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

Mikrowellenherd mit einem Vorschubkastensystem

Four micro-ondes avec système de régulateur d'alimentation

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Description

[0001] The present invention relates to a microwave oven with a feed box system according to the preamble of 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] US 6,246,039 B1 discloses a microwave oven with a magnetron and a wave guide. The wave guide is formed by a combining portion and a matching portion. The antenna of the magnetron projects into the combining portion. The matching portion is arranged between the heating chamber and the combining portion. The cross-section of the matching portion increases towards the side surface of the heating chamber. The heating chamber, the combining portion and the matching portion are made of single parts in each case.

[0010] US 4,808,794 discloses a specially designed wave guide for a microwave oven. The wave guide is formed by an upper plate and base plate disposed above the heating chamber. A magnetron is arranged at an end portion of the base plate. The upper plate covers the base plate. The base plate includes an open cavity in continuation of the heating chamber.

[0011] US 4,159,406 discloses a wave guide structure for a microwave oven. The wave guide members are joined at the heating chamber by cooperating integral rivet means.

[0012] GB 2 107 160 A discloses microwave ovens, wherein the edges of a plurality of plate elements are curled with one another in order to provide the heating compartment. This structure prevents or reduces leakage of microwave energy.

[0013] EP 0 186 104 A2 discloses a microwave heating oven, wherein the axis of the antenna is parallel to the adjacent plane of the cavity wall.

[0014] JP 61 072936 A discloses a microwave oven, wherein the edges of the plate elements for the oven cavity are curled with one another. The curled edges prevent or reduce leakage of microwave energy.

[0015] EP 2 037 180 A1 discloses a built-in kitchen appliance. The oven cavity is made of stainless steel or enamelled steel.

[0016] GB 2 331 687 A discloses a microwave oven with drainage holes. The drainage holes are arranged in the corner of the wave guide and in the bracket for the motor.

[0017] US 4, 701, 586 discloses a microwave oven with a system for mounting a magnetron exterior to the microwave chamber. A magnetron antenna extends through an orifice in the chamber.

[0018] JP 2005 011620 A discloses a microwave oven with a stirrer wing arranged in a top chamber above the oven cavity. A wave guide is arranged above said top chamber.

[0019] GB 2 267 634 A discloses a microwave oven with a wave stirrer fan arranged in a wave guide above the oven cavity. A magnetron is arranged in an outer portion of said wave guide.

[0020] In the above microwave ovens there are a lot of potential gaps between the feed box and the oven cavity or between the fed box and the microwave channel, respectively, so that microwave energy can emanate through those gaps.

[0021] 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.

[0022] This object is achieved by the microwave oven according to claim 1.

[0023] According to the present invention the secondary feed box and at least that cavity wall, at which the feed box system is arranged, form a single-piece part, and 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.

[0024] 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, wherein the 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 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.

[0025] 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.

[0026] Since the 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, said wave labyrinth contributes to the closeness of the oven cavity.

[0027] 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.

[0028] 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 production of the microwave oven with the feed box system.

[0029] 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.

[0030] 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.

[0031] Additionally, the secondary feed box and the oven cavity may be enamelled.

[0032] For example, the primary feed box is welded, screwed, clinched and/or riveted to the secondary feed box.

[0033] 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.

[0034] 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.

[0035] According to the preferred embodiment of the present invention the microwave source is a magnetron.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] 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.

[0046] 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

[0047]

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 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,

characterized in that
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, and 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.

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
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.

4. 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.

5. The microwave oven according to any one of the claims 1 to 3,
characterized in that
the secondary feed box (12) is formed out of the oven cavity (16) by embossing and/or deep-drawing.

6. 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.

7. 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.

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

9. 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).

10. The microwave oven according to claim 9,
characterized in that
the wave labyrinth (22) encloses the recess completely or at least partially.

11. The microwave oven according to any one of the preceding claims,
characterised in that
the microwave oven comprises at least one stirrer (24) arranged at least partially within the secondary feed box (12).

12. The microwave oven according to claim 11,
characterize in that
the stirrer (24) extends partially into the oven cavity (16).

13. The microwave oven according to any one of the preceding claims,
characterized in that
the microwave source is a magnetron (18).

Patentansprüche

1. Mikrowellenherd mit einem Einspeisekastensystem, wobei:

- das Einspeisekastensystem einen primären Einspeisekasten (10) und einen sekundären Einspeisekasten (12) einschließt,
- der primäre Einspeisekasten (10) und der sekundäre Einspeisekasten (12) übereinander an einer Hohlraumwand (14) eines Hohlraums (16) des Herdes angeordnet sind,
- der Umfang des primären Einspeisekastens (10) kleiner als der Umfang des sekundären Einspeisekastens (12) ist,
- der primäre Einspeisekasten (10) an dem sekundären Einspeisekasten (12) befestigt ist und eine Aussparung des zweiten Einspeisekastens (12) bedeckt,
- eine Mikrowellenquelle (18) an dem primären Einspeisekasten (10) angeordnet ist;
- eine Antenne (20) der Mikrowellenquelle (18) sich in das Innere des primären Einspeisekastens (10) erstreckt, und
- die Achse der Antenne (20) sich entlang einer anderen Richtung als ein Normalenvektor der Hohlraumwand (14) erstreckt, an der das Einspeisekastensystem angeordnet ist,

dadurch gekennzeichnet, dass der sekundäre Einspeisekasten (12) und mindestens jene Hohlraumwand (14), an der das Einspeisekastensystem angeordnet ist, ein einstückiges Teil bilden, und dass überlappende Abschnitte (22) des primären Einspeisekastens (10) und des sekundären Einspeisekastens (12) komplementär zueinander gebildet sind, so dass die überlappenden Abschnitte (22) ein Wellenlabyrinth bilden.

2. Mikrowellenherd nach Anspruch 1, **dadurch gekennzeichnet, dass** sich die Achse der Antenne (20) rechtwinklig zu dem Normalenvektor der Hohlraumwand (14) erstreckt, an der das Einspeisekastensystem angeordnet ist.

3. Mikrowellenherd nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die überlappenden Abschnitte (22) des primären Einspeisekastens (10) und/oder des sekundären Einspeisekastens (12) einen S-förmigen oder mäandrierenden Querschnitt aufweisen.

4. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der sekundäre Einspeisekasten (12) aus jener Hohlraumwand (14), an der das Einspeisekastensystem angeordnet ist, durch Prägen und/oder Tiefziehen gebildet ist.

5. Mikrowellenherd nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** der sekundäre Einspeisekasten (12) aus dem Hohlraum (16) des Herdes heraus durch Prägen und/oder Tiefziehen

gebildet ist.

6. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der sekundäre Einspeisekasten (12) und mindestens jene Hohlraumwand (14), an der das Einspeisekastensystem angeordnet ist, emailliert sind.

7. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der sekundäre Einspeisekasten (12) und der Hohlraum (16) des Herdes emailliert sind.

8. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der primäre Einspeisekasten (10) an den sekundären Einspeisekasten (12) geschweißt, geschraubt, geheftet und/oder genietet ist.

9. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der primäre Einspeisekasten (10) eine Aussparung an dem sekundären Einspeisekasten (12) bedeckt.

10. Mikrowellenherd nach Anspruch 9, **dadurch gekennzeichnet, dass** das Wellenlabyrinth (22) die Aussparung vollständig oder mindestens teilweise umschließt.

11. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Mikrowellenherd mindestens einen Rührer (24) umfasst, der mindestens teilweise in dem sekundären Einspeisekasten (12) angeordnet ist.

12. Mikrowellenherd nach Anspruch 11, **dadurch gekennzeichnet, dass** sich der Rührer (24) teilweise in den Hohlraum (16) des Herdes erstreckt.

13. Mikrowellenherd nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mikrowellenquelle ein Magnetron (18) ist.

Revendications

1. Four à micro-ondes avec un système de boîtes d'alimentation, dans lequel :

- le système de boîtes d'alimentation comporte une boîte d'alimentation primaire (10) et une boîte d'alimentation secondaire (12),
- la boîte d'alimentation primaire (10) et la boîte d'alimentation secondaire (12) sont disposées l'une au-dessus de l'autre au niveau d'une paroi de cavité (14) d'une cavité de four (16),
- la circonférence de la boîte d'alimentation primaire (10) est plus petite que la circonférence de la boîte d'alimentation secondaire (12),
- la boîte d'alimentation primaire (10) est fixée à la boîte d'alimentation secondaire (12) et recouvre une encoche de ladite boîte d'alimentation secondaire (12),
- une source de micro-ondes (18) est disposée au niveau de la boîte d'alimentation primaire (10),
- une antenne (20) de la source de micro-ondes (18) s'étend à l'intérieur de la boîte d'alimentation primaire (10), et
- l'axe de l'antenne (20) s'étend le long d'une autre direction qu'un vecteur normal de la paroi de cavité (14) au niveau de laquelle est disposé le système de boîtes d'alimentation,

caractérisé en ce que
la boîte d'alimentation secondaire (12) et au moins la paroi de cavité (14) au niveau de laquelle est disposé le système de boîtes d'alimentation forment une pièce monobloc, et des parties se chevauchant (22) de la boîte d'alimentation primaire (10) et de la boîte d'alimentation secondaire (12) sont formées de façon complémentaire l'une à l'autre, de telle sorte que les parties se chevauchant (22) forment un labyrinthe à ondes.

2. Four à micro-ondes selon la revendication 1, **caractérisé en ce que**
l'axe de l'antenne (20) s'étend orthogonalement au vecteur normal de la paroi de cavité (14) au niveau de laquelle est disposé le système de boîtes d'alimentation.

3. Four à micro-ondes selon la revendication 1 ou 2, **caractérisé en ce que**
les parties se chevauchant (22) de la boîte d'alimentation primaire (10) et/ou de la boîte d'alimentation secondaire (12) ont une forme de S ou une section transversale en forme de méandres.

4. Four à micro-ondes selon l'une quelconque des revendications précédentes, **caractérisé en ce que**
la boîte d'alimentation secondaire (12) est formée hors de la paroi de cavité (14) au niveau de laquelle est disposé le système de boîtes d'alimentation, par gaufrage et/ou emboutissage profond.

5. Four à micro-ondes selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que**
la boîte d'alimentation secondaire (12) est formée hors de la cavité de four (16) par gaufrage et/ou emboutissage profond.

6. Four à micro-ondes selon l'une quelconque des revendications précédentes,

caractérisé en ce que
la boîte d'alimentation secondaire (12) et au moins la paroi de cavité (14) au niveau de laquelle est disposé le système de boîtes d'alimentation sont émaillées.

7. Four à micro-ondes selon l'une quelconque des revendications précédentes,
caractérisé en ce que
la boîte d'alimentation secondaire (12) et la cavité de four (16) sont émaillées.

8. Four à micro-ondes selon l'une quelconque des revendications précédentes,
caractérisé en ce que
la boîte d'alimentation primaire (10) est soudée, vissée, rivée et/ou rivetée à la boîte d'alimentation secondaire (12).

9. Four à micro-ondes selon l'une quelconque des revendications précédentes,
caractérisé en ce que
la boîte d'alimentation primaire (10) recouvre une encoche de la boîte d'alimentation secondaire (12).

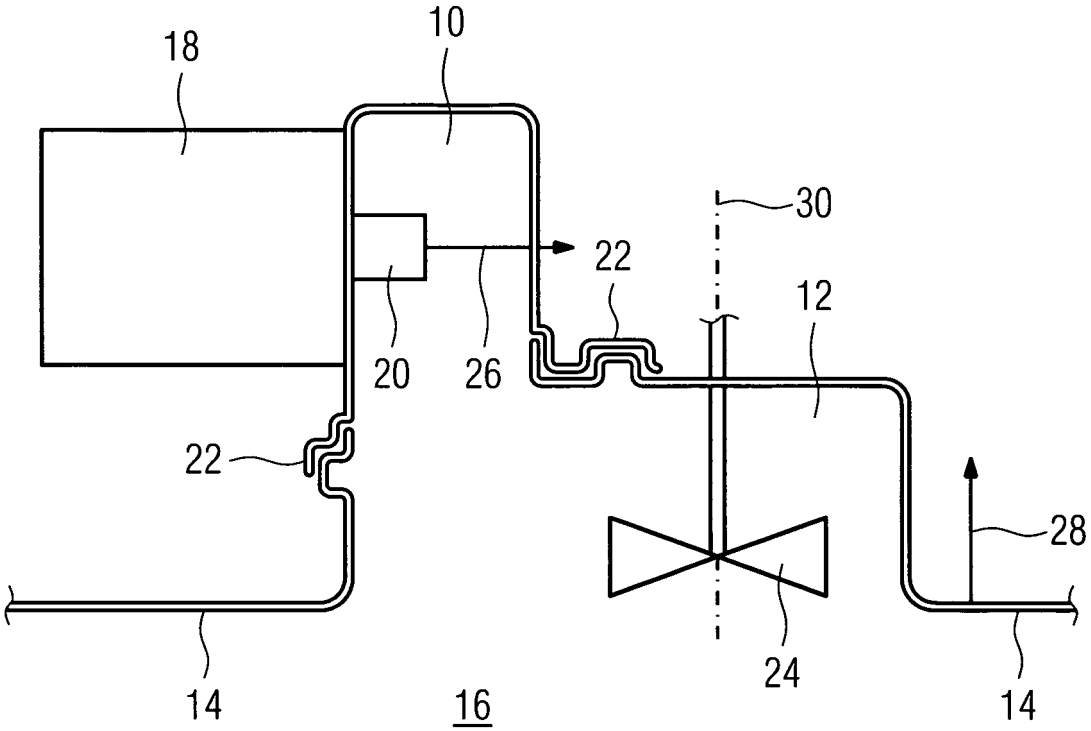
10. Four à micro-ondes selon la revendication 9,
caractérisé en ce que
le labyrinthe à ondes (22) encercle entièrement ou au moins partiellement l'encoche.

11. Four à micro-ondes selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le four à micro-ondes comprend au moins un agitateur (24) disposé au moins partiellement à l'intérieur de la boîte d'alimentation secondaire (12).

12. Four à micro-ondes selon la revendication 11,
caractérisé en ce que
l'agitateur (24) s'étend partiellement dans la cavité de four (16).

13. Four à micro-ondes selon l'une quelconque des revendications précédentes,
caractérisé en ce que
la source de micro-ondes est un magnétron (18).

FIG 1



REFERENCES CITED IN THE DESCRIPTION

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