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Levinson

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[54] **MICROWAVE KILN TO COOK FOOD**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 704,389, Feb. 9, 1968.

[52] **U.S. Cl.** 219/10.55

[51] **Int. Cl.** H05b 9/06

[58] **Field of Search** 219/10.55, 10.49; 99/192

[56] **References Cited**

UNITED STATES PATENTS

2,495,435	1/1950	Welch	219/10.55 X
2,600,566	6/1952	Moffett	219/10.55
2,622,187	12/1952	Welch	219/10.55
2,648,047	8/1953	Hollingsworth	333/81 B
2,830,162	4/1958	Copson et al.	219/10.55 X
3,469,053	9/1969	Levinson	219/10.55
3,539,751	10/1970	Levinson	219/10.55

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Assistant Examiner—Hugh D. Jaeger
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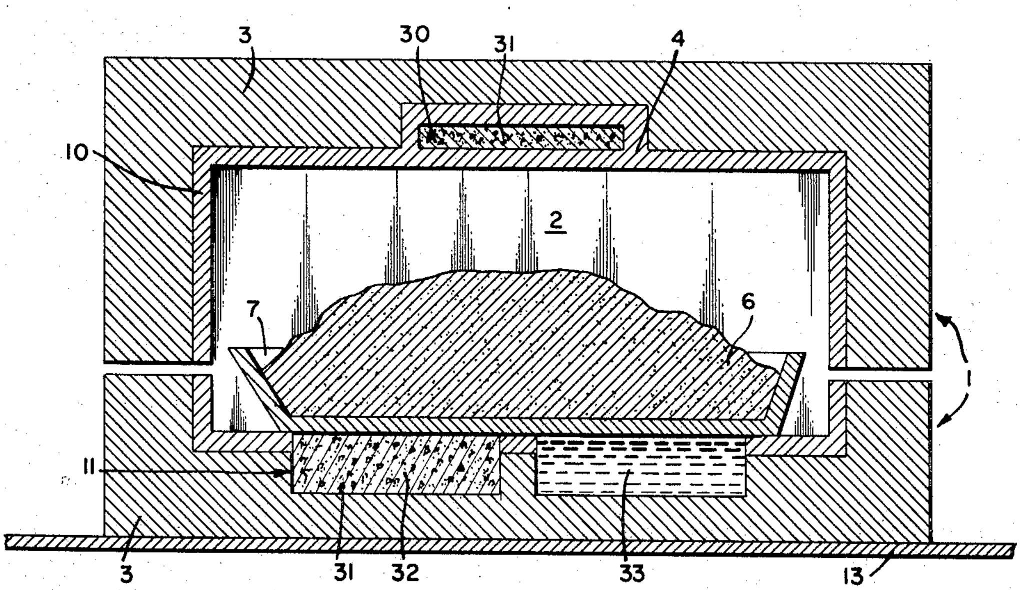
[57] **ABSTRACT**

A microwave oven is provided with a heat insulating structure containing a work chamber lined with a microwave lossy material where said lining: 1) can be porous to water, 2) can represent an acceptable load to said microwave oven, 3) can define a closed cavity, 4) can be a mixture of a lossy electrical material and a lossy magnetic material, and 5) can be used in conjunction with a non-magnetic-metal, heat-conducting workload container.

7 Claims, 3 Drawing Figures



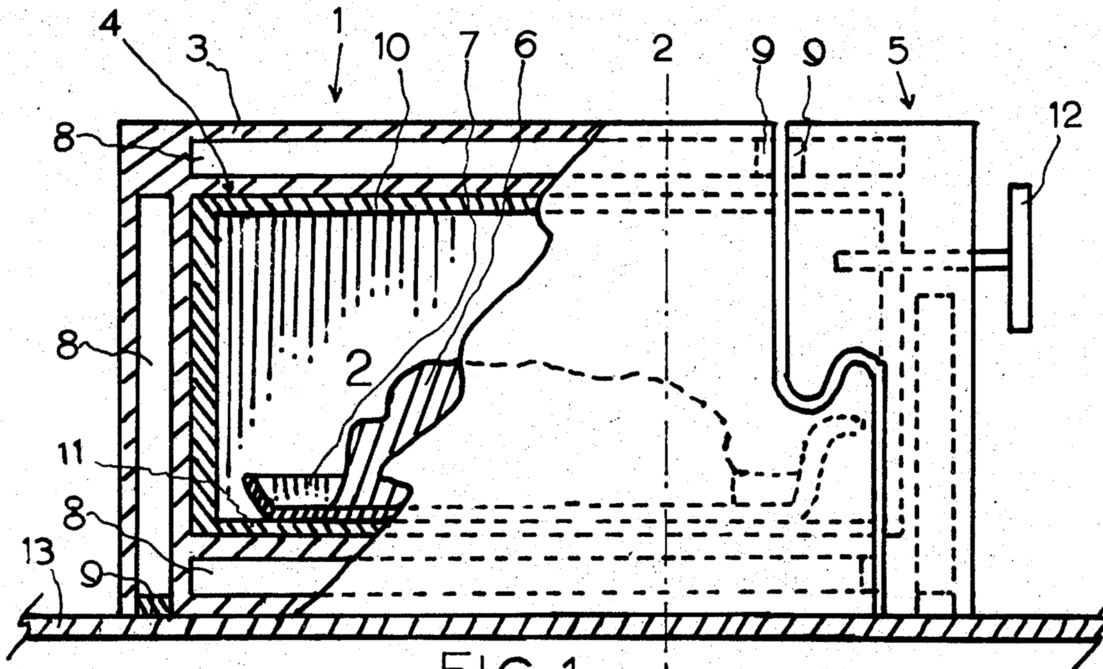


FIG. 1

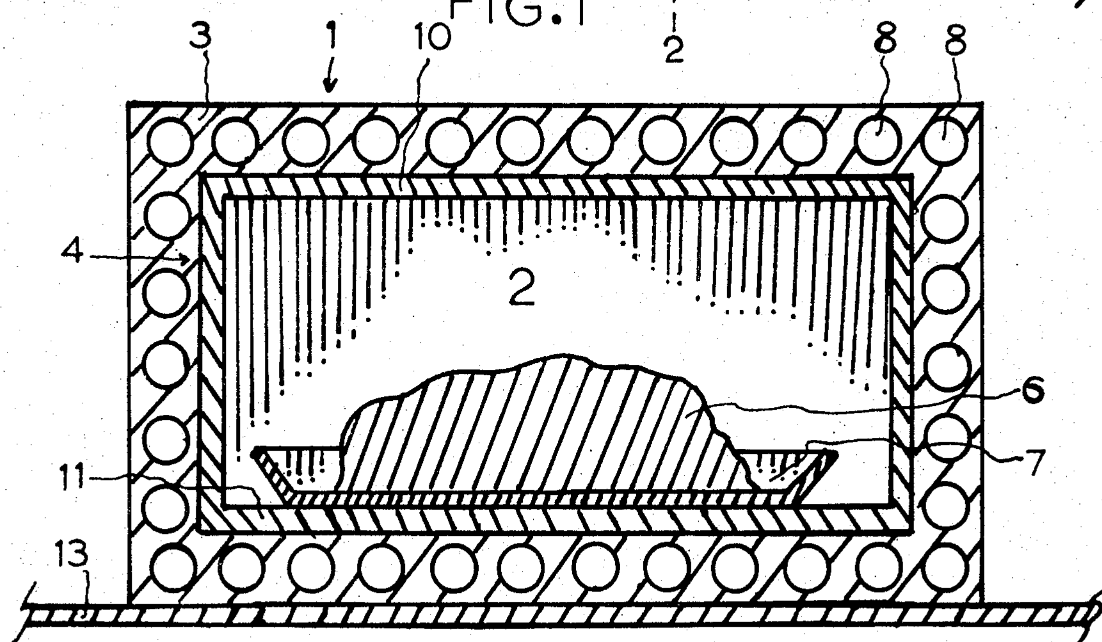


FIG. 2

INVENTOR.

BY Melvin Levinson

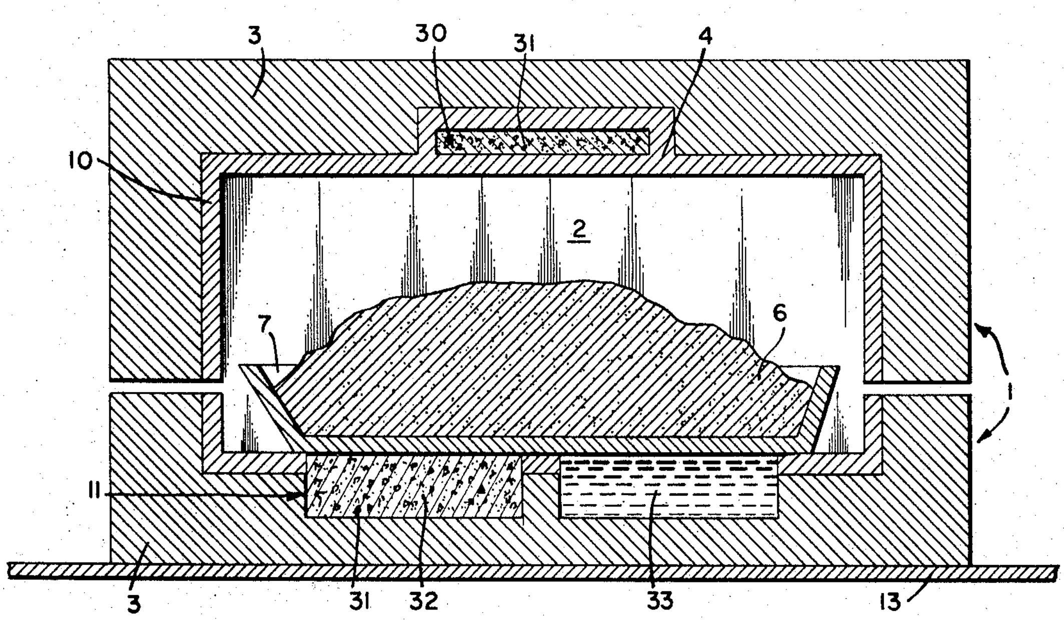


FIG. 3

MICROWAVE KILN TO COOK FOOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my copending application, U.S. Ser. No. 704,389, filed Feb. 9, 1968.

BACKGROUND OF THE INVENTION

This invention provides a microwave oven, per se, with means 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. 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 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 structure for a microwave oven which will fry, bake, broil, brown and/or barbecue food.

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

Another object of this invention is to provide structure for a microwave oven which will safely accept, defrost and cook TV dinners prepackaged in aluminum trays.

Another object of this invention is to describe means and 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 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.

BRIEF DESCRIPTION OF THE DRAWING

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.

FIG. 3 is a cross-section, composite view depicting additional embodiments of the invention.

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. Section 5, consisting of the entire front plus a small part of top and top sides of box 1, can be removed to expose work chamber 2 and permit the insertion and removal of a foodstuff 6. Foodstuff 6 is shown contained in a removable container 7 provided with a handle.

Heat insulating walls are best made of a low-loss, low-mass, heat-insulating material capable of withstanding the high refractory temperatures, circa 2,000°F, generated by 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 Briklok 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 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 there thru 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 densor 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.

In FIG. 3, 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 a pocket 30 of microwave lossy arcing material, as ferrite particles 31, 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 homogeneous. 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 vapor condensing on colder sections and evaporating from hotter sections. When floor lining **11** is constructed of a porous material, as ceramic refractory mortar, water condensing on the outer sides of container **7** drips off and is absorbed and, by capillary action, dispersed in floor lining **11** where it presents a larger 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 heat insulating box **1 6** until the foodstuff **6** approaches temperatures hotter than are required for eating. In fact, the escape of observable steam (note that section **5** does not form a vapor 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 50°–500 °F metal thermometer **12**, 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 equalize, 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 removable 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 imediately 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. Thermometer **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 manufacturer's identical TV dinners, a simple conventional timer (not shown) can be employed. I prefer a combination of timer and thermometer.

In a second representative example of operation, either with or without empty container **7** as desired, microwave kiln **1** is heated to a predetermined temperature without foodstuff **6** in work chamber **2**. At the predetermined 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 introduced 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 container **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 manufactured with less mass than a comparable glass ceramic 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 gravy as it shields the gravy from direct microwave action. 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 ceramic's larger mass takes longer to heat and oven would have to be preheated).

In FIG. **3**, aluminum representative of other nonmagnetic metals, can be additionally used as follows: I have discovered that a mixture of two microwave lossy materials **31**, **32**, one which is lossy because of its electrical properties **32**, as carbon, mixed with a second material which is principally lossy because of its magnetic properties **31**, 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 better loading and evener heating is advantageous when kiln is preheated empty. And, when aluminum container 7 subsequently rests on said preheated mixture, the electrical material 38 is not lossy in juxtaposition as the electric field is at a minimum close to metal aluminum container 7. The magnetic field and the heating of the magnetic material 31 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 properties of aluminum and the relatively cool container 7 and foodstuff 6 operate together to keep the magnetic material 31 in thermal contact with aluminum container 7 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, proximetry 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 6. 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 manor 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 33 as illustrated in FIG. 3.

I claim:

1. In a microwave oven comprising a chamber for receiving an article to be heated, means for emitting microwave energy to said chamber, and a heating member within said chamber, the improvement in said heating member comprising:
   a body of non-lossy, microwave-permeable, heat-insulating material forming a chamber therein,
   a lossy material lining the interior walls of said chamber, and
   access means to said chamber for receiving an article to be heated.

2. In a microwave oven according to claim 1, where said heating member provides an acceptable load to said means for emitting microwave energy.

3. In a microwave oven according to claim 1, wherein at least one wall of said lining is provided with pockets of microwave-lossy, arcing material.

4. In a microwave oven according to claim 1, wherein the roof of the lining is more lossy than the base.

5. In a microwave oven according to claim 1, an aluminum container for receiving said article to be heated.

6. In a microwave oven comprising a chamber for receiving an article to be heated, means for emitting microwave energy to said chamber, and a heating member within said chamber, the improvement in said heating member comprising:
   a body of non-lossy, microwave-permeable, heat-insulating material forming a chamber therein,
   a lossy material lining the base of said chamber, said base being provided with a mixture of lossy electrical material and lossy magnetic material, and
   access means to said chamber for receiving an article to be heated.

7. In a microwave oven according to claim 6, wherein the base is porous to liquids.

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