - 2. In a method of baking a foodstuff, according to claim 1, the added step of:
      - monitoring the temperature of said baking chamber during said exposure to microwave energy.
   - 3. In a method of baking a foodstuff, according to claim 1, the added step of:
      - heating a cooking container within said baking chamber before locating said foodstuff within said baking chamber.
   - 4. In a method of baking a foodstuff, according to claim 1, the added step of:
      - removing said foodstuff from said baking chamber, and additionally exposing said baking chamber to microwave energy until said baking chamber heats to a temperature sufficient to incinerate any waste products and splatter left from said baking of said foodstuff.
   - 5. In a method of baking a foodstuff, according to claim 1, the added step of:
      - additionally exposing said baking chamber with said foodstuff to be baked therein for an additional predetermined time to microwave energy to heat the interior of said foodstuff by direct exposure to said microwave energy and to heat the surface of said foodstuff by the dual heating action of both heat energy newly converted from said additional exposure to said microwave energy within said foodstuff and heat energy newly released from said additional exposure from said microwave absorptive material.
   - 6. In a method of baking a foodstuff, according to claim 5, the added step of:
      - monitoring the temperature of said baking chamber during said additional exposure to microwave energy.
   - 7. In a method of baking a foodstuff, according to claim 5, which includes:
      - where said foodstuff is meat, heating said baking chamber during said first exposure to microwave energy to a temperature hot enough to ignite said meat when said meat is subsequently placed within said baking chamber to result in a barbecued portion of meat.