United States Patent

Kobayashi

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[54] **MICROWAVE SEAL FOR ELECTRONIC RANGE**

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

[58] **Field of Search**.....219/10.55

[56] **References Cited**

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[57] **ABSTRACT**

The disclosed microwave seal for electronic range comprises a choke coupling type microwave cavity communicating with a clearance between a range main body and a door in addition to a microwave seal of any desired type. The microwave cavity serves to choke the second harmonic frequency component of the microwave energy to prevent the same from leaking from the range, while the microwave seal serves to prevent the basic frequency component of the microwave energy from leaking.

4 Claims, 5 Drawing Figures

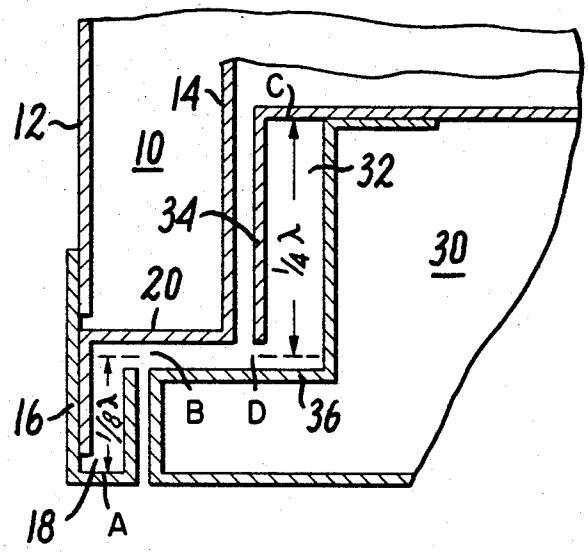


FIG. 1

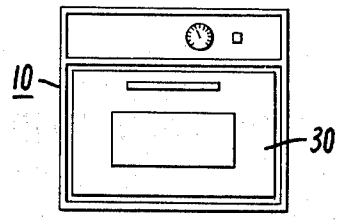


FIG. 2

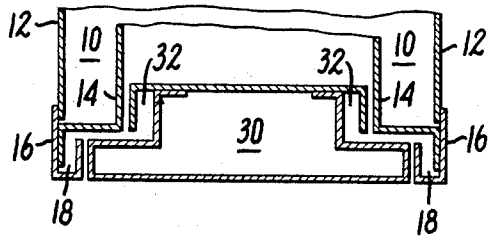


FIG. 3

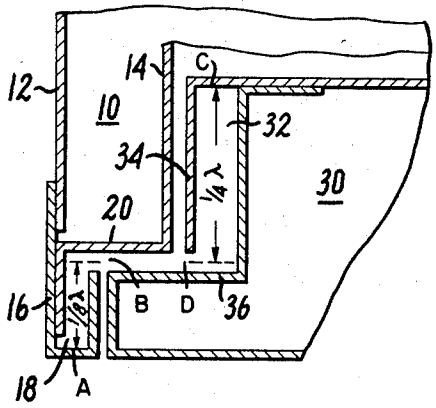


FIG. 4

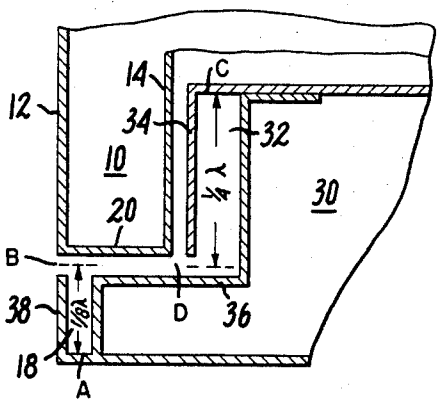
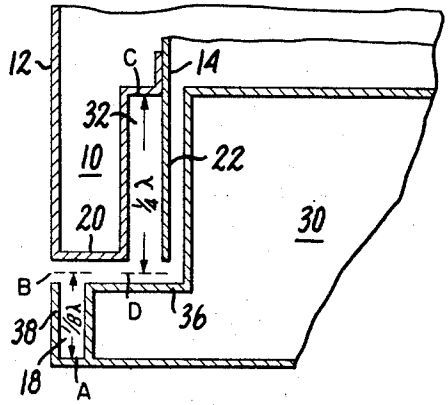


FIG. 5



MICROWAVE SEAL FOR ELECTRONIC RANGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to microwave seals for electronic ranges.

2. Description of the Prior Art

The so-called electronic range for heating and cooking foods or the like through the use of high frequency electromagnetic energy is generally provided with a clearance between the range main body and the door and various kinds of sealing means are provided in the clearance for sealing the microwave energy generated from a magnetron disposed in the range. One of the most widely used sealing means is the choke coupling type sealing device. This is because a relatively high sealing effect can be obtained, and, since no mechanical contact is employed, free from the fear of deterioration due to the secular change of the sealing means. The conventional microwave seal of the choke coupling type for electronic ranges has comprised a range main body for accommodating the food to be heated and a door for obtaining easy access to the food, the clearance between the main body and the door being provided with a microwave cavity, thereby to decrease the microwave energy which is to leak from that clearance.

This arrangement, however, has been disadvantageous in that the microwave seal employed therein is effective only for a basic frequency component of the microwave energy generated from the magnetron incorporated in the range and quite useless for the high frequency component of the generated microwave energy. More specifically, the conventional seal of the choke coupling type has comprised a microwave cavity having a depth equal to one fourth of the wavelength of the basic frequency wave alone. Therefore, with the conventional sealing device, the microwave sealing effect can be expected only in terms of the basic frequency wave energy, while the second harmonic frequency component can not at all be expected to be sealed. This is because, since the second harmonic frequency component of the microwave energy has a wavelength one-half the basic wavelength, the impedance thereof is at its minimum at the clearance between the range main body and the door.

The magnetrons generally used in the electronic range, however, radiate the required electromagnetic wave energy having a frequency of, for example, 2,450 MHz together with its harmonic frequency components, in particular, relatively large amount of second harmonic frequency component. Although the amount of the second harmonic frequency energy escaping from the clearance is not so high as to cause undesirable effect to the human body, the wireless communication network utilizing the frequency band corresponding to the second harmonic frequency has been often caused to have a serious radio wave trouble.

Accordingly, an object of the invention is to provide a new and improved microwave seal for use in electronic ranges eliminating the above mentioned disadvantages of the conventional device.

Another object of the invention is to provide a microwave seal for use in electronic ranges and which is simple in construction and still effective for sealing not only the basic frequency component of the microwave energy but also the harmonic frequency component.

Further object of the invention is to provide a microwave seal for electronic ranges capable of being easily constructed by utilizing an ornamental frame provided around the front face of the range.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a microwave seal for an electronic range comprising a microwave seal means and a microwave cavity having a depth equal to one-eighth of the wavelength of a basic frequency component of the employed microwave energy to prevent a second harmonic frequency component of the microwave energy from leaking from the electronic range main body.

The invention also provides a microwave seal for sealing the microwave energy radiated from the electromagnetic wave oscillator disposed in the electronic range, comprising a first microwave cavity having a depth equal to one-fourth of a wavelength of a basic frequency component of said microwave energy to prevent the basic frequency component of said microwave energy from leaking from said electronic range, and a second microwave cavity having a depth equal to one-eighth of the wavelength of said basic frequency component of said microwave energy to prevent a second harmonic frequency component of said microwave energy from leaking from the electronic range, said first and second microwave cavities being formed to communicate with a clearance formed between said electronic range main body and said door when the door is closed.

BRIEF DESCRIPTION OF THE DRAWING

The invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawing in which:

FIG. **1** is a front view of an electronic range to which the microwave seal constructed in accordance with the present invention can be applied;

FIG. **2** is a fragmental sectional view useful for explaining the invention;

FIG. **3** is an enlarged fragmental sectional view showing one portion of FIG. **2**;

FIGS. **4** and **5** are fragmental sectional views similar to FIG. **3** but showing modifications of the invention.

Throughout the several FIGS. the like reference characters designate the identical or corresponding components.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing and in particular to FIG. **1** thereof, it is seen that an electronic range to which the present invention can be applied comprises an electronic range main body generally designated by the reference numeral **10** and a door generally designated by the reference numeral **30**. The illustrated electronic range is of the conventional design except for having the microwave seal of the present invention which will hereinafter be described in detail.

FIGS. **2** and **3** show a fragmental section of the front portion of the electronic range main body **10** and the door **30** at their closed position as viewed from the top thereof. In these Figures, it is seen that the range main body **10** comprises a housing **12** enclosing a heating compartment **14** for accomodating and heating the food to be heated or cooked. It is to be understood that a microwave oscillator such as a magnetron for radiating microwave energy having a given fundamental frequency is disposed in the heating compartment **14**, although it is not illustrated. The door **30** capable of opening and closing the heating compartment **14** is provided on the front portion of the range main body **10** for the purpose of providing an easy access of the interior of the electronic range.

At that front portion of the main body **10** close to and encircling the door **30** is formed a rectangular ornamental frame **16** made of any suitable metallic material and having substantially U-shaped rectangular channel configuration which serves as a microwave cavity **18**. One of the legs of the U of the ornamental frame **16** is elongated to be fixedly attached to the outer surface of the housing **12** to form the microwave cavity **18** open at that side close to the periphery of the door **30**. The microwave cavity **18** thus formed has a depth or length equal to one-eighth of the wavelength of the basic frequency component of the microwave energy as shown in FIG. **3**. Since the end wall A of the microwave cavity **18** is positioned at the distance equal to one-eighth of the basic wavelength of the microwave energy as measured from the

center (illustrated by a dash line in FIG. 3) of a gap B formed between the shorter leg of the U of the frame **16** and a wall **20** of the electronic range main body **10** defining the other end of the microwave cavity **18**, the point at which the basic frequency electromagnetic wave energy exhibits its maximum impedance comes at the gap B formed between an end of the shorter leg of the U and the opposing portion of the wall **20**.

Similarly, the door **30** which is adapted to fit to the front portion of the range main body **10** with a predetermined clearance therebetween has another microwave cavity **32** defined by an extension **34** and a side wall of the door **30** and having a depth or length equal to one-fourth of the basic wavelength of the microwave energy as measured from the center of a gap D formed between the extension **34** and a wall **36** of the door **30** defining the other end thereof as illustrated in FIG. **3**. It is easily understood that the maximum impedance point of the microwave energy reflected at an end wall C of the cavity **32** is located at the gap D forming an entrance of the cavity **32** for the microwave energy.

With the arrangement as above described, one part of the microwave energy generated from the magnetron mounted inside the heating compartment **14** travels through the clearance formed between the main body **10** and the door **30** to enter into the first microwave cavity **32** formed in the door **30**. The basic frequency component of the microwave energy is choked at the gap D because of the gap D is the maximum impedance point with respect to the basic frequency component. However, at the gap D, the second harmonic frequency component of the microwave is at its minimum in impedance because the distance between the end wall C and the center of the gap D equals one-half of the wavelength of the second harmonic frequency component. This allows the second harmonic frequency component of the microwave energy to leak from that gap D.

According to the invention, however, since the electronic range further comprises the second microwave cavity **18** having the depth equal to one-eighth of the basic wavelength of the microwave energy, the second harmonic frequency component leaked from the gap D is captured by the second microwave cavity **18** and choked at the gap B. This is because the center of the gap B is located at the distance equal to one-eighth of the basic wavelength from the end wall A of the second microwave cavity **18** so that the maximum impedance point of the second harmonic frequency component falls on this gap B.

From the foregoing description, it is easily understood that, according to the present invention, not only the microwave energy of the basic frequency, but also the electromagnetic wave energy of the second harmonic frequency generated from the magnetron are prevented from leaking from the clearance between the range main body and the door.

Also, since the ornamental frame encircling the front face of the electronic range is utilized as a member for forming a microwave cavity, the microwave sealing effect can be obtained with a simple construction without any additional component.

FIG. **4** shows another embodiment of the invention wherein the second microwave cavity **18** of FIG. **3** is formed on the edge portion of the door **30** instead of on the range main body **10**. As seen from FIG. **4**, the second microwave cavity **18** is defined by an extension **38** of a substantially L-shaped cross section member projecting from the front face of the door **30**. In other respects, the microwave seal illustrated in FIG. **4** is of the identical construction to that shown in FIG. **3**.

FIG. **5** shows still another embodiment of the invention wherein the first microwave cavity **32** which corresponds to that illustrated in FIG. **4** is modified. FIG. **5** shows that the first microwave cavity **32** is formed on the edge portion of the opening of the range main body **10** instead of on the door **30**. The first microwave cavity **32** is defined by a reduced portion formed on that portion of the main body **10** facing to the side wall of the door **30** and an elongated member **22** projecting from the inner wall of the heating compartment **14**. In other respects, the seal is of the identical design to that illustrated in FIG. **4**.

From the foregoing description, it is easily understood that the operations of the microwave seals illustrated in FIGS. **4** and **5** are quite identical to that of the device previously described in conjunction with FIGS. **1** to **3**.

As has been heretofore described, the invention provides a microwave seal for electronic ranges effective not only for the basic frequency component of the microwave energy, but also for the second harmonic frequency component of the microwave energy with a simple and compact construction.

Although the invention has been described only in terms of a few modifications, it is to be understood that the various modifications can also be performed without departing from the spirits of the invention.

What I claim is:

1. In a microwave oven: a heating compartment having means therein defining an access opening; an end wall encircling said access opening; a movably mounted door movable to effect opening and closing of said access opening; a microwave energy oscillator for radiating microwave energy having a given fundamental frequency into said heating compartment; means defining a first clearance between a portion of said heating compartment and the opposed adjacent portion of said door; means defining a second clearance between said end wall and the opposed adjacent portion of said door; and a microwave energy seal comprising means defining a first microwave cavity in communication with said first clearance and having a length equal to one-fourth of the wavelength of said fundamental frequency of the microwave energy thereby presenting a sufficiently high impedance to choke the fundamental frequency component of said microwave energy, and means defining a second microwave cavity in communication with said second clearance and having a length equal to one-eighth of the wavelength of said fundamental frequency of the microwave energy thereby presenting a sufficiently high impedance to choke the second harmonic frequency component of said microwave energy; whereby said microwave oven is sealed against microwave energy leakage.

2. A microwave oven according to claim **1**; wherein said means defining a second microwave cavity comprises an ornamental frame member connected to said end wall and having a configuration defining said second microwave cavity.

3. A microwave oven according to claim **1**; wherein said means defining a second microwave cavity comprises an ornamental frame member attached to said door in opposed spaced-apart relationship therewith and defining therebetween said second microwave cavity.

4. A microwave oven according to claim **1**; wherein said first clearance, second clearance, first microwave cavity and second microwave cavity are all disposed adjacent one side of said door; and means defining a similar arrangement of clearances and microwave cavities adjacent the other side of said door.

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