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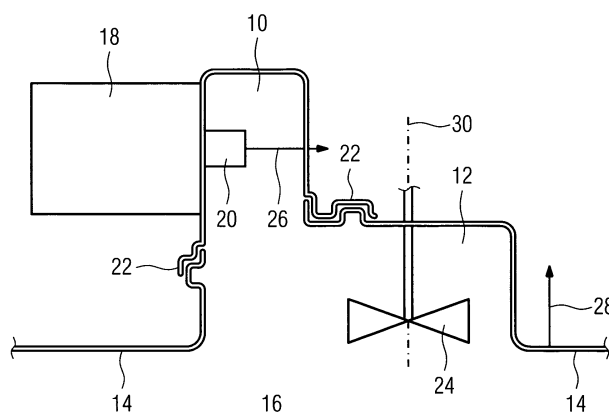
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(54) **A microwave oven with a feed box system**

(57) The present invention relates to a microwave oven with a feed box system. The feed box system includes a primary feed box (10) and a secondary feed box (12). The primary feed box (10) and the secondary feed box (12) are arranged one upon the other at a cavity wall (14) of an oven cavity (16). The circumference of the primary feed box (10) is smaller than the circumference of the secondary feed box (12). The secondary feed box (12) and at least that cavity wall (14), at which the feed

box system is arranged, form a single-piece part. The primary feed box (10) is fixed to the secondary feed box (12) and covers a recess of said secondary feed box (12). A microwave source (18) is arranged at the primary feed box (10). An antenna (20) of the microwave source (18) extends into the interior of the primary feed box (10). The axis of the antenna (20) extends along another direction as a normal vector of the cavity wall (14), at which the feed box system is arranged.

FIG 1



Description

[0001] The present invention relates to a microwave oven with a feed box system according to claim 1.

[0002] Microwave ovens are efficient cooking devices for heating food and beverages. However, the strong electromagnetic fields used for the microwave heating are a potential threat to the health of the operator. A special attention has to be paid in order to minimize any leakage of such electromagnetic waves.

[0003] One of the critical parts within the microwave ovens is the connection between the wave source and the oven cavity. Very high power densities of the electromagnetic field occur in this area. Thus, a wave-tight system for the connection between the wave source and the oven cavity is required. For example, a magnetron can be used as the wave source.

[0004] In known microwave ovens the connection between the magnetron and the oven cavity comprises three functional units. The first functional unit is a feed box acting as a wave channel between the magnetron and the oven cavity. The second functional unit is an interface portion for tightly mounting the magnetron to the feed box. The third functional unit is the fixation of the feed box to the oven cavity.

[0005] The connection of the magnetron to the feed box is unproblematic with respect to microwave leakage. Also the setup of the feed box causes no difficulties related to microwave leakage. The critical point is the fixation of the feed box onto the oven cavity, since the connection between two separate components may create gaps through which microwaves can emanate into the surrounding area. For example, said gaps are caused by mechanical tolerances or by a limited planarity.

[0006] The US 5,825,000 describes a microwave oven with a feed box fixed directly at the oven cavity. The feed box comprises a wider portion and a smaller portion. A magnetron is fixed at the wider portion.

[0007] In the DE 31 47 044 C2 a microwave oven with a feed box under the bottom wall of the oven cavity is disclosed. The feed box extends substantially under the whole bottom wall. Under the feed box a magnetron is arranged. Within said feed box there are a stirrer and an antenna of said magnetron.

[0008] The US 3,939,320 discloses a microwave oven with a feed box above the oven cavity. A magnetron is arranged in the outer portion of the microwave oven. Between the feed box and the magnetron is a microwave channel.

[0009] In the above microwave ovens there are a lot of potential gaps between the feed box and the oven cavity or between the feed box and the microwave channel, respectively, so that microwave energy can emanate through those gaps.

[0010] It is the object of the present invention to provide a microwave oven with an improved closeness between the wave source and the oven cavity.

This object is achieved by the microwave oven according

to claim 1.

[0011] According to the present invention the microwave oven comprises a feed box system, wherein:

- 5 - the feed box system includes a primary feed box and a secondary feed box,
- the primary feed box and the secondary feed box are arranged one upon the other at a cavity wall of an oven cavity,
- 10 - the circumference of the primary feed box is smaller than the circumference of the secondary feed box,
- the secondary feed box and at least that cavity wall, at which the feed box system is arranged, form a single-piece part,
- 15 - the primary feed box is fixed to the secondary feed box and covers a recess of said secondary feed box,
- a microwave source is arranged at the primary feed box;
- an antenna of the microwave source extends into the interior of the primary feed box, and
- 20 - the axis of the antenna extends along another direction as a normal vector of the cavity wall, at which the feed box system is arranged.

25 **[0012]** The core of the present invention is the feed box system with two separate feed boxes, wherein one feed box forms a single-piece part with the cavity wall, on the one hand and the direction of the antenna with respect to the normal vector of the cavity wall on the other hand. The number of potential gaps is reduced. The secondary feed box and the cavity wall form a single-piece part, so that there cannot be any potential gap between them. The primary feed box cover the recess of the secondary feed box, so that the probability of potential gaps between the primary and secondary feed box is reduced. The direction of the antenna impacts the streamlines of the electric and magnetic fields of the microwave with respect to the cavity wall.

30 **[0013]** According to the preferred embodiment of the present invention the axis of the antenna extends orthogonal to the normal vector of that cavity wall, at which the feed box system is arranged. This constellation of the antenna restricts the directions of the streamlines of the electric and magnetic fields and supports the closeness of the oven cavity.

35 **[0014]** Preferably, overlapping portions of the primary feed box and the secondary feed box are formed complementary to each other, so that the overlapping portions form a wave labyrinth. The wave labyrinth contributes to the closeness of the oven cavity.

40 **[0015]** For example, the overlapping portions of the primary feed box and/or of the secondary feed box have an S-shaped or meander-shaped cross-section.

45 **[0016]** According to the preferred embodiment of the present invention the secondary feed box is formed out of that cavity wall, at which the feed box system is arranged, by embossing and/or deep-drawing. The embossing and/or deep-drawing allow an efficient produc-

tion of the microwave oven with the feed box system.

[0017] Additionally, the secondary feed box may be formed out of the oven cavity by embossing and/or deep-drawing. This is an efficient method for the production of the oven cavity with the secondary feed box.

[0018] Further, the secondary feed box and at least that cavity wall, at which the feed box system is arranged, may be enamelled. Since the primary feed box is fixed afterwards, the primary feed box remains un-enamelled. This allows a very good electrical contact between the wave source and the primary feed box.

[0019] Additionally, the secondary feed box and the oven cavity may be enamelled.

[0020] For example, the primary feed box is welded, screwed, clinched and/or riveted to the secondary feed box.

[0021] According to the preferred embodiment of the present invention the primary feed box covers a recess of the secondary feed box. Thereby, the wave labyrinth may enclose the recess completely or at least partially.

[0022] For example, the microwave oven may comprise at least one stirrer arranged at least partially within the secondary feed box. However, the stirrer may extend partially into the oven cavity.

[0023] According to the preferred embodiment of the present invention the microwave source is a magnetron.

[0024] The invention will be explained in more detail below by means of an exemplary embodiment. Reference is thereby made to the drawing, wherein

FIG 1 shows a schematic sectional view of a feed box system within a microwave oven according to a preferred embodiment of the present invention.

[0025] FIG 1 shows a schematic sectional view of a feed box system according to a preferred embodiment of the present invention. The feed box system is arranged within a microwave oven. The feed box system includes a primary feed box 10 and a secondary feed box 12. The primary feed box 10 and the secondary feed box 12 are arranged one upon the other at a top wall 14 of an oven cavity 16.

[0026] In this embodiment the primary feed box 10 and the secondary feed box 12 are substantially formed as cuboids. The secondary feed box 12 is arranged directly above an oven cavity 16. The base area of the secondary feed box 12 may be rectangular, circular or square. The primary feed box 10 is arranged directly above the secondary feed box 12. The width of the primary feed box 10 is smaller than the width of the secondary feed box 12. Also the circumference of the primary feed box 10 is smaller than the circumference of the secondary feed box 12.

[0027] In this example the feed box system is arranged on a top wall 14 of the oven cavity 16. Alternatively, the feed box system may be arranged at a side wall of the oven cavity 16. The secondary feed box 12 and the top

wall 14 or side wall of the oven cavity 16, respectively, form a single-piece part. For example, the secondary feed box 12 is formed out of the top wall 14 or side wall of the oven cavity 16, respectively, by an embossing or by a deep-drawing.

[0028] The primary feed box 10 is fixed to the secondary feed box 12 and covers a recess of said secondary feed box 12. For example, the primary feed box 10 is welded, screwed, clinched or riveted to the secondary feed box 12. The overlapping portions 22 of the primary feed box 10 and the secondary feed box 12 comprise multiple grooves extending along the circumference of the recess in the secondary feed box 12. Thus, the overlapping portions 22 of the primary feed box 10 and of the secondary feed box 12 have an S-shaped or meander-shaped cross-section.

[0029] Further, the overlapping portions 22 of the primary feed box 10 and of the secondary feed box 12 are complementary to each other, so that said overlapping portions form a wave labyrinth 22. Said wave labyrinth 22 encloses the common portion of the primary feed box 10 and the secondary feed box 12 completely or at least partially.

[0030] By an enamel process the top wall 14 of the oven cavity 14 as well as the secondary feed box 12 is coated. The primary feed box 10 is fixed to the secondary feed box 12 after the enamel process. Thus, the primary feed box 10 is not coated by the enamel process. Additionally, further walls of the oven cavity 16 may be enamelled. For example, each wall of the oven cavity 14 and the secondary feed box 12 may be coated by the enamel process.

[0031] A magnetron 18 is attached at the outer side of the primary feed box 10. An antenna 20 of the magnetron 18 extends into the interior of the primary feed box 10. In this example, the direction 26 of the antenna 20 extends orthogonal to a normal vector 28 of the top wall 14 of the oven cavity 16. In general, the direction 26 of the antenna 20 of the inventive feed box system extends along another axis as the normal vector 28 of the cavity wall 14, at which said feed box system is arranged.

[0032] Within the secondary feed box 12 a stirrer 24 is arranged. The stirrer 24 is rotatable around a vertical rotation axis 30. An axle 32 of the stirrer 24 penetrates a top wall of the secondary feed box 12. In this example, the stirrer 24 is arranged within the secondary feed box 12. Alternatively, the stirrer 24 can extend at least partially into the interior of the oven cavity 16.

[0033] The microwave oven with the feed box system according to the present invention requires less material as in the prior art due to the embossing or deep-drawing the secondary feed box 12 out of the oven cavity 16. A wave-tight connection between the primary feed box 10 and the secondary feed box 12 can be easily realized. The connection between the primary feed box 10 and the secondary feed box 12 needs only a few screws or bolts. Thus, the present invention allows a low cost production of the microwave oven with the feed box system.

[0034] The connection between the primary feed box 10 and the secondary feed box 12 allows a good electrical contact between the wave source and the feed box system. The embossing and/or deep-drawing of the secondary feed box 12 out of the oven cavity 16 allow an increased stiffness of the oven cavity 16.

List of Reference Numerals

[0035]

10	primary feed box
12	secondary feed box
14	top wall, cavity wall
16	oven cavity
18	magnetron
20	antenna
22	overlapping portions, wave labyrinth
24	stirrer
26	direction of the antenna
28	normal vector of the wall
30	vertical rotation axis

Claims

1. A microwave oven with a feed box system, wherein:

- the feed box system includes a primary feed box (10) and a secondary feed box (12),
- the primary feed box (10) and the secondary feed box (12) are arranged one upon the other at a cavity wall (14) of an oven cavity (16),
- the circumference of the primary feed box (10) is smaller than the circumference of the secondary feed box (12),
- the secondary feed box (12) and at least that cavity wall (14), at which the feed box system is arranged, form a single-piece part,
- the primary feed box (10) is fixed to the secondary feed box (12) and covers a recess of said secondary feed box (12),
- a microwave source (18) is arranged at the primary feed box (10) ;
- an antenna (20) of the microwave source (18) extends into the interior of the primary feed box (10), and
- the axis of the antenna (20) extends along another direction as a normal vector of the cavity wall (14), at which the feed box system is arranged.

2. The microwave oven according to claim 1, **characterized in that** the axis of the antenna (20) extends orthogonal to the normal vector of the cavity wall (14), at which the

feed box system is arranged.

3. The microwave oven according to claim 1 or 2, **characterized in that** overlapping portions (22) of the primary feed box (10) and the secondary feed box (12) are formed complementary to each other, so that the overlapping portions (22) form a wave labyrinth.

4. The microwave oven according to any one of the preceding claims, **characterized in that** the overlapping portions (22) of the primary feed box (10) and/or of the secondary feed box (12) have an S-shaped or meander-shaped cross-section.

5. The microwave oven according to any one of the preceding claims, **characterized in that** the secondary feed box (12) is formed out of that cavity wall (14), at which the feed box system is arranged, by embossing and/or deep-drawing.

6. The microwave oven according to any one of the claims 1 to 4, **characterized in that** the secondary feed box (12) is formed out of the oven cavity (16) by embossing and/or deep-drawing.

7. The microwave oven according to any one of the preceding claims, **characterized in that** the secondary feed box (12) and at least that cavity wall (14), at which the feed box system is arranged, are enamelled.

8. The microwave oven according to any one of the preceding claims, **characterized in that** the secondary feed box (12) and the oven cavity (16) are enamelled.

9. The microwave oven according to any one of the preceding claims, **characterized in that** the primary feed box (10) is welded, screwed, clinched and/or riveted to the secondary feed box (12).

10. The microwave oven according to any one of the preceding claims, **characterized in that** the primary feed box (10) covers a recess of the secondary feed box (12).

11. The microwave oven according to claim 10 as far as referred back to claim 3, **characterized in that**

the wave labyrinth (22) encloses the recess completely or at least partially.

12. The microwave oven according to any one of the preceding claims,
characterized in that
the microwave oven comprises at least one stirrer (24) arranged at least partially within the secondary feed box (12). 5 10
13. The microwave oven according to claim 12,
characterized in that
the stirrer (24) extends partially into the oven cavity (16). 15
14. The microwave oven according to any one of the preceding claims,
characterized in that
the microwave source is a magnetron (18). 20

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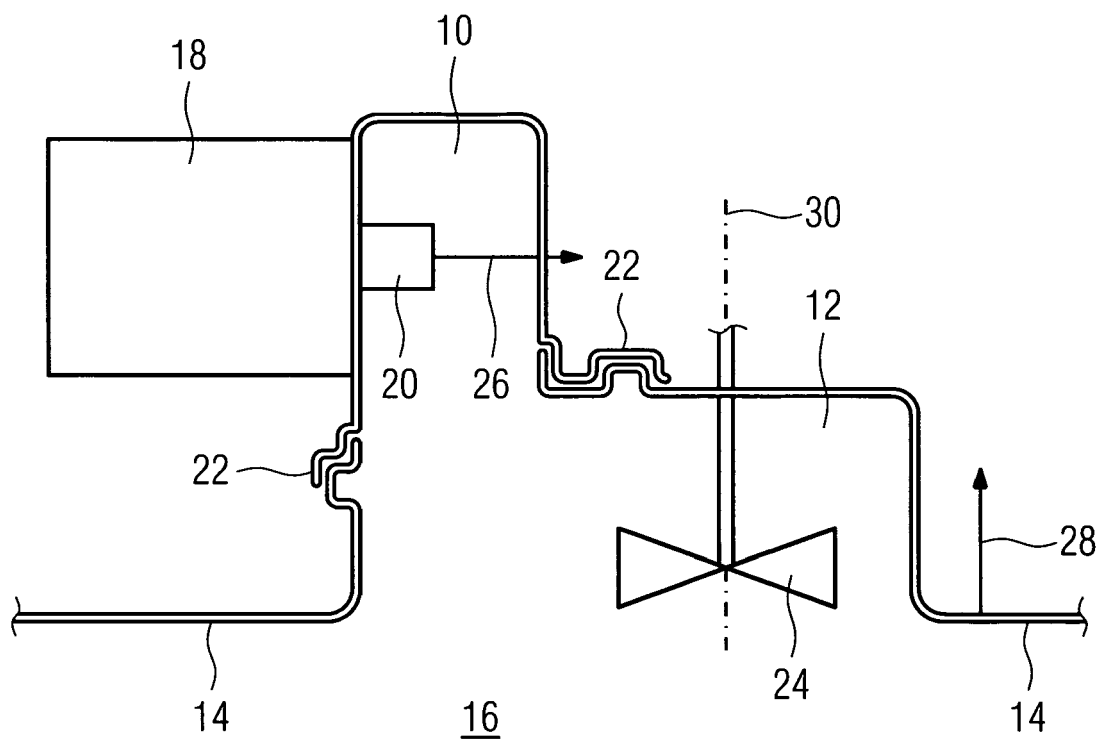
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FIG 1





EUROPEAN SEARCH REPORT

 Application Number
EP 09 00 6048

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 December 2009	Examiner Galary, Grzegorz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 09 00 6048

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			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 December 2009	Examiner Galary, Grzegorz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)



Application Number

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 09 00 6048

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-2,5-6,9,14

claims searched

1.1. claims: 1-2

direction of antenna

1.2. claims: 5-6

subject S2 as defined in the reasoned statement

1.3. claim: 9

subject S4 as defined in the reasoned statement

1.4. claim: 14

subject S6 as defined in the reasoned statement

2. claims: 3-4,10-11

subject S1 as defined in the reasoned statement

3. claims: 7-8

subject S3 as defined in the reasoned statement

4. claims: 12-13

subject S5 as defined in the reasoned statement

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 00 6048

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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