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SPIRAL ANTENNA FOR ELECTRONIC OVEN

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Fig. 1.

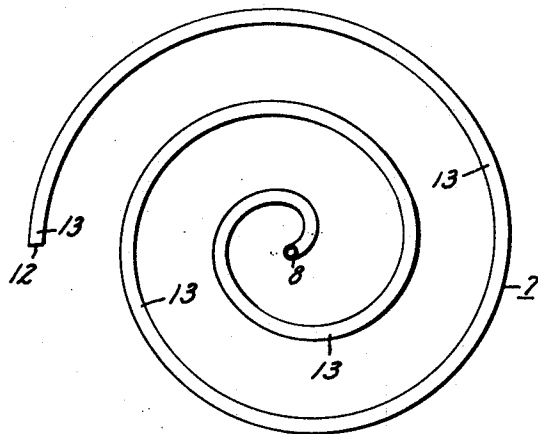
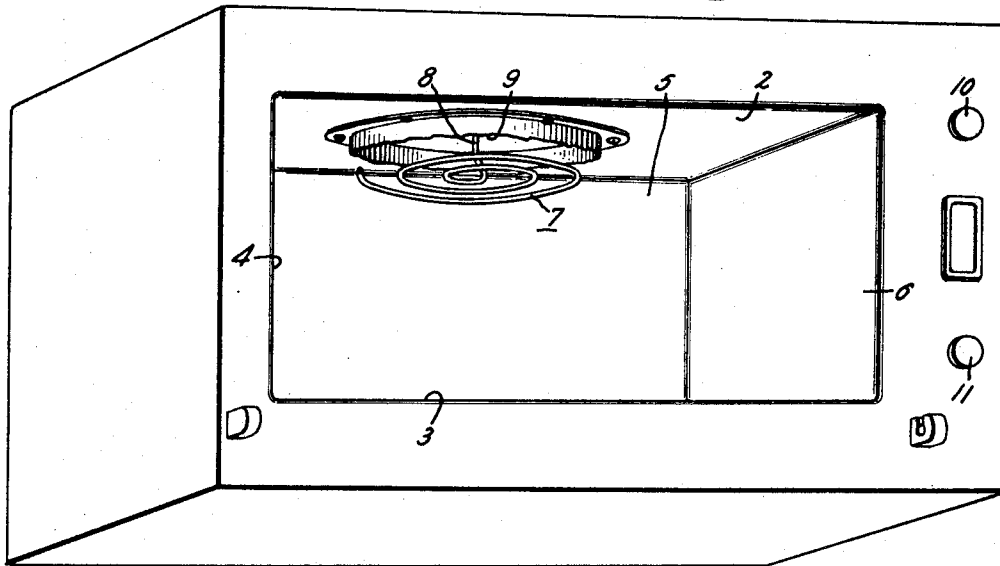


Fig. 2.

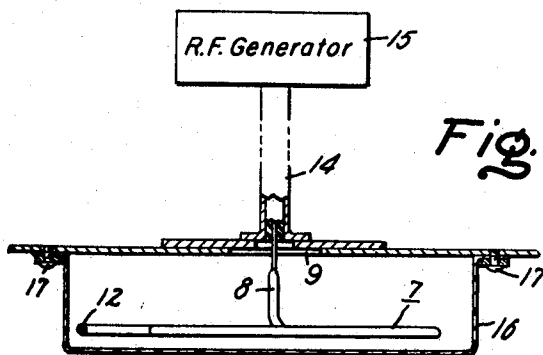


Fig. 3.

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SPIRAL ANTENNA FOR ELECTRONIC OVEN
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5 Claims

ABSTRACT OF THE DISCLOSURE

The antenna for an electronic oven used for microwave cooking is formed as a spiral of coplanar turns having a length of from two to three wavelengths at the operating frequency of the oven and is located near the top of the oven, a high frequency connection being made to the center of the spiral.

Our invention relates to electronic ovens of the type used for microwave cooking, and in particular to an antenna for use in such ovens.

One of the difficult problems associated with home electronic cooking is attaining a field distribution within the oven which results in uniform cooking. Some such ovens have employed the oven itself as a resonant box, the box being excited by either a loop near an outside wall or by a vertical probe near the center of the top wall. Such systems operating in the fundamental mode or one of low order have been found to be restrictive of the physical size load that could be handled in the oven. They have also found that there is a wide variation of the resonant frequency of the system because of the effect of the food load.

Other systems have attempted to overcome the difficulties and objections of the resonant box-type of oven by storing more energy in the antenna itself and less energy in the oven box. One such effort employed a resonant disk antenna approximately one-half wavelength in diameter and spaced near the upper wall of the oven. However, it was found that the electric field lines in this system were between the disk and the upper wall of the oven and a lesser amount fringed downward into the main portion of the oven. While the system, as a result, was found to cause less variation in the frequency and could be loaded easily with typical food portions, the food itself would cook more rapidly around the perimeter because of a dearth in fields in the center of the oven.

It is a primary object of our invention to provide an easily fabricated antenna for an electronic oven that has a high degree of frequency stability.

It is another object of our invention to provide an antenna for an electronic oven that provides tight coupling to typical cooking loads at almost any location within the oven.

A still further object of our invention is to provide an easily fabricated antenna for an electronic oven in which the resonant frequency of the antenna is not materially affected by the moisture content or position of the food in the oven.

In its broadest aspect, our invention consists in providing a spirally-wound antenna for an electronic oven, the antenna having a length of between two and three wavelengths at the frequency of the microwave energy supplied to the oven. The antenna is positioned adjacent the upper surface of the oven and has a centrally located input connection which extends through the upper wall of the oven to result in storing more energy in the antenna and less in the oven itself and provide improved frequency stability for the electronic oven.

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The subject matter which we regard as our invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, both as to its organization and method of operation, together with additional advantages and objects may best be understood by referring to the following description taken in connection with the accompanying drawings wherein like reference characters refer to like elements and in which:

FIGURE 1 is a perspective view of an electronic oven employing the antenna of our invention;

FIGURE 2 is a plan view of an antenna employed in the oven of FIGURE 1; and

FIGURE 3 illustrates a modification of the antenna of FIGURE 1 together with the high-frequency connections to the antenna.

In FIGURE 1, the oven 1 is illustrated as comprising a top surface or wall 2, a bottom wall 3, and side walls 4, 5, and 6. A front door (not shown) completes the enclosure. The structure of the oven 1 is that conventionally used but does not require thermal insulation for the various walls. Positioned within the oven is an antenna 7 of our invention located near the lower surface of upper wall 2.

As shown in FIGURE 2, the antenna 7 is formed as a spiral of substantially coplanar turns and has a centrally-located input terminal 8 which extends through an opening 9 in the top wall 2 of oven 1 and is connected to a source of high-frequency energy (not shown). Such a source is that conventionally employed in electronic ovens and its operation is controlled by knobs 10, 11.

In accordance with our invention, we have found that when the length of the spiral antenna is between two wavelengths and three wavelengths at the operating frequency of the oven, more energy is stored in the antenna and less in the oven itself, so that improved frequency stability of the electronic oven results. The turns of the spiral antenna 7 are substantially equally spaced from the center lead 8 and the outer end 12 is left unterminated. The turns are substantially coplanar and are positioned in the oven at a point which is about 20 percent of the distance between the upper surface 2 and lower surface 3 of the oven. We have found that with this spacing a spiral antenna which is two and one-half wavelengths long gives particularly good uniform coupling of the energy to the food despite its position within the oven. We have found that for the antenna, copper tubing 1/8 inch in diameter serves excellently as an antenna. The points 13 on the antenna of FIGURE 2 indicate regions of high electric field in such a structure.

In the modification of our antenna structure shown in FIGURE 3, antenna 7 is connected by a length 14 of a 50-ohm matching cable to a high-frequency generator 15. In order to prevent the possibility of any moisture gathering around the connection, we provide a thermoplastic shield 16 around the entire antenna structure. Shield 16 is secured to upper wall 2 by means of a plurality of screws 17.

In the operation of an electronic oven employing our improved antenna, the spiral antenna provides both electric and magnetic fields within the oven. This combined effect with our spiral antenna provides an excellent frequency stability since the cooking load placed within the oven produces little counteracting frequency disturbance upon the two fields of such an antenna with the result that very little frequency change is observed. Also, because of the distributive nature of the fields from the spiral antenna, the energy distribution within the oven is quite uniform so that the position of the cooking load within the oven is not critical. We have found that a substantial frequency response and match is obtained even though the food is placed within the oven at various locations. Further, we have found that a spiral antenna of

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two and one-half wavelengths is particularly effective in this regard, although with a length of two wavelengths, very little change in matching or resonant frequency is observed for different positions of the food.

In coupling the radio frequency generator 15 to the antenna, we make the connections at the connecting cable 14 as short as possible. By so doing, spurious operating modes are effectively subdued and the overall performance is remarkably stable.

While we have shown and described preferred embodiments of our invention, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from our invention in its broader aspects and we, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In an electronic range having an oven having opposed top and bottom surfaces and interconnecting side wall surfaces and a source of high frequency energy the improvement which comprises a spirally wound antenna comprising a plurality of substantially coplanar turns supported in juxtaposed relation with said top surface, said antenna having a length between two and three wavelengths of high frequency waves from said source, said antenna having a centrally positioned terminal connected to said source.

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2. The range of claim 1 in which the length of said antenna is two and one-half wavelengths.

3. The range of claim 1 in which the length of said antenna is two wavelengths.

4. The range of claim 1 in which the distance between the antenna and said bottom surface is approximately four times the distance between the antenna and said top surface.

5. The range of claim 4 in which the top surface has an aperture, said centrally positioned terminal is positioned below said aperture and a load matching cable is connected to said terminal and passes through said aperture.

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