



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.12.2018 Bulletin 2018/51

(51) Int Cl.:
H05B 6/64 (2006.01)

(21) Application number: **17175706.5**

(22) Date of filing: **13.06.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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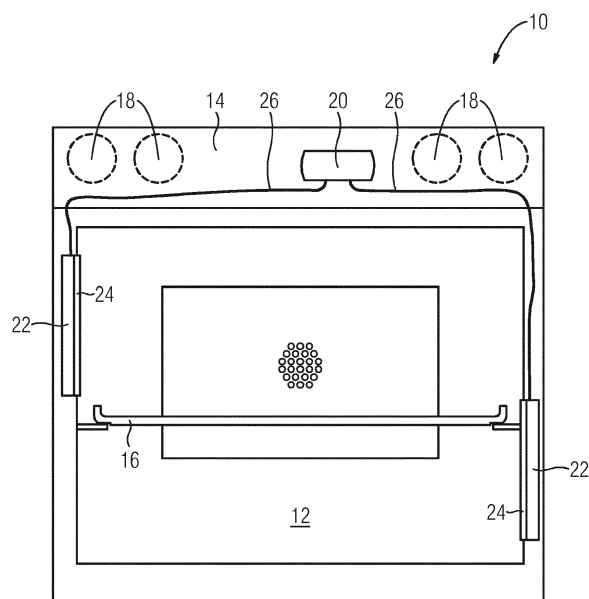
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(54) **DOMESTIC APPLIANCE WITH A CAVITY AND AN ILLUMINATION SYSTEM**

(57) The present invention relates to a domestic appliance (10) with a cavity (12), in particular a cooking oven (10) with an oven cavity (12). The domestic appliance (10) comprises an illumination system for illuminating the cavity (12). The illumination system comprises at least one microwave generating unit (20) and at least one light-emitting plasma device (22). The light-emitting plasma device (22) includes or is a container filled with at least one substance providing light-emitting plasma. The light-emitting plasma device (22) is arranged in a

wall of the cavity (12). The light-emitting plasma device (22) includes at least one transparent portion (24). At least a part of the transparent portion (24) is directed to the interior of the cavity (12). The microwave generating unit (20) and the light-emitting plasma device (22) are connected via a wave guide (26), so that microwaves generated by the microwave generating unit (20) are transferred to the substance providing light-emitting plasma.

FIG 1



Description

[0001] The present invention relates to a domestic appliance with a cavity and an illumination system for illuminating said cavity. In particular, the present invention relates to a cooking oven with an oven cavity and an illumination system for illuminating said oven cavity.

[0002] The cavity of a domestic appliance, in particular of a cooking oven, is a closed compartment. In order to control a treatment in the cavity a transparent door and an illumination is provided. Especially, the illumination within an oven cavity of the cooking oven plays a significant role that the user can reliably inspect a cooking process without opening an oven door. On the one hand, a light source element has to provide a sufficient brightness. On the other hand, the light source element has to be heat resistant.

[0003] However, conventional illumination systems do not fulfil all the necessary requirements by reasonable complexity.

[0004] It is an object of the present invention to provide a domestic appliance with a cavity and an illumination system, which is heat resistant and provides a sufficient illumination of the cavity by low complexity.

[0005] The object is achieved by the domestic appliance according to claim 1.

[0006] According to the present invention a domestic appliance with a cavity, in particular a cooking oven with an oven cavity, is provided, wherein:

- the domestic appliance comprises an illumination system for illuminating the cavity,
- the illumination system comprises at least one microwave generating unit and at least one light-emitting plasma device,
- the light-emitting plasma device includes or is a container filled with at least one substance providing light-emitting plasma,
- the light-emitting plasma device is arranged in a wall of the cavity,
- the light-emitting plasma device includes at least one transparent portion,
- at least a part of the transparent portion is directed to the interior of the cavity, and
- the microwave generating unit and the light-emitting plasma device are connected via a wave guide, so that
- microwaves generated by the microwave generating unit (20) are transferred to the substance providing light-emitting plasma.

[0007] The light for the cavity is generated by the light-emitting plasma device. The light-emitting plasma within the light-emitting plasma device is ignited and maintained by microwaves. Electrodes and the like components are not required, so that the illumination of the cavity is realised by low complexity.

[0008] In particular, the microwaves generated by the

microwave generating unit are within one group of the official industrial, scientific and medical (ISM) bands, wherein preferably said bands have central frequencies of 900 MHz, 2.450 MHz or 5.700 MHz.

[0009] For example, the microwave generating unit is a solid-state device (SSD) basing on semiconductor technology.

[0010] According to a special embodiment, the illumination system comprises at least two microwave generating units connected to at least one light-emitting plasma device, wherein preferably the frequencies of the microwaves generated by said microwave generating units are slightly different from each other.

[0011] Further, at least one light-emitting plasma device may be arranged in a top wall of the cavity.

[0012] Alternatively or additionally, at least two light-emitting plasma devices are arranged in opposite side walls of the cavity, wherein preferably at least two of said light-emitting plasma devices are arranged at different levels.

[0013] Furthermore, the light-emitting plasma device may include at least one housing. In particular, the transparent portion of the light-emitting plasma device is formed as a part of said housing. Preferably, the transparent portion is made of glass or plastics.

[0014] For example, the light-emitting plasma device includes at least one plasma bulb filled with the at least one substance providing light-emitting plasma. Preferably, said plasma bulb is arranged inside the housing of the light-emitting plasma device.

[0015] Moreover, the transparent portion may comprise a structure for diffusing the emitted light. The diffused emitted light allows an improved illumination of the cavity.

[0016] In particular, the wave guide is a flexible wave guide, wherein preferably the wave guide is a coaxial cable.

[0017] Advantageously, the damping loss of the wave guide is lower than three decibel per meter (dB/m).

[0018] According to one embodiment, the wave guide is permanently connected to the microwave generating unit and/or to the light-emitting plasma device, so that the wave guide, the microwave generating unit and/or the light-emitting plasma device form an integral part.

[0019] Alternatively or additionally, the wave guide is detachably connected to the microwave generating unit and/or to the light-emitting plasma device.

[0020] For example, the wave guide is connected to the microwave generating unit and/or to the light-emitting plasma device by at least one screwable connector, wherein preferably said screwable connector is an SMA (Sub-Miniature-A) connector. The screwable connector provides a tight and leakage-free connection.

[0021] Alternatively or additionally, the wave guide may be connected to the microwave generating unit and/or to the light-emitting plasma device by at least one pluggable connector, wherein preferably said pluggable connector is an MCX (Miniature CoaX) and/or SMB (Sub-

Miniature-B) connector.

[0022] Novel and inventive features of the present invention are set forth in the appended claims.

[0023] The present invention will be described in further detail with reference to the drawings, in which

FIG 1 illustrates a schematic front view of a cooking oven with an illumination system according to a first embodiment of the present invention,

FIG 2 illustrates a schematic front view of a cooking oven with an illumination system according to a second embodiment of the present invention, and

FIG 3 illustrates a schematic sectional view of a light-emitting plasma device for the illumination system of the cooking oven according to the present invention.

[0024] FIG 1 illustrates a schematic front view of a cooking oven 10 with an illumination system according to a first embodiment of the present invention.

[0025] The cooking oven 10 comprises an oven cavity 12 and a user interface 14. The oven cavity 12 is closable by an oven door. By reasons of clarity, the oven door is not shown in FIG 1. The user interface 14 is arranged above the oven cavity 12. In this example, the user interface 14 includes four adjusting knobs 18. The oven cavity 12 is adapted for receiving one or more baking trays 16. In this example, one baking tray 16 is arranged at about half height inside the oven cavity 12.

[0026] The cooking oven 10 comprises an illumination system. In this embodiment, the illumination system includes a microwave generating unit 20 and two light-emitting plasma (LEP) devices 22. Each light-emitting plasma device 22 is connected to the microwave generating unit 20 via a wave guide 26 in each case. Preferably, the wave guides 26 are flexible wave guides. Each light-emitting plasma device 22 includes a transparent portion 24. In this embodiment, the light-emitting plasma devices 22 are arranged in the side walls of the oven cavity 12. The transparent portions 24 of the light-emitting plasma devices 22 are directed to the interior of the oven cavity 12. The transparent portions 24 of the light-emitting plasma devices 22 are made of glass or plastics. The transparent portions 24 may comprise a structure in order to refract the light. In this example, the one light-emitting plasma device 22 is arranged in an upper portion of the side wall on the left hand side, while the other light-emitting plasma device 22 is arranged in a lower portion of the side wall on the right hand side, so that both spaces above and beneath the baking tray 16 are illuminated.

[0027] The microwave generating unit 20 may be an arbitrary microwave generator fulfilling the spatial constraints of the cooking oven 10. For example, the microwave generating unit 20 is a so-called solid-state device (SSD) basing on semiconductor technology. The fre-

quencies of the microwaves generated by the microwave generating unit 20 must be suitable for igniting and maintaining light-emitting plasma. Preferably, the frequencies of the microwaves generated by the microwave generating unit 20 are within one group of the official industrial, scientific and medical (ISM) bands having central frequencies of 900 MHz, 2.450 MHz or 5.700 MHz. In particular, the cumulated microwave power generated by the microwave generating unit 20 is between 10 W and 50 W. However, lower or higher microwave power values may be also provided, if required. For example, energy saving may require lower microwave power values.

[0028] The light-emitting plasma device 22 includes or is a container filled with substance suitable for providing light-emitting plasma. For example, said substance is an inert gas, preferably argon.

[0029] Preferably, the substance is directly ignited by microwaves. In this case, electrodes in the light-emitting plasma device 22 are not necessary. In particular, low-pressure plasma is directly ignited. In general, each suitable method for igniting plasma may be provided.

[0030] In particular, the wave guides 26 between the microwave generating unit 20 and the light-emitting plasma devices 22 have a damping loss lower than three decibel per meter (dB/m). Preferably, the wave guides 26 are coaxial cables. The coaxial cable is flexible and allows several positions for the microwave generating unit 20 and light-emitting plasma device 22. The microwave generating unit 20 should be placed on a sufficient cool area of the cooking oven 10. If the microwave generating unit 20 is realised by the solid-state device, then the temperature should be lower than 70°C in the area of said solid-state device. In contrast, there are no special thermal conditions for the light-emitting plasma device 22. The light-emitting plasma device 22 may be placed very close to the oven cavity 12. The generation of plasma is unaffected by high temperatures.

[0031] The connection of the wave guide 26 to the microwave generating unit 20 and light-emitting plasma devices 22 may be permanent or detachable. In the latter case, appropriate connector systems may be used. For example, SMA (Sub-Miniature-A) connectors provide a reliable and leakage-free connection of the wave guide 26 to the microwave generating unit 20 and light-emitting plasma devices 22, wherein a male plug is screwed onto a female jack connector. In similar way, pluggable connector systems, e.g. MCX (Miniature CoaX) or SMB (Sub-Miniature-B) connectors, are also suitable for connecting the wave guide 26 to the microwave generating unit 20 and/or light-emitting plasma device 22. The pluggable connections allow a fast assembling of the illumination system.

[0032] Further, the triad of microwave generating unit 20, light-emitting plasma device 22 and wave guide 26 may be formed as an integral unit. Moreover, two components, e.g. the wave guide 26 and the light-emitting plasma device 22 may be formed as the integral unit.

[0033] FIG 2 illustrates a schematic front view of the

cooking oven 10 with an illumination system according to a second embodiment of the present invention.

[0034] The cooking oven 10 comprises the oven cavity 12 and the user interface 14. The oven cavity 12 is closable by the oven door, which is not shown in FIG 2 by reasons of clarity. In this example, the user interface 14 is arranged above the oven cavity 12 and includes the four adjusting knobs 18. The oven cavity 12 is adapted for receiving one or more baking trays 16. In this example, one baking tray 16 is arranged at about half height inside the oven cavity 12.

[0035] The cooking oven 10 comprises the illumination system. In this embodiment, the illumination system includes two microwave generating units 20 and one light-emitting plasma device 22. The light-emitting plasma device 22 is connected to the microwave generating units 20 via two wave guides 26. Preferably, the wave guides 26 are flexible wave guides, e.g. coaxial cables. The light-emitting plasma device 22 includes the transparent portion 24. In this embodiment, the light-emitting plasma device 22 is arranged in the stop wall of the oven cavity 12. The transparent portion 24 of the light-emitting plasma device 22 is directed downwards to the interior of the oven cavity 12. In this example, the upper side of the baking tray 16 is illuminated.

[0036] For example, the microwave generating units 20 may be solid-state devices. In particular, the frequencies of the microwaves generated by the microwave generating units 20 may be slightly different from each other. For example, the frequencies of the microwaves generated by the microwave generating units 20 are 900 MHz and 910 MHz. This improves the illumination efficiency of the light-emitting plasma device 22.

[0037] In particular, the damping loss of the wave guides 26 between the microwave generating units 20 and the light-emitting plasma device 22 is lower than three decibel per meter (dB/m). Preferably, the wave guides 26 are flexible coaxial cables, so that several positions for the microwave generating units 20 and the light-emitting plasma device 22 are possible. The microwave generating units 20 are arranged in a sufficient cool area of the cooking oven 10. If the microwave generating units 20 are solid-state devices, then the temperature should be lower than 70°C in these areas. In contrast, there are no special thermal conditions for the light-emitting plasma device 22. The light-emitting plasma device 22 may be placed very close to the oven cavity 12. The generation of plasma is unaffected by high temperatures.

[0038] The connection of the wave guide 26 to the microwave generating units 20 and the light-emitting plasma device 22 may be permanent or detachable. In the latter case, SMA (Sub-Miniature-A) connectors may be used, wherein the male plug is screwed onto the female jack connector. The SMA connector provides a reliable and leakage-free connection of the wave guide 26 to the microwave generating units 20 and light-emitting plasma device 22. Further, pluggable connector systems, like MCX (Miniature Coax) or SMB (Sub-Miniature-B) con-

nectors, are also suitable for connecting the wave guide 26 to the microwave generating units 20 and/or to the light-emitting plasma device 22. The pluggable connections allow a quick assembling of the illumination system.

[0039] FIG 3 illustrates a schematic sectional view of the light-emitting plasma device 22 for the illumination system of the cooking oven 10 according to the present invention. FIG 3 shows an example for the internal structure of the light-emitting plasma device 22.

[0040] The light-emitting plasma device 22 includes a housing 28. The transparent portion 24 of the light-emitting plasma device 22 is formed as a part of said housing 28. Preferably, the transparent portion is made of glass or plastics.

[0041] A plasma bulb 30 is arranged inside the housing 28 of the light-emitting plasma device 22. In this example, the plasma bulb 30 is arranged in the centre of the housing 28 of the light-emitting plasma device 22. The plasma bulb 30 is filled with the substance suitable for providing the light-emitting plasma. For example, said substance is an inert gas, preferably argon. The plasma bulb 30 is connected to one end of the wave guide 26. Thus, the plasma bulb 30 is directly connected to the microwave generating unit 20.

[0042] The lifetime of the light-emitting plasma device 22 is relative high, since no electrodes are required and therefore no wear occurs. The flexible wave guides allow an optimised placement of the microwave generating units 20 and the light-emitting plasma devices 22. The light-emitting plasma device 22 has a high temperature resistance. The light-emitting plasma device 22 provides a high brightness inside the oven cavity 12, so that the food stuff may be easily inspected by the user without opening the oven door.

[0043] In general, the present invention relates to an arbitrary domestic appliance 10 with a cavity 12 and an illumination system for illuminating said cavity 12.

[0044] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiment, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit 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

[0045]

10	cooking oven
12	oven cavity
14	user interface
16	baking tray
18	adjusting knob
20	microwave generating unit

- 22 light-emitting plasma device
- 24 transparent portion of the light-emitting plasma device
- 26 wave guide
- 28 housing
- 30 plasma bulb

Claims

1. A domestic appliance (10) with a cavity (12), in particular a cooking oven (10) with an oven cavity (12), wherein:

- the domestic appliance (10) comprises an illumination system for illuminating the cavity (12),
- the illumination system comprises at least one microwave generating unit (20) and at least one light-emitting plasma device (22),
- the light-emitting plasma device (22) includes or is a container filled with at least one substance providing light-emitting plasma,
- the light-emitting plasma device (22) is arranged in a wall of the cavity (12),
- the light-emitting plasma device (22) includes at least one transparent portion (24),
- at least a part of the transparent portion (24) is directed to the interior of the cavity (12), and
- the microwave generating unit (20) and the light-emitting plasma device (22) are connected via a wave guide (26), so that
- microwaves generated by the microwave generating unit (20) are transferred to the substance providing light-emitting plasma.

2. The domestic appliance according to claim 1, **characterised in that** the microwaves generated by the microwave generating unit (20) are within one group of the official industrial, scientific and medical (ISM) bands, wherein preferably said bands have central frequencies of 900 MHz, 2.450 MHz or 5.700 MHz.
3. The domestic appliance according to claim 1 or 2, **characterised in that** the microwave generating unit (20) is a solid-state device (SSD) basing on semiconductor technology.
4. The domestic appliance according to any one of the preceding claims, **characterised in that** the illumination system comprises at least two microwave generating units (20) connected to at least one light-emitting plasma device (22), wherein preferably the frequencies of the microwaves generated by said microwave generating units (20) are slightly different from each other.

5. The domestic appliance according to any one of the preceding claims, **characterised in that** at least one light-emitting plasma device (22) is arranged in a top wall of the cavity (12).

6. The domestic appliance according to any one of the preceding claims, **characterised in that** at least two light-emitting plasma devices (22) are arranged in opposite side walls of the cavity (12), wherein preferably at least two of said light-emitting plasma devices (22) are arranged at different levels.

7. The domestic appliance according to any one of the preceding claims, **characterised in that** the light-emitting plasma device (22) includes at least one housing (28), wherein the transparent portion (24) of the light-emitting plasma device (22) is formed as a part of said housing (28), and wherein preferably the transparent portion (24) is made of glass or plastics.

8. The domestic appliance according to any one of the preceding claims, **characterised in that** the light-emitting plasma device (22) includes at least one plasma bulb (30) filled with the at least one substance providing light-emitting plasma, wherein preferably said plasma bulb (30) is arranged inside the housing (28) of the light-emitting plasma device (22).

9. The domestic appliance according to any one of the preceding claims, **characterised in that** the transparent portion (24) comprises a structure for diffusing the emitted light.

10. The domestic appliance according to any one of the preceding claims, **characterised in that** the wave guide (26) is a flexible wave guide (26), wherein preferably the wave guide (26) is a coaxial cable (26).

11. The domestic appliance according to any one of the preceding claims, **characterised in that** the damping loss of the wave guide (26) is lower than three decibel per meter (dB/m).

12. The domestic appliance according to any one of the preceding claims, **characterised in that** the wave guide (26) is permanently connected to the microwave generating unit (20) and/or to the light-emitting plasma device (22), so that the wave guide

(26), the microwave generating unit (20) and/or the light-emitting plasma device (22) form an integral part.

13. The domestic appliance according to any one of the preceding claims, **characterised in that** the wave guide (26) is detachably connected to the microwave generating unit (20) and/or to the light-emitting plasma device (22). 5 10
14. The domestic appliance according to claim 13, **characterised in that** the wave guide (26) is connected to the microwave generating unit (20) and/or to the light-emitting plasma device (22) by at least one screwable connector, wherein preferably said screwable connector is an SMA (Sub-Miniature-A) connector. 15
15. The domestic appliance according to claim 13 or 14, **characterised in that** the wave guide (26) is connected to the microwave generating unit (20) and/or to the light-emitting plasma device (22) by at least one pluggable connector, wherein preferably said pluggable connector is an MCX (Miniature CoaX) and/or SMB (Sub-Miniature-B) connector. 20 25

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FIG 1

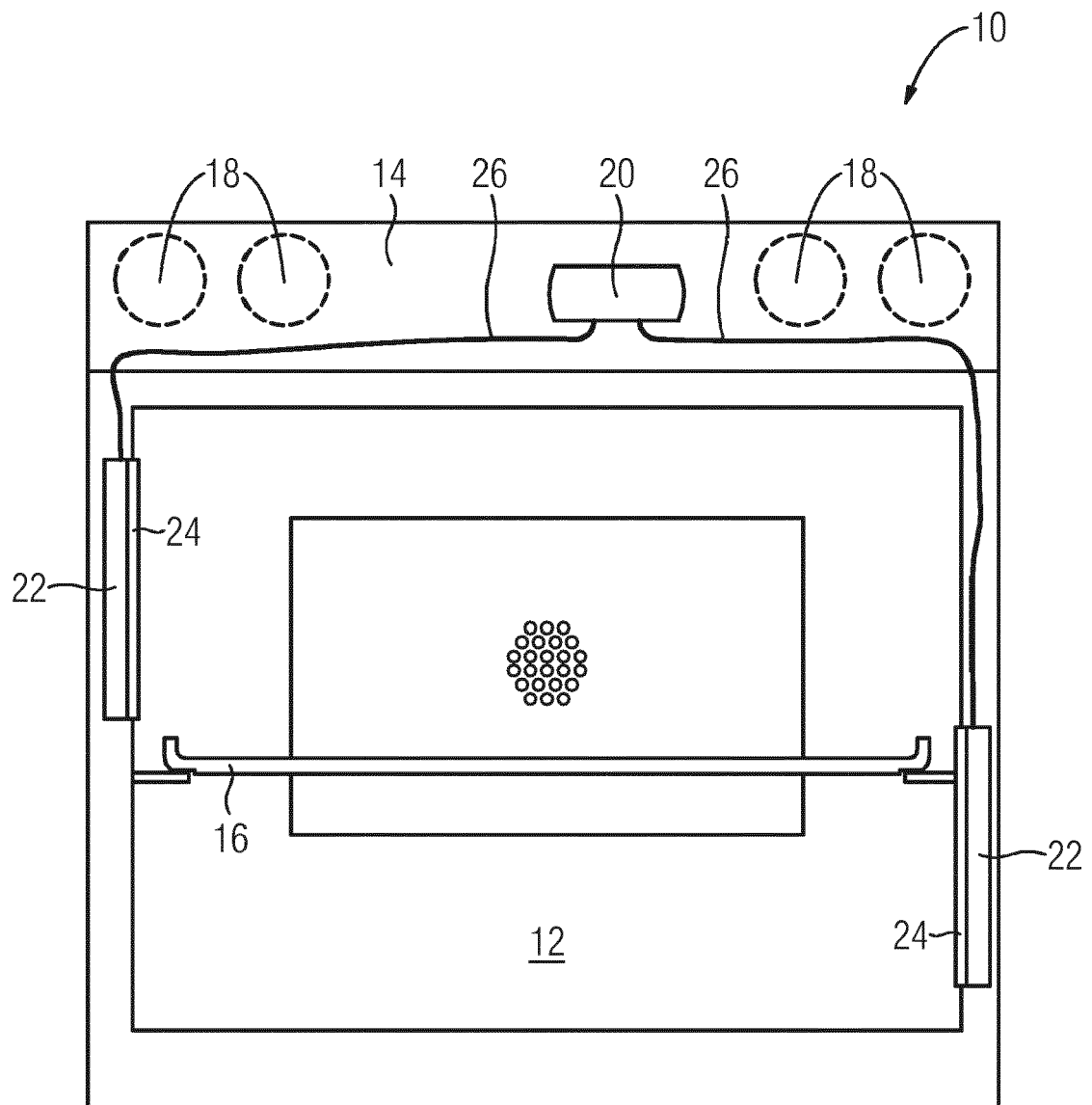


FIG 2

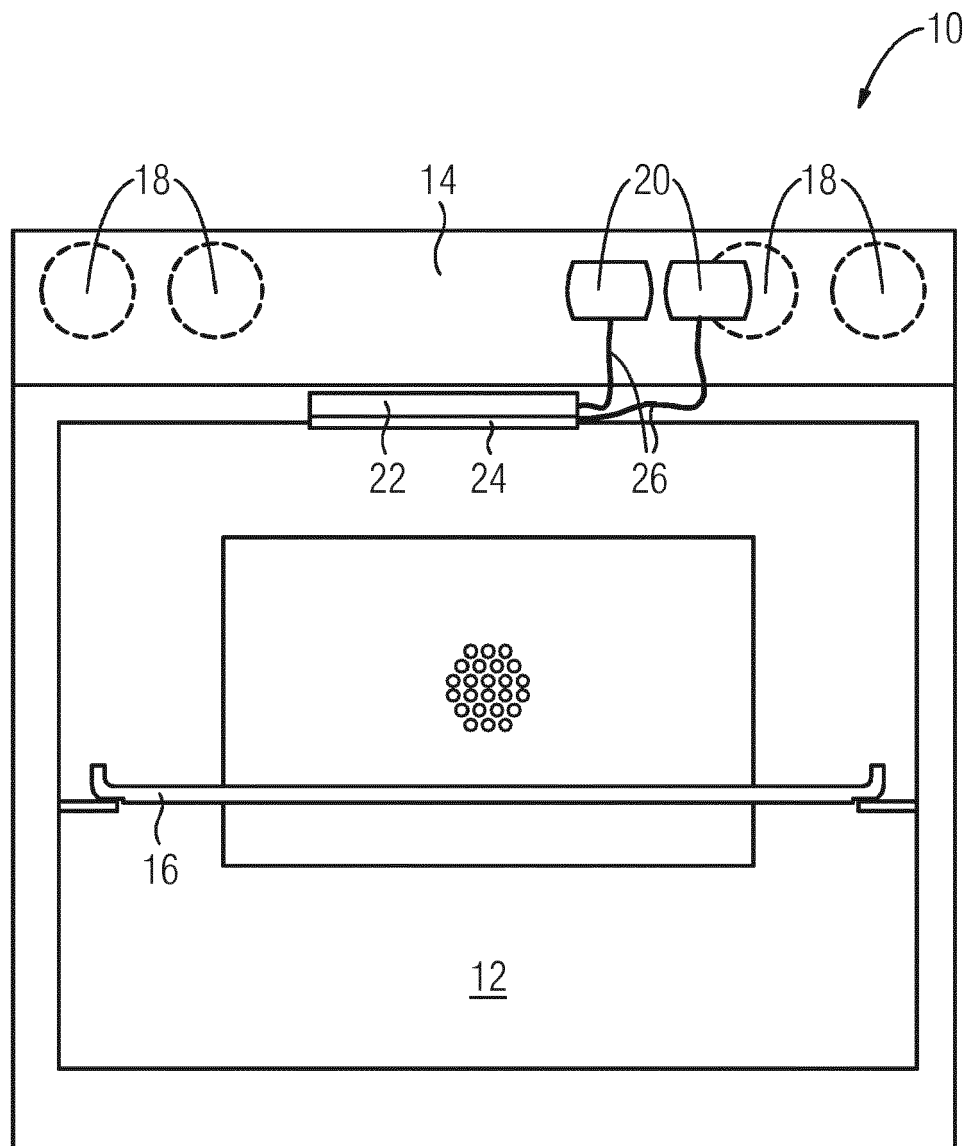
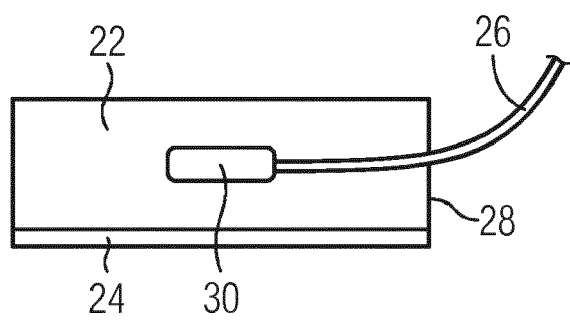


FIG 3





EUROPEAN SEARCH REPORT

 Application Number
 EP 17 17 5706

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 17 17 5706

5 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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