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CONVEYOR MICROWAVE OVEN

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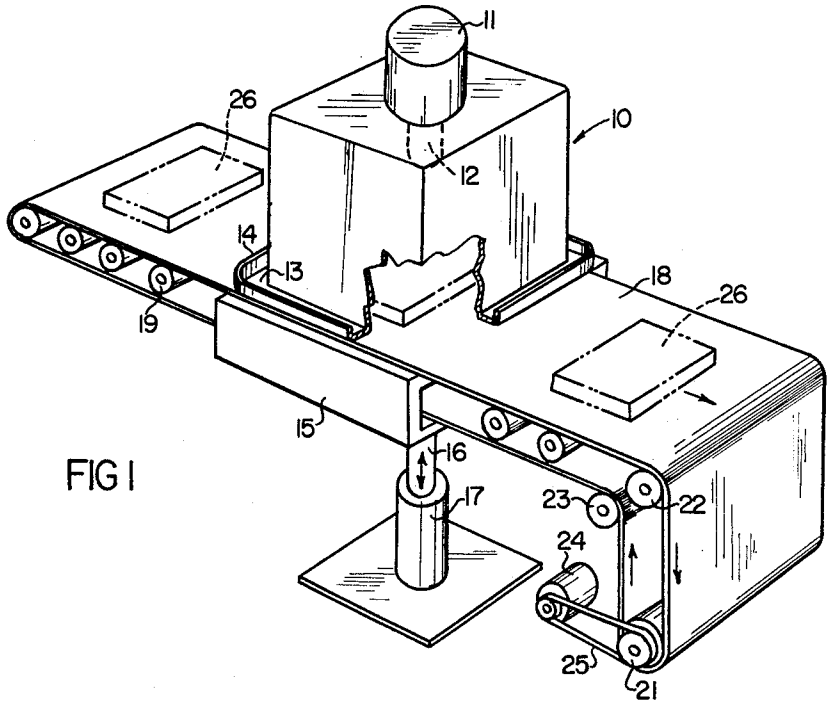


FIG 1

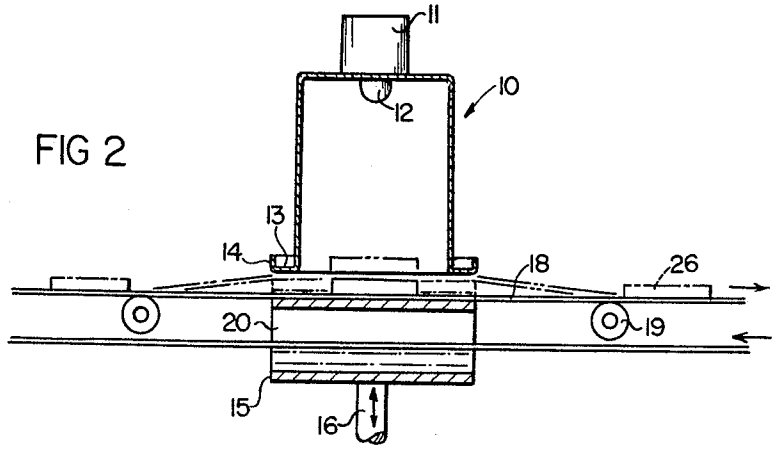


FIG 2

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3,177,333
CONVEYOR MICROWAVE OVEN

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This invention relates to a microwave oven assembly for successively heating products advanced or transported through the oven by conveyor means.

The microwave to be employed for the heating must, of course, be confined and, for safety and other reasons, that is preferably accomplished by a suitable enclosure or, in other words, a substantially closed structure to which access to the region of the high-frequency energy is at least limited and from which there is substantially no radiation. In attempting to adapt such an electronic oven to conveyor use, the conventional approach has been to provide an almost fully closed housing with entrance and exit tunnels at opposite sides through which a conveyor can be advanced to carry the articles to and from the interior of the housing or oven cavity, with these tunnels being of particular size and shape in relation to the frequency of the electromagnetic energy to act as radiation traps. The tunnels thus function in the nature of wave guides effective at the particular frequency of operation to cut off transmission of the energy therethrough. This proposed solution to the problem of protecting against leakage is not very satisfactory, since the tunnels at the frequencies employed for microwave cooking must be of relatively small dimensions and the size of the article or product which can be handled is correspondingly limited.

It is a primary object of the present invention to provide a conveyor microwave oven combination in which leakage is eliminated without the noted limitation on the size of the product to be heated.

Another object is to provide such a combination utilizing improved capacitative sealing of the oven during the periods of generation of the high-frequency electromagnetic energy therein, that is, during intervals of microwave heating.

It is also an object to provide a conveyor microwave oven assembly in which the oven is completely physically closed for periodic intervals of high-frequency energization.

It is also an object to provide an electronic oven having relatively movable sections separable for insertion and removal of food products and the like to be heated therein and including improved means for sealing said sections when closed.

Other objects and advantages of the invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a largely schematic perspective of apparatus in accordance with the present invention; and

FIG. 2 is a partial longitudinal section of said apparatus.

Referring now to the drawings in detail, reference numeral 10 designates the main portion of a microwave oven comprising a top wall and four side walls made of metal.

A suitable source of the microwave energy, such as a magnetron, is indicated at 11 with a radiating portion 12 extending into the oven through the top wall. It will be appreciated that this representation is schematic, and that other available expedients could be employed for feeding of the high-frequency electromagnetic energy to the interior of the oven.

The oven 10 is open at the bottom and has a continuous outwardly extending flange 13 about the bottom periphery, terminating in a short outer vertical wall 14. The horizontal or outward extent of such flange is appreciable, as illustrated, and in normally spaced opposition thereto an oven bottom 15 is provided. In actual practice, flanges 13 having horizontal distances ranging from slightly under one half inch up to two inches have proved highly satisfactory. The bottom 15, as particularly illustrated, is also formed of metal and comprises a horizontally disposed hollow member of rectangular cross-section. For a purpose to be described, the bottom 15 is supported on the upper end of a piston rod 16 extending vertically from a fluid operated piston-cylinder device 17 of appropriate form, whereby the bottom of the oven can be vertically reciprocated as indicated by the double headed arrow on the rod.

A continuous conveyor belt 18 preferably made of a thin dielectric material, and preferably a low loss dielectric material, such, for example, rubberized cloth or fabric, is disposed about idler rolls 19 in a horizontal portion thereof wherein the upper course moves over the top surface of the oven bottom 15 and the lower course passes through the opening 20 in such bottom member. Although varying thicknesses of the conveyor belt may, of course, be used, satisfactory results have been obtained during use of belt thicknesses ranging from approximately ten thousandths of an inch to approximately 40 thousandths of an inch. At one end of such horizontal portion, the right end as viewed in the drawings, the belt 18 has a vertical portion at the lower end of which there is an interior drive roll 21 which will, when rotated, frictionally drive the conveyor. The upper course passes downwardly over an idler roll 22 at this end and the lower course is engaged over an external idler 23 in appropriate angular relation at the same end. An electric motor 24 is shown having a pulley connection 25 to the drive roll 21 for power rotation of the latter.

It will be noted that the conveyor belt 18 in the illustrated embodiment of the invention is of a width corresponding to the distance between the outer terminal sections of the oven flange 13 at the sides parallel to the extent of the conveyor. The shallow boxes 26 shown on the conveyor are intended to represent food products to be heated or cooked by the microwave oven, and a direction of conveyor travel has been assumed for convenience in the manner shown by the arrows.

When the oven bottom 15 is raised from its normally lowered position, its top surface engages the underside of the upper course of the conveyor belt 18 and locally lifts the same to the condition shown by the dashed outline in FIG. 2, wherein the bottom presses the interposed conveyor belt section against oven flange 13 about the full periphery of the oven. A given product 26 placed on the receiving end of the conveyor can thereby be carried by controlled energization of the conveyor drive motor 24 to the region just beneath the oven 10 and the elevating mechanism 17 for the bottom 15 then actuated to close the oven. The drive of the conveyor and the means for raising and lowering the bottom will preferably be automatically synchronized so that the conveyor advances stepwise, with a rest period so related to the microwave cook-

ing operation to be performed as to be of sufficient duration for thus closing the oven about a product advanced therein, performance of the heating cycle, and subsequent retraction of the oven bottom. Since microwave cooking periods are generally short, continuous drive of the conveyor could be used, if desired, with appropriate take-up loops to accommodate the temporary arrest of the section of the conveyor engaged between the oven and the bottom when closed.

The supply of microwaves to the oven should also preferably be made responsive to the opening and closing of the bottom for safety, with many types of such interlocks suitable for the purpose.

Since, as previously noted, the belt shown is wide enough to be engaged about the full bottom of the oven, it provides in itself a complete solid dielectric seal between the oven proper and the bottom. If it should be desired to employ a conveyor of less width, strips of dielectric of the same thickness as the conveyor can be applied to those underside sections of the flange 13 which do not engage the conveyor belt in the closed oven condition.

The interposition of thin dielectric material between the relatively movable sections of the oven provides high capacity sealing of the two, and it is believed that the microwave energy is effectively short circuited through such capacitative seal. In any event, it has been found that there is substantially no leakage of radiation in this assembly, and the use of solid dielectric for the purpose precludes arcing, which might more readily occur if a simple air gap were employed. The use of the solid dielectric seal also eliminates the concern for arcing whenever metal-to-metal contact is relied upon for conductively joining relatively movable electronic oven sections, this being the conventional and relatively more exacting type of sealing used in standard non-conveyor electronic ovens.

The present improvements have utility not only in large scale continuous operations, but also in vending or coin-operated dispensing machines wherein sandwiches, for example, can be heated as they are to be dispensed, with the conveyor above described serving upon initiation of an operating cycle to advance the product through the oven for discharge. In a sense, the bottom of the new oven also serves a conveyor function in elevating the product in its act of closure of the oven, so that the bottom of this construction might be considered as a movable product receiver as well as the means for effecting the solid dielectric sealed closure of the oven, with other mechanisms for controlling movement thereof obviously being available in addition to the particular form described.

Although there have been described, by way of example only, various preferred materials and satisfactorily employed dimensions, these exemplifications are not intended to limit the scope of the invention as it will be obvious to those skilled in the art that other means can be employed within the purview of the principles embodied in the invention. Thus, other modes of applying the principles of the invention may be employed, change being made regarding the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. In an electronic oven assembly, enclosure means comprising separately formed complemental housing sections which are electrically conductive, means for relatively moving said sections toward and away from one another between open and closed conditions of adjustment thereof, said sections in the open condition of adjustment being separated for insertion of a food product and the like to be heated, and in the closed condition of adjustment being brought together cooperably to define

a closed oven cavity, with such an inserted product therewithin, means for supplying high-frequency energy to said closed oven cavity for heating of the product therein, and thin solid dielectric material interengaged between the opposed surfaces of the sections when brought together fully about the joint thereof for solid dielectric capacitance sealing of the same against leakage of the high-frequency energy.

2. An electronic oven assembly as set forth in claim 1 wherein said sections of the enclosure means are disposed one above the other.

3. An electronic oven assembly as set forth in claim 1 wherein at least a portion of the solid dielectric material for sealing the housing sections when closed is a conveyor on which the food product is carried between the separated sections of the enclosure means when open for positioning in the oven cavity formed by closure thereof.

4. An electronic oven assembly as set forth in claim 1 wherein the sections of the enclosure means respectively form an upper shell open at the bottom and a bottom closure therefor, with the latter adapted to receive the food product to be heated when relatively separated in the open condition of adjustment of the enclosure means.

5. An electronic oven assembly as set forth in claim 4 wherein at least a portion of the solid dielectric seal is a conveyor extending between the separated upper shell and bottom closure for carrying the food product to and from such enclosure means.

6. In an electronic oven assembly, a conveyor belt of thin dielectric material, conductive enclosure means having cooperable sections disposed respectively at opposite sides of said conveyor belt at an intermediate location along the same, means for relatively moving said sections between an open condition of adjustment in which the conveyor can pass freely therebetween and a closed condition in which they are brought together forcibly against the interposed belt section, the conductive sections of the enclosure means when in the closed condition thus being separated by the interposed belt section and the latter forming a solid dielectric capacitive seal for the closed sections, the conveyor belt being operable to advance a plurality of food products and the like successively through the aforesaid location, with the cooperable enclosure sections in closed condition defining an oven cavity about the interposed belt section and hence a product thereon, and means for supplying high-frequency energy to the thus formed oven cavity.

7. An electronic oven assembly as set forth in claim 6 wherein said conveyor is substantially horizontal in its travel through the location of the enclosure means, and the sections of the latter are relatively reciprocable and respectively above and below the same.

8. An electronic oven assembly as set forth in claim 7 wherein the upper section of the enclosure means is a shell open at the bottom and having a bottom peripheral flange, and the lower section is a bottom plate closure, the flange and said plate closure being forced together against the conveyor belt therebetween in the closed condition of the enclosure means.

9. An electronic oven assembly as set forth in claim 8 wherein the bottom plate closure beneath the article-advancing course of the conveyor is vertically reciprocated and operative to engage and elevate the conveyor section at said location against the upper shell flange, with an article on such section thereby being moved within the shell.

10. In an oven assembly, a downwardly open top oven enclosure, means for supplying said top oven enclosure with microwave energy, separate oven bottom means movable relative to said enclosure into and out of enclosure closing position, said top oven enclosure and said bottom being electrically conductive, and solid dielectric means disposed between the lower peripheral edge of said downwardly open top oven enclosure and said bottom means,

the solid dielectric means being interengaged between the top oven enclosure and the bottom means for solid dielectric capacitive sealing thereof in the closed condition.

11. The oven assembly of claim 10 wherein said dielectric means comprises a horizontal movable food supporting and conveying means.

12. The oven assembly of claim 11 further including power means operable to raise said bottom means and said dielectric conveying means into said enclosure sealing position.

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RICHARD M. WOOD, *Primary Examiner.*