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(54) **A wave choke system for a microwave oven**

Drosselspulensystem für einen Mikrowellenherd

Système de support à ondes pour four à micro-ondes

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Description

[0001] The present invention relates to a wave choke system for a microwave oven according to the preamble of claim 1 and to a microwave oven according to the preamble of claim 12.

[0002] Microwave ovens generate electromagnetic fields in order to heat food stuff and beverages. The strong electromagnetic fields generated by microwave ovens are a potential threat to the health of the operator, if said electromagnetic fields or parts of them leave the cavity. The door of the microwave oven is a critical part. In particular, microwaves may leave the cavity through the gap between the door and the frame of the cavity.

[0003] Typically, the gap between the door and the cavity is sealed with respect to microwaves by integrating wave chokes into the door and/or the frame of the cavity. Said wave chokes base on a $\lambda/4$ transformation or an LC oscillator. However, mechanical tolerances of the cavity frame and the frame of the oven door can evoke local areas of an increased leakage.

[0004] US 3,678,238 discloses a wave choke system for a microwave oven, wherein said wave choke system comprises an elongate channel bordered by side walls made of a conductive material. The channel extends along the door frame or the cavity frame. The channel includes one recess for a $\lambda/4$ transformation. A gap with a length of $\lambda/4$ is formed between the door frame and the cavity frame.

[0005] It is an object of the present invention to provide an improved wave choke system for a microwave oven.

[0006] This object is achieved by the wave choke system according to claim 1.

[0007] According to the present invention the channel is an integrated part or an appendix of either the door frame or the cavity frame.

[0008] The main idea of the present invention is the arrangement of the both recesses for the $\lambda/4$ transformation within the channel and their formation by the step between them. The step allows two successive recesses for the $\lambda/4$ transformation. Each of the recesses is, therefore, provided for a $\lambda/4$ transformation or acting as a $\lambda/4$ wave trap. The structure of the inventive wave choke system allows a low complexity. Thus, the wave choke system according to the present invention may be realized by low costs. In particular, the channel as integrated part within the door frame or as appendix at the door frame can be realized by simple means.

[0009] In a preferred and advantageous embodiment the channel includes an outer circumferential side wall, a first inner circumferential side wall, a second inner circumferential side wall and an outer side wall, wherein the first inner circumferential side wall corresponds with the first recess and forms an inner circumferential side wall of the first recess and the second inner circumferential side wall corresponds with the second recess and forms an inner circumferential side wall of the second recess.

[0010] In a first variant of this embodiment the channel includes further an inner side wall and the outer circumferential side wall comprises the gap of the channel besides the inner side wall, wherein except for said gap, the channel is completely enclosed by electrically conductive side walls.

[0011] In a second alternative variant of said embodiment the gap of the channel is arranged between the outer circumferential side wall and the first inner circumferential side wall and, except for said gap, the channel is completely enclosed by electrically conductive side walls.

[0012] In a further embodiment the channel encloses circumferentially the oven door completely or at least partially and/or in a closed state of the oven door the channel extends along the cavity frame.

[0013] Preferably an edge of the step extends substantially or at least approximately parallel to the longitudinal axis of the channel.

[0014] Alternatively or additionally the channel is an integrated part or an appendix of the cavity frame. Also this embodiment can be easily produced.

[0015] Preferably, the channel has an L-shaped cross section. Said L-shaped cross section minimizes the costs of materials. For example, the both legs of the L-shaped cross section form the recesses of the channel.

[0016] Further, the gap may be arranged besides or within the interspace of the door frame and the cavity frame. This position of the gap allows an optimal choking of the microwaves.

[0017] According to a preferred embodiment of the present invention the gap is covered by an element made of at least one non-conductive material. For example, said element is formed as an L-shaped profile section and covers the gap as well as a side wall beside. The cover element may be arranged in front of the cavity frame. The cover element prevents the infiltration of undesirable particles into the channel.

[0018] Additionally, at least one transparent element may be arranged on at least one outer side at the side wall of the channel. In particular, the transparent element is made of at least one non-conductive material. For example, the transparent element is made of glass.

[0019] Preferably, the transparent element is provided for allowing an insight into the cavity.

[0020] At last, the present invention relates to a microwave oven comprising at least one wave choke system as described above.

[0021] The novel and inventive features believed to be the characteristic of the present invention are set forth in the appended claims.

[0022] The invention will be described in further detail with reference to the drawing, in which

FIG 1 illustrates a perspective view of a section of a wave choke system for microwave oven according to a first embodiment of the present invention, and

FIG 2 illustrates a perspective view of a section of a wave choke system for microwave oven according to a second embodiment of the present invention.

[0023] FIG 1 illustrates a perspective view of a section of a wave choke system for microwave oven according to a first embodiment of the present invention. The cross section of the illustrated section corresponds with the cross section of the whole wave choke system.

[0024] The wave choke system comprises an elongate channel 10 with an L-shaped cross section. The channel 10 is arranged within a door frame of the microwave oven. It is provided, that the channel 10 encloses circumferentially the oven door completely or at least partially. The channel 10 forms a part or an appendix of a door frame 34. In a closed state of the oven door the channel 10 extends along a cavity frame 36.

[0025] The channel 10 of the wave choke system comprises a first recess 12 and a second recess 14. Each of the recesses 12 and 14 is provided for a $\lambda/4$ transformation. The recesses 12 and 14 are separated by a step 16. The edge of said step 16 extends along the longitudinal axis of the channel 10. The first recess 12 and the second recess 14 form the both legs of the L-shaped cross section of the channel 10. Thus, the channel 10 includes two portions acting as $\lambda/4$ wave traps.

[0026] The channel 10 includes an outer circumferential side wall 18, a first inner circumferential side wall 20, a second inner circumferential side wall 22, an outer side wall 24 and an inner side wall 26. The side walls 18, 20, 22, 24 and 26 of the channel 10 are made of an electrically conductive material, in particular of metal. The first inner circumferential side wall 20 corresponds with the first recess 12 and forms an inner circumferential side wall of the first recess 12. In a similar way, the second inner circumferential side wall 22 corresponds with the second recess 14 and forms an inner circumferential side wall of the second recess 14.

[0027] In this embodiment, the outer circumferential side wall 18 comprises a gap 28 besides the inner side wall 26. Except said gap 28, the channel 10 is completely enclosed by electrically conductive side walls 18, 20, 22, 24 and 26.

[0028] Further, the wave choke system comprises a transparent element 30 and a cover element 32. The transparent element 30 is arranged at the outer side of the outer circumferential side wall 18. The transparent element 30 is made of a non-conductive and transparent material. In this embodiment, the transparent element 30 is made of glass. The transparent element 30 allows an insight into the cavity. The cover element 32 is formed as an L-shaped profile section and covers the gap 28 as well as the inner side wall 26. The cover element 32 is made of a non-conductive material. Further, the cover element 32 is arranged in front of the cavity frame 36. The cover element 32 prevents the infiltration of undesirable particles into the channel 10.

[0029] FIG 2 illustrates a perspective view of a section of a wave choke system for microwave oven according to a second embodiment of the present invention. Identical, corresponding and similar elements of the wave choke system have the same reference numerals as in FIG 1. The cross section of the illustrated section corresponds with the cross section of the whole wave choke system.

[0030] The wave choke system of the second embodiment comprises also the elongate channel 10 with the L-shaped cross section. The channel 10 is arranged within the door frame of the microwave oven. It is provided, that the channel 10 completely or at least partially encloses circumferentially the oven door. The channel 10 is a part or the appendix of the door frame 34. In a closed state of the oven door the channel 10 extends along the cavity frame 36.

[0031] The channel 10 of the wave choke system according to the second embodiment comprises also the first recess 12 and the second recess 14. The recesses 12 and 14 are provided for $\lambda/4$ transformations. The recesses 12 and 14 are separated by the step 16. The edge of said step 16 extends along the longitudinal axis of the channel 10. The first recess 12 and the second recess 14 form the both legs of the L-shaped cross section of the channel 10. The channel 10 of the second embodiment includes also two portions acting as $\lambda/4$ wave traps.

[0032] The channel 10 includes the outer circumferential side wall 18, the first inner circumferential side wall 20, the second inner circumferential side wall 22 and the outer side wall 24. The side walls 18, 20, 22 and 24 of the channel 10 are made of an electrically conductive material, in particular of metal. The first inner circumferential side wall 20 corresponds with the first recess 12 and forms an inner circumferential side wall of the first recess 12. In the same way, the second inner circumferential side wall 22 corresponds with the second recess 14 and forms an inner circumferential side wall of the second recess 14.

[0033] In this embodiment, the gap 28 is arranged between the outer circumferential side wall 18 and the first inner circumferential side wall 20. Except said gap 28, the channel 10 is completely enclosed by electrically conductive side walls 18, 20, 22 and 24. Thus, the difference between the first embodiment in FIG 1 and the second embodiment in FIG 2 is the position of the gap 28. In the first embodiment the gap 28 is arranged at the outer circumferential side wall 18. In the second embodiment the gap 28 is provided instead of the inner side wall 26 in FIG 1. Thus, the inner side wall 26 is lacking in the second embodiment according to FIG 2.

[0034] Further, the wave choke system according to the second embodiment comprises the transparent element 30 and a cover element 32. The transparent element 30 is arranged at the outer side of the outer circumferential side wall 18. The transparent element 30 is made of a non-conductive and transparent material. Also in this embodiment, the transparent element 30 is made of

glass. The transparent element 30 allows an insight into the cavity. The cover element 32 is formed as an L-shaped profile section and covers the gap 28 and an inner portion of the outer circumferential side wall 18. The cover element 32 is made of a non-conductive material. Further, the cover element 32 is arranged in front of the cavity frame 36. The cover element 32 prevents the infiltration of undesirable particles into the channel 10.

[0035] Further embodiments of the wave choke system according to the present invention may be realized. For example, the orientation of the channel 10 in relation to the oven door and the cavity frame can be varied. The substantial features of the wave choke system according to the present invention are the both recesses 12 and 14 for the $\lambda/4$ transformation and the step 16 between them. 12 and 14 for the $\lambda/4$ transformation and the step 16 between them.

[0036] The wave choke system according to the present invention with the both recesses 12 and 14 beside the step 16 allows an improved sealing of microwaves. The leakage between the oven door and the cavity frame is reduced. The inventive wave choke system has a higher bandwidth. The functionality of the wave choke system according to the present invention is more robust against mechanical tolerances of the cavity walls and frame. At last, the inventive wave choke system can be produced in an easy way.

[0037] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawing, it is to be understood that the present invention is not limited to those precise embodiments and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

List of reference numerals

[0038]

10	channel
12	first recess
14	second recess
16	step
18	outer circumferential side wall
20	first inner circumferential side wall
22	second inner circumferential side wall
24	outer side wall
26	inner side wall
28	gap
30	transparent element
32	cover element
34	door frame
36	cavity frame

Claims

1. A wave choke system for a microwave oven, wherein said wave choke system comprises at least one elongate channel (10) bordered by side walls (18, 20, 22, 24, 26) made of one or more conductive materials and by at least one gap (28), wherein the channel (10) is provided for extending at least partially along the door frame (34) and/or along the cavity frame (36), and wherein the channel (10) comprises at least two successive recesses (12, 14) and a step (16) between said recesses (12, 14), wherein each of the recesses (2, 14) is provided for a $\lambda/4$ transformation or acting as a $\lambda/4$ wave trap,
characterized in that
the channel (10) is an integrated part or an appendix of either the door frame (34) or the cavity frame (36).

2. The wave choke system according to claim 1, wherein the channel (10) includes an outer circumferential side wall (18), a first inner circumferential side wall (20), a second inner circumferential side wall (22) and an outer side wall (24), wherein the first inner circumferential side wall (20) corresponds with the first recess (12) and forms an inner circumferential side wall of the first recess (12) and the second inner circumferential side wall (22) corresponds with the second recess (14) and forms an inner circumferential side wall of the second recess (14).

3. The wave choke system according to claim 2, wherein the channel (10) includes further an inner side wall (26) and the outer circumferential side wall (18) comprises the gap (28) of the channel (10) besides the inner side wall (26), wherein except for said gap (28), the channel (10) is completely enclosed by electrically conductive side walls (18, 20, 22, 24 and 26).

4. The wave choke system according to claim 2, wherein the gap (28) of the channel (10) is arranged between the outer circumferential side wall (18) and the first inner circumferential side wall (20) and wherein except for said gap (28), the channel (10) is completely enclosed by electrically conductive side walls (18, 20, 22 and 24).

5. The wave choke system according to any of the preceding claims, wherein the channel (10) encloses circumferentially the oven door completely or at least partially and/orin a closed state of the oven door the channel (10) extends along the cavity frame (36).

6. The wave choke system according to any of the preceding claims, wherein the two recesses (12 and 14) are separated by the step (16) and the both recesses (12, 14) are arranged beside the step (16).

7. The wave choke system according to any one of the

preceding claims, wherein the channel (10) has an L-shaped cross section, wherein preferably the both legs of the L-shaped cross section form the recesses (12, 14) of the channel.

8. The wave choke system according to any one of the pre ceding claims, wherein the gap (28) is arranged besides or within the interspace of the door frame (34) and the cavity frame (36).

9. The wave choke system according to any one of the preceding claims, wherein the gap (28) is covered by a cover element (26) made of at least one non-conductive material, wherein preferably the cover element (32) is formed as an L-shaped profile section and/or covers the gap (28) as well as the inner side wall (26) and/or is arranged in front of the cavity frame (36) and/or prevents the infiltration of undesirable particles into the channel (10).

10. The wave choke system according to any one of the preceding claims, wherein at least one transparent element (30) is arranged on at least one outer side at the side wall (18) of the channel (10), in particular at the outer side of the outer circumferential side wall (18), wherein the transparent element (30) is made of at least one non-conductive material and/or of glass and/or is provided for allowing an insight into the cavity.

11. The wave choke system according to any one of the preceding claims, wherein an edge of the step (16) extends at least approximately parallel to the longitudinal axis of the channel (10).

12. A microwave oven comprising an oven cavity having a cavity frame (36) and an oven door having a door frame (34) and at least one wave choke system according to any one of the claims 1 to 11.

Patentansprüche

1. Wellendrosselsystem für einen Mikrowellenofen, wobei das Wellendrosselsystem mindestens einen langgestreckten Kanal (10) umfasst, der durch Seitenwände (18, 20, 22, 24, 26) aus einem oder mehreren leitenden Materialien und durch mindestens einen Spalt (28) begrenzt wird, wobei der Kanal (10) dafür vorgesehen ist, sich mindestens teilweise entlang des Türrahmens (34) und/oder entlang des Garraumrahmens (36) zu erstrecken, und wobei der Kanal (10) mindestens zwei aufeinanderfolgende Vertiefungen (12, 14) und eine Stufe (16) zwischen den Vertiefungen (12, 14) umfasst, wobei jede der Vertiefungen (12, 14) für eine $\lambda/4$-Umwandlung vorgesehen ist oder als eine $\lambda/4$-Wellenfalle wirkt,
dadurch gekennzeichnet, dass
der Kanal (10) ein integrierter Teil oder ein Anhang entweder des Türrahmens (34) oder des Garraumrahmens (36) ist.

2. Wellendrosselsystem nach Anspruch 1, wobei der Kanal (10) eine äußere Umfangs-Seitenwand (18), eine erste innere Umfangs-Seitenwand (20), eine zweite innere Umfangs-Seitenwand (22) und eine äußere Seitenwand (24) umfasst, wobei die erste innere Umfangs-Seitenwand (20) mit der ersten Vertiefung (12) korrespondiert und eine innere Umfangs-Seitenwand der ersten Vertiefung (12) bildet, und wobei die zweite innere Umfangs-Seitenwand (22) mit der zweiten Vertiefung (14) korrespondiert und eine innere Umfangs-Seitenwand der zweiten Vertiefung (14) bildet.

3. Wellandrossolsystem nach Anspruch 2, wobei der Kanal (10) ferner eine innere Seitenwand (26) umfasst und die äußere Umfangs-Seitenwand (18) den Spalt (28) des Kanals (10) neben der inneren Seitenwand (26) umfasst, wobei der Kanal (10) mit Ausnahme des Spalts (28) vollständig von elektrisch leitenden Seitenwänden (18, 20, 22, 24 und 26) eingeschlossen ist.

4. Wellendrosselsystem nach Anspruch 2, wobei der Spalt (28) des Kanals (10) zwischen der äußeren Umfangs-Seitenwand (18) und der ersten inneren Umfangs-Seitenwand (20) angeordnet ist und wobei der Kanal (10) mit Ausnahme des Spalts (28) vollständig von elektrisch leitenden Seitenwänden (18, 20, 22 und 24) eingeschlossen ist.

5. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei der Kanal (10) die Ofentür in Umfangsrichtung vollständig oder mindestens teilweise umgibt und/oder der Kanal (10) sich in einem geschlossenen Zustand der Ofentür entlang des Garraumrahmens (36) erstreckt.

6. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei die zwei Vertiefungen (12 und 14) durch die Stufe (16) voneinander getrennt sind und die beiden Vertiefungen (12, 14) neben der Stufe (16) angeordnet sind.

7. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei der Kanal (10) einen L-förmigen Querschnitt aufweist, wobei vorzugsweise die beiden Beine des L-förmigen Querschnitts die Vertiefungen (12, 14) des Kanals bilden.

8. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei der Spalt (28) neben oder in dem Zwischenraum zwischen dem Türrahmen (34) und dem Garraumrahmen (36) angeordnet ist.

9. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei der Spalt (28) durch ein Abdeckungselement (26) aus mindestens einem nichtleitenden Material bedeckt ist, wobei das Abdeckungselement (32) vorzugsweise als Profilabschnitt mit L-förmigem Querschnitt ausgebildet ist und/oder den Spalt (28) sowie die innere Seitenwand (26) bedeckt und/oder vor dem Garraumrahmen (36) angeordnet ist und/oder das Eindringen von unerwünschten Partikeln in den Kanal (10) verhindert.

10. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei mindestens ein transparentes Element (30) an mindestens einer Außenseite an der Seitenwand (18) des Kanals (10) angeordnet ist, insbesondere an der Außenseite der äußeren Umfangs-Seitenwand (18), wobei das transparente Element (30) aus mindestens einem nichtleitenden Material und/oder aus Glas hergestellt ist und/oder vorgesehen ist, um einen Einblick in den Garraum zu ermöglichen.

11. Wellendrosselsystem nach einem der vorhergehenden Ansprüche, wobei sich eine Kante der Stufe (16) wenigstens annähernd parallel zur Längsachse des Kanals (10) erstreckt.

12. Mikrowellenofen, umfassend einen Ofengarraum mit einem Garraumrahmen (36) und eine Ofentür mit einem Türrahmen (34) und mindestens ein Wellendrosselsystem nach einem der Ansprüche 1 bis 11.

Revendications

1. Système d'étranglement d'onde pour un four à micro-ondes, où ledit système d'étranglement d'onde comprend au moins un canal oblong (10) délimité par des parois latérales (18, 20, 22, 24, 26) réalisées en un ou plusieurs matériaux conducteurs et par au moins un espace (28), où le canal (10) est réalisé pour s'étendre au moins partiellement le long du châssis de porte (34) et/ou le long du châssis de cavité (36), et où le canal (10) comprend au moins deux évidements successifs (12, 14) et un gradin (16) entre lesdits évidements (12, 14), où chacun des évidements (12, 14) est prévu pour une transformation $\lambda/4$ ou agissant comme un piège d'onde $\lambda/4$,
caractérisé en ce que
le canal (10) est une partie intégrée ou un appendice soit du châssis de porte (34) soit du châssis de cavité (36).

2. Système d'étranglement d'onde selon la revendication 1, dans lequel le canal (10) comprend une paroi latérale circonférentielle extérieure (18), une première paroi latérale circonférentielle intérieure (20), une deuxième paroi latérale circonférentielle intérieure (22) et une paroi latérale extérieure (24), où la première paroi latérale circonférentielle intérieure (20) correspond au premier évidement (12) et forme une paroi latérale circonférentielle intérieure du premier évidement (12), et la deuxième paroi latérale circonférentielle intérieure (22) correspond au deuxième évidement (14) et forme une paroi latérale circonférentielle intérieure du deuxième évidement (14),

3. Système d'étranglement d'onde selon la revendication 2, dans lequel le canal (10) comprend en outre une paroi latérale intérieure (26), et la paroi latérale circonférentielle extérieure (18) comprend l'espace (28) du canal (10) à côté de la paroi latérale intérieure (26), où à l'exception dudit espace (28), le canal (10) est complètement renfermé par les parois latérales électriquement conductrices (18, 20, 22, 24 et 26).

4. Système d'étranglement d'onde selon la revendication 2, dans lequel l'espace (28) du canal (10) est agencé entre la paroi latérale circonférentielle extérieure (18) et la première paroi latérale circonférentielle intérieure (20), et où à l'exception dudit espace (28), le canal (10) est complètement renfermé par les parois latérales électriquement conductrices (18, 20, 22 et 24).

5. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel le canal (10) renferme circonférentiellement la porte du four complètement ou au moins partiellement et/ou, à un état fermé de la porte du four, le canal (10) s'étend le long du châssis de cavité (36).

6. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel les deux évidements (12 et 14) sont séparés par le gradin (16), et les deux évidements (12, 14) sont agencés à côté du gradin (16).

7. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel le canal (10) a une section transversale en forme de L, où de préférence les deux branches de la section transversale en forme de L forment les évidements (12, 14) du canal.

8. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel l'espace (28) est agencé à côté ou dans l'espace entre le châssis de porte (34) et le châssis de cavité (36).

9. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel l'espace (28) est couvert par un élément de recouvrement (26) réalisé en au moins un matériau non-

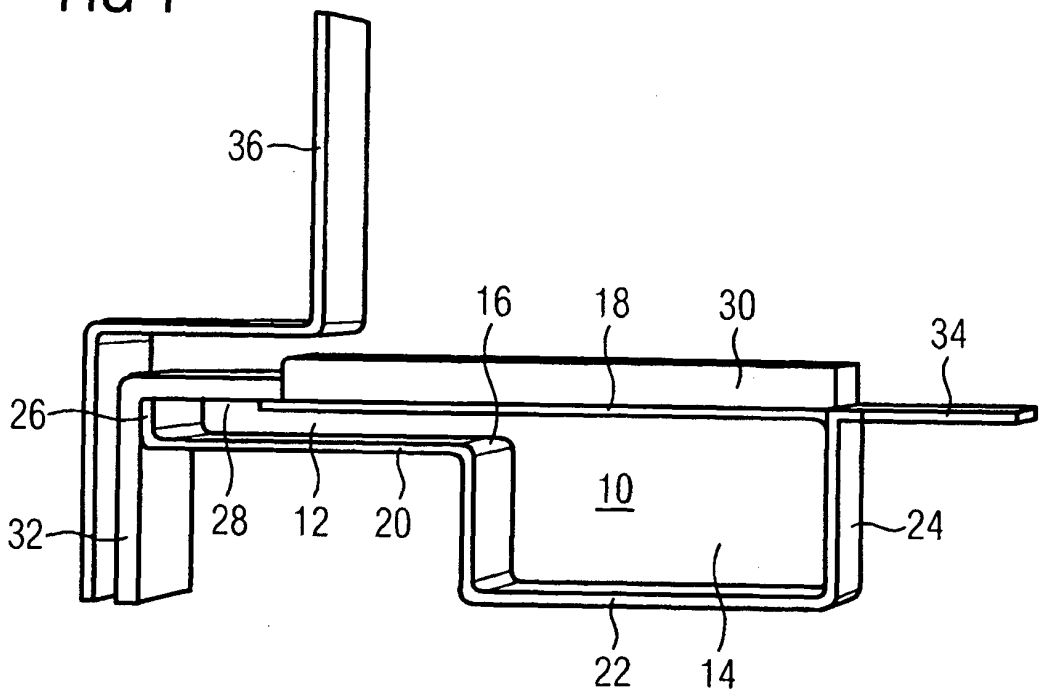
conducteur, où de préférence, l'élément de recouvrement (32) est formé comme une section de profilé en forme de L et/ou couvre l'espace (28) ainsi que la paroi latérale intérieure (26) et/ou est agencé devant le châssis de cavité (36) et/ou empêche l'infiltration de particules non souhaitables dans le canal (10).

10. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel au moins un élément transparent (30) est agencé sur au moins un côté extérieur à la paroi latérale (18) du canal (10), en particulier au côté extérieur de la paroi latérale circonférentielle extérieure (18), où l'élément transparent (30) est réalisé en au moins un matériau non-conducteur et/ou en verre et/ou est prévu pour permettre de voir l'intérieur de la cavité.

11. Système d'étranglement d'onde selon l'une quelconque des revendications précédentes, dans lequel un bord du gradin (16) s'étend au moins d'une manière approximativement parallèle à l'axe longitudinal du canal (10).

12. Four à micro-ondes comprenant une cavité de four ayant un châssis de cavité (36) et une porte de four ayant un châssis de four (34) ainsi qu'au moins un système d'étranglement d'onde selon l'une quelconque des revendications 1 à 11.

FIG 1


36
16
18
30
34
26
28
12
20
10
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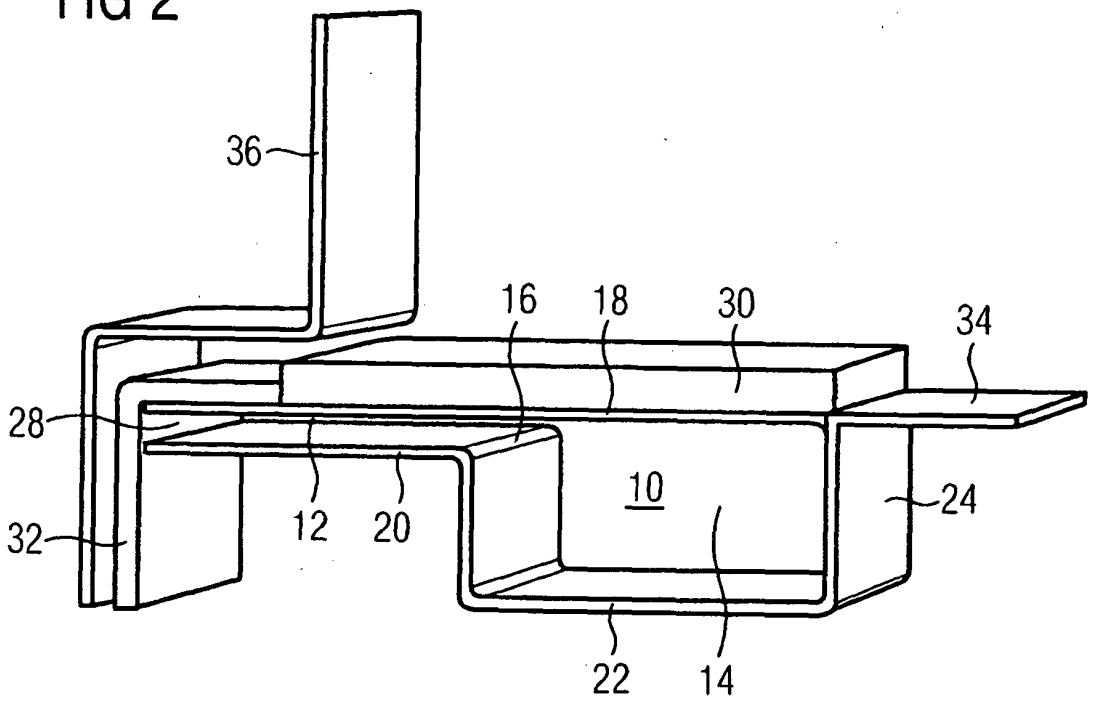
24
22
14

FIG 2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REFERENCES CITED IN THE DESCRIPTION

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