Feb. 14, 1967 G. B. LONG 3,304,401

MICROWAVE OVEN DOOR CLOSURE

Filed Aug. 28, 1964 2 Sheets-Sheet 1

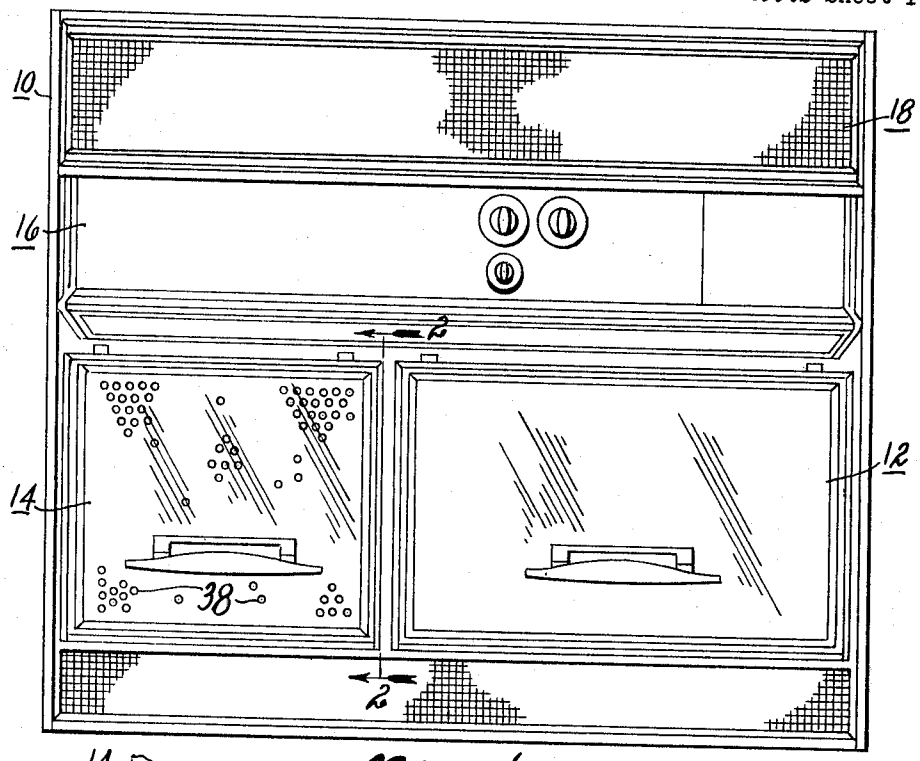

Fig. 1

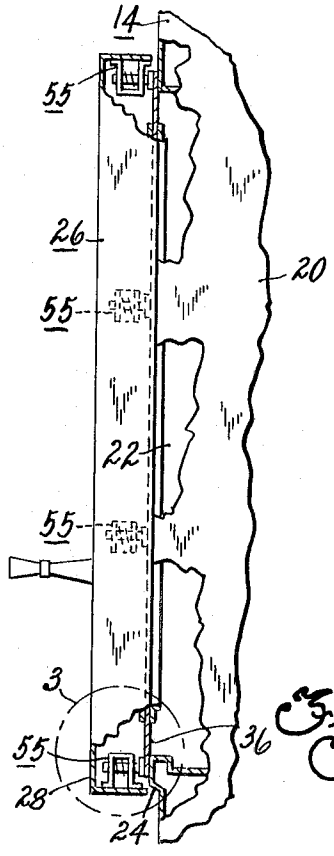

Fig. 2

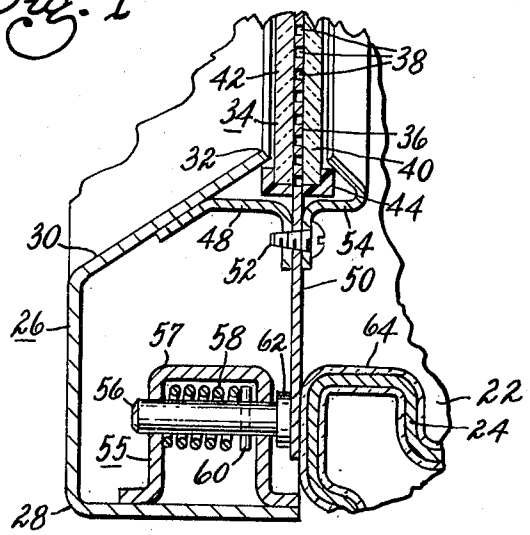

Fig. 3

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MICROWAVE OVEN DOOR CLOSURE

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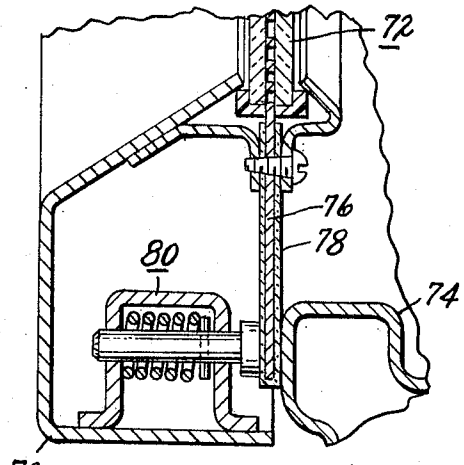

Fig. 4

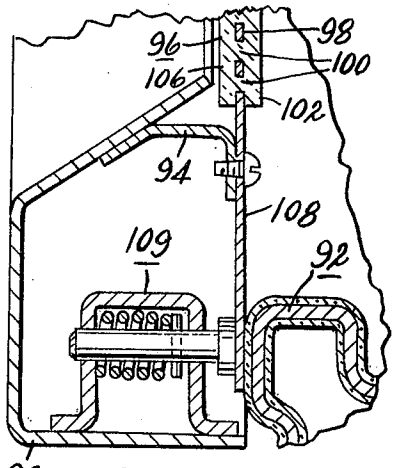

Fig. 5

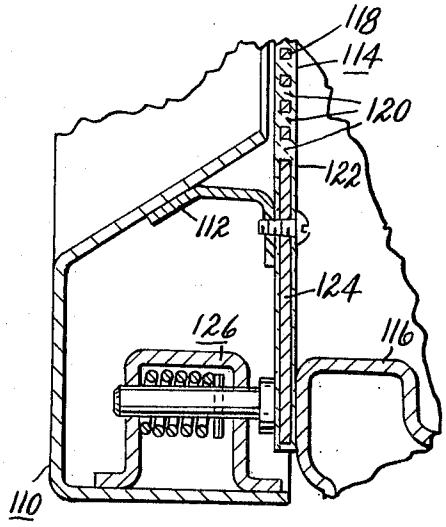

Fig. 6

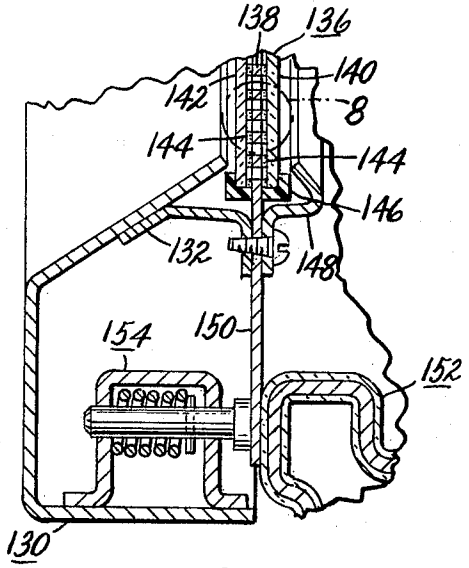

Fig. 7

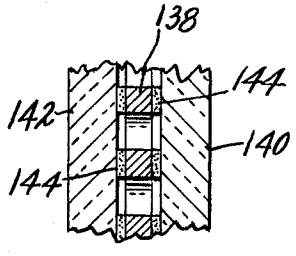

Fig. 8

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United States Patent Office 3,304,401
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3,304,401

MICROWAVE OVEN DOOR CLOSURE

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9 Claims. (Cl. 219—10.55)

This invention relates to electronic cooking apparatus and more particularly to see-through door closure assemblies for association with microwave oven assemblies.

In microwave ovens, in addition to treating foodstuffs or the like by means of a microwave pattern generated by a source of microwave energy, it is desirable to include a source of radiant heat energy in the oven structure for effecting baking and broiling steps. In the case of microwave ovens having such combined food treating capacity, it is desirable to provide a door closure assembly that includes means for shielding against the escape of hot vapors and splashed greases or the like from the oven cavity while including means to effect a suitable shield against the escape of microwave energy from interiorly of the oven. See-through microwave door closures are often disclosed such as that set forth in United States Patent No. 2,958,754 to Hahn, issued November 1, 1960. While these doors are suitable for their intended purpose, they often are unsuitable for use in ovens having the combined cooking capabilities mentioned above and, more importantly, often are very expensive to manufacture.

An object of the present invention, therefore, is to improve microwave ovens of the type including both microwave energy and radiant energy heating sources by the provision therein of a door closure assembly including a see-through window portion including a thin perforated metal core for shielding against the escape of microwave energy from the oven interior, transparent imperforate surfaces on either face of the core for shielding against the escape of vapors and splashed greases and means for sealing against the penetration of vapor between the core and the imperforate surfaces on either face of the core and wherein the core or shield member includes an imperforate flange that overlies a collar on the oven structure defining the opening thereto whereby when the door is closed the flange portion of the core will engage the collar to prevent leakage of microwave energy from the interior of the oven around the outer edge of the door closure assembly.

A further object of the present invention is to simplify see-through microwave oven door closures by the provision of a laminated see-through window having a thin perforated metal core and imperforate transparent surfaces on either side thereof with the perforated metal core having an imperforate flange directed outwardly of the window structure to overlie a continuous flange on the microwave oven liner defining the opening therein with the closure further including a layer of porcelain on one of the flange members that sealingly engages the other of the flange members to prevent any substantial leakage of hot vapors or splashing of grease from the oven while also serving as a microwave shield and further serving as a means for economically reducing microwave arcing between the oven liner and its door closure.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein

preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a view in front elevation of an electronic oven including the improved door closure structure of the present invention;

FIGURE 2 is an enlarged view in vertical section, partially broken away, taken along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged, fragmentary view in vertical section of the area 3 in FIGURE 2;

FIGURE 4 is an enlarged, fragmentary view in vertical section like FIGURE 3 showing another embodiment of the invention;

FIGURE 5 is an enlarged, fragmentary view in vertical section like FIGURE 3 of another embodiment of the invention;

FIGURE 6 is an enlarged, fragmentary view in vertical section like FIGURE 3 of still another embodiment of the invention;

FIGURE 7 is an enlarged, fragmentary view in vertical section like FIGURE 3 of still another embodiment of the present invention; and

FIGURE 8 is an enlarged view in vertical section of the area 8 in FIGURE 7.

Referring now to the drawings, in FIGURE 1, a built-in type cooking appliance **10** is illustrated including side-by-side ovens **12** and **14** having a control panel **16** located above that extends completely across the width of the appliance **10** and above the panel **16** is a vent opening **18**.

In the illustrated arrangement the oven **14** is a microwave oven assembly of the type including a microwave generator unit or magnetron for microwave cooking and a suitable source of radiant energy such as an electrical resistance element that serves to produce baking and broiling effects within the oven cavity. The details of the oven **14** including the energy sources therein are more specifically set forth in copending United States application, Serial No. 360,980, of Homer W. Deaton, filed April 20, 1964, with it being understood that the oven illustrated in the copending application is merely representative of a typical microwave oven having such dual energy sources therein for cooking that is improved by the door closure of the present invention.

In combination microwave ovens of the Deaton type, it is necessary to shield against microwave emissions from the oven cavity and it is also desirable to include a barrier between the oven opening and the exterior of the oven that blocks the escape of hot vapors, grease splatter and the like exteriorly of the oven cavity.

In accordance with certain of the concepts of the present invention, as illustrated in FIGURE 2, the oven **14** includes an oven liner **20** that forms a cavity **22** having an access opening thereto formed by a continuous flange member or collar **24** that makes up a part of the liner **20**.

In the embodiment of the invention illustrated by FIGURES 2 and 3, the access opening formed by the flange or collar **24** is closed by means of an improved see-through door assembly **26** including a continuous peripheral frame **28** having an inwardly inclined lip **30** that forms a door opening **32** having a planar extent substantially continuous with the planar extent of the access opening formed by the collar **24**. The opening **32** is covered by an improved see-through window structure

34 that is constructed in accordance with certain of the principles of the present invention to include a centrally located, thin metal core 36 approximately .010 inch to .020 inch thick that includes a perforated region substantially throughout the planar extent of the opening 32, for example, formed by a plurality of openings 38 having a 3/16 inch diameter on 1/4 inch centers. Such openings serve as a means for permitting a substantial visual examination of foodstuffs being cooked within the oven cavity 22 while blocking the escape of microwave energy therefrom exteriorly of the appliance 10. As best seen in FIGURE 3, the thin, perforated metal core 36 has its inner surface covered by a transparent imperforate layer 40 and the outer surface likewise is covered by a transparent imperforate layer 42 of plastic, Pyrex, glass or other like suitable material. By virtue of this arrangement, the layers 40, 42 serve as a shield against the escape of hot vapors and splashed greases from the oven cavity 22 and, moreover, they permit quick cleaning of the window structure 34. Additionally, the combination of the transparent layers 40, 42 and the perforated core 36 serves to produce an adequate see-through structure for visual observation of items being cooked.

Another feature of the improved door structure 26 is that the exposed peripheral edge of the transparent layers 40, 42 at the thin microwave barrier or core 36 is enclosed by a continuous channel-shaped sealing element 44 of a suitable flexible resilient material, for example, a natural or synthetic rubber such as neoprene which serves to prevent the entrance of vapor across the interface between the transparent layers 40, 42 and the thin microwave core 36. By virtue of this arrangement, any tendency for separation of the transparent layers 40, 42 from the microwave barrier is substantially eliminated.

In the illustrated arrangement, the window assembly 34 is representatively illustrated as being supported from the lip 30 of the peripheral frame 28 by means of a bracket 48 that has one end fixedly secured to the lip 30 and the other end thereof depending therefrom to have a surface thereon in juxtaposition with an outwardly directed, imperforate flange 50 on the thin microwave core 36. A suitable fastening means, for example, a screw 52 may secure the flange 50 to the bracket 48 for holding the window assembly 34 in place across the frame opening 32.

The screw 52 in the illustrated embodiment of the invention further serves to connect a convoluted member 54 to the imperforate flange 50 so that the continuous, flexible, resilient sealing element 44 is covered by an imperforate metal layer to prevent microwave energy in the oven cavity 22 from acting on the sealing element 44 so as to adversely affect its resiliently sealing characteristics.

The imperforate core flange 50 extends from the openings 32 so as to overlie the outwardly facing surface of the liner flange or collar 24. The flange 50 has a substantial flexibility so that when the door 26 is closed, it will naturally have a tendency to lie in close juxtaposition relationship with the outer surface of the collar 24. To improve the contact between the flexible flange 50 and the outer surface of the collar 24, suitable spring biasing assemblies 55 are provided to further force the flange 50 against the collar 24. More specifically, the assemblies 55 are located at spaced points around the frame 28 and each includes a plunger element 56 slidably mounted in a channel-shaped bracket member 57 secured to frame 28 whereby a coil spring element 58 in surrounding relationship with the plunger 56 within the channel-shaped support 57 will act on a pin 60 through the plunger 56 to bias a head portion 62 on the plunger 56 against the outer surface of the flange 50 so that it will be held firmly against the collar 24. The biasing action of the flange 50 against the collar or flange 24 effects an unusually good seal against the escape of microwave energy at the outer periphery of the door assembly 26. Preferably, in practicing the present invention, the flange of collar 24 should include a coating 64 of a porcelain enamel of the grade used for oven liners. The smooth surface of the enamel coating 64, in combination with the extremely flexible integral extension or flange 50 from the microwave core 36, enhances the microwave sealing characteristics at the outer periphery of the door 26 and, moreover, serves as a means or attenuating the voltage across the microwave shield or barrier 36 to thereby reduce the tendency for microwave arcing between the oven liner 20 and the door closure assembly 26.

The embodiment of the invention illustrated in FIGURE 4 is substantially like that of FIGURE 3 in that a peripheral door frame 70 like frame 28 supports a window assembly 72 like assembly 34 to close an access opening to an oven enclosure formed by a collar or oven liner flange member 74. In this embodiment, the centrally located microwave core has an imperforate, thin, flexible flange 76 directed outwardly of the door frame opening similar to the flange 50 in FIGURE 3, but in this arrangement, the collar 74 is a continuation of a bare metal oven liner and the flange 76 is coated with a layer of porcelain 78 like the layer of poreclain 64 in the embodiment of FIGURE 3 whereby a spring biasing assembly 80 like that in FIGURE 3 will act to bias the porcelain coated flange 76 against the bare metal collar 74 to effect a microwave seal and arc proof assembly substantially equivalent to that of FIGURE 3.

In the embodiment of FIGURE 6, a door frame member 110 including a support bracket 112 serves to support another improved see-through window assembly 114 that serves both to block the escape of microwave energy, hot vapors and grease or the like from the oven enclosure through the door opening while serving as a means in cooperation with a bare metal oven liner flange or collar 116 to prevent leakage of microwave energy between the door and the collar and also to reduce or eliminate arcing therebetween.

The window assembly 114 in this embodiment includes a centrally located microwave barrier core 118 having openings 120 therein like the openings 38 in the embodiment of FIGURE 3. In this arrangement, the shield 118 is coated by a very thin layer of plastic material 122, for example, a transparent epoxy resin, over all of the surface thereof including an outwardly directed, imperforate flange portion 124 thereof. The very thin coating or envelope 122 of plastic material fills the perforations 120 and is of a minimum thickness so as not to materially affect the substantial flexibility of the metal core 118. The provision of the thin plastic coating 122 over the imperforate flange 124 serves to introduce a voltage attenuating media between the core flange 124 and the liner collar or flange 116. Since the core flexibility is maintained, a good microwave seal is effected between the flange 124 and the collar 116 and the provision of the thin plastic layer 122 at the interface between the flange 124 and the collar 116 effects the desired arc proofing found in the earlier embodiments. In this embodiment, like in the earlier embodiments, a spring biasing assembly 126 additionally may be provided to assure good sealing contact between the door and oven liner flange members.

In the embodiment of FIGURE 7, a door frame member 130 is provided including a bracket 132 for supporting a window assembly 136 on the door to block the opening therethrough. In this embodiment, the window structure 136 includes a microwave barrier or core 138 like the barrier 36 of the first embodiment. A suitable transparent, imperforate shield 140 is located in juxtaposition with the inner face of the core 138 and a like imperforate, transparent shield 142 is located on the opposite face and as illustrated in FIGURE 8, each of the shield surfaces 140, 142 is cemented or otherwise adhered to the core 138 by a thin layer of a suitable adhesive material 144 that coats the outer faces of the core 138.

In order to prevent the entrance of hot vapors across the interface between the shields **140, 142** and core **138**, a continuous, channel-shaped, flexible, resilient seal member **146** is arranged to seal the exposed edges of the surfaces **140, 142** of the window arrangement **136**. A convoluted, continuous seal protector **148** on bracket **132** covers the seal **146** against damaging microwave exposure. In this arrangement, like the others, an imperforate metal outwardly directed flange **150** extends from the core **138** to overlie a porcelainized liner collar **152** to be spring biased thereagainst by a spring biasing assembly **154**.

While the embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a microwave oven assembly having a microwave generator, the combination of, a liner forming an oven cavity, said liner including a continuous flange forming an opening into said cavity, a continuous peripheral frame member forming a door opening, a see-through window assembly blocking said opening including a flat perforated metal core for blocking microwave energy, an imperforate sheet of transparent material in juxtaposition with each face of said perforated metal core, means for preventing penetration of vapor between said core and said sheets, said core including an imperforate flexible flange directed outwardly of said door opening to overlie said liner flange, said flexible core flange biasingly engaging said liner flange when the door is closed to prevent microwave leakage around the periphery of the door, and a coating of voltage attenuating material on one of said flanges serving to prevent microwave arcing at the juncture between the oven liner and the door closure.

2. In a microwave oven assembly having a microwave generator, the combination of, a liner forming an oven cavity, said liner including a continuous flange forming an opening into said cavity, a continuous peripheral frame member forming a door opening, a see-through window assembly blocking said opening including a flat perforated metal core for blocking microwave energy, an imperforate sheet of transparent material in juxtaposition with each face of said perforated metal core, a flexible continuous channel-shaped sealing member of resilient organic material enclosing the edges of said jutxapositioned transparent sheets adjacent said perforated metal core for preventing penetration of vapor between said sheets and core, an imperforate metal shield interposed between said sealing member and said oven cavity for preventing microwave deterioration of said sealing element, said core including an imperforate flexible flange directed outwardly of said door opening to overlie said liner flange, said flexible core flange biasingly engaging said liner flange when the door is closed to prevent microwave leakage around the periphery of the door, and a coating of voltage attenuating material on one of said flanges serving to prevent microwave arcing at the juncture between the oven liner and the oven opening door closure members.

3. In the combination of claim **2**, said voltage attenuating material consisting of a coat of porcelain material.

4. In a microwave oven structure having a microwave generator, the combination of, a microwave cavity enclosure having a porcelainized liner including a continuous collar portion forming an opening to the microwave cavity region, a continuous peripheral door frame member forming a central door opening overlying said microwave cavity opening, a see-through shield structure for preventing the escape of microwave energy and hot vapors from the microwave cavity region including a flat thin metal core having a perforated central region substantially completely overlying the planar extent of said door opening for blocking the escape of microwave energy therethrough, a transparent imperforate sheet in juxtaposition with each face of said thin perforated metal core, means for bonding said transparent sheets to said metallic barrier, a continuous resilient channel-shaped

flexible sealing member enclosing the edge portions of said transparent sheets of material at said core for preventing vapor penetration across the interfaces therebetween, said metal core having an outwardly directed imperforate flange portion extending to overlie said continuous porcelainized collar and sealingly engaging said collar when said door structure is closed to substantially eliminate convective interchange between said microwave cavity region and the environment surrounding the microwave oven, said imperforate flange in conjunction with said porcelainized collar further serving to effectively eliminate microwave arcing between the oven enclosure and said door frame member while preventing leakage of microwave energy exteriorly of said oven cavity around the periphery of the door.

5. In a microwave oven assembly having a microwave generator, the combination of, a microwave cavity forming enclosure including a continuous flange for forming an opening to said cavity region, a door for closing said collar-formed opening including a continuously formed peripheral frame member defining an opening centrally of said door that overlies the opening to the oven cavity, an imperforate see-through assembly for closing said door opening to prevent leakage of vapors, fumes and microwave energy exteriorly of said cavity region including a flat perforated metal core formed substantially continuously throughout the planar extent of said door opening for blocking microwave energy, a transparent imperforate surface on each face of said core to prevent leakage of vapor and fumes from the oven cavity, said metal core including an imperforate outwardly directed flange extending to overlie said oven enclosure collar for biasingly engaging said collar to prevent leakage of microwave energy between said door frame member and said oven enclosure when the door is closed, and voltage attenuating means on one of said flange members forming a smooth vapor sealing surface therebetween and for reducing microwave arcing between the oven enclosure and the door closure.

6. In the combination of claim **5**, said see-through assembly including a continuous flexible channel-shaped sealing member of resilient organic material enclosing the exposed edges of said assembly to prevent vapor penetration across the interfaces between said core and imperforate surfaces, and means including an imperforate metal member interposed between said sealing strip and said oven cavity for preventing microwave deterioration of said sealing member.

7. In the combination of claim **5**, said metal core being integrally molded with said imperforate transparent surfaces for preventing vapor penetration between said core and said surfaces.

8. In the combination of claim **5**, said metal core including the imperforate flange thereon being coated by a plastic envelope to form said imperforate transparent surfaces, said plastic envelope on said metal core flange serving as said voltage attenuating means to reduce microwave arcing between said oven enclosure and said door.

9. In a microwave oven assembly having a microwave generator, the combination of, a microwave cavity forming enclosure including a continuous flange for forming an opening to said cavity region, a door for closing said collar-formed opening including a continuously formed peripheral frame member defining an opening centrally of said door that overlies the opening to the oven cavity, an imperforate see-through assembly for closing said door opening to prevent leakage of vapors, fumes and microwave energy exteriorly of said cavity region including a flat perforated metal core formed substantially continuously throughout the planar extent of said door opening for blocking microwave energy, a transparent imperforate surface on each face of said core to prevent leakage of vapor and fumes from the oven cavity, said metal core

including an imperforate outwardly directed flange extending to overlie said oven enclosure collar for engaging said collar to prevent leakage of microwave energy between said door frame member and said oven enclosure, a porcelain layer on one of said flange members for forming a smooth sealing surface therebetween and for reducing microwave arcing between the oven enclosure and the door closure.

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