



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.01.2020 Bulletin 2020/03

(51) Int Cl.:
H05B 6/12 (2006.01)

(21) Application number: **18182343.6**

(22) Date of filing: **09.07.2018**

(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:
KH MA MD TN

- **PEGOLO, Luca**
33074 Fontanafredda (IT)
- **PAOLELLA, Matteo**
33170 Vallenoncello (IT)
- **JEANNETEAU, Laurent**
47122 Forli (IT)
- **VIROLI, Alex**
47122 Forli (IT)
- **MILANESI, Filippo**
47122 Forli (IT)
- **CASO, Daniele**
47122 Forli (IT)

(71) Applicant: **ELECTROLUX APPLIANCES AKTIEBOLAG**
105 45 Stockholm (SE)

(72) Inventors:
• **SCOTTO D'APOLLONIA, Adriano**
47122 Forli (IT)

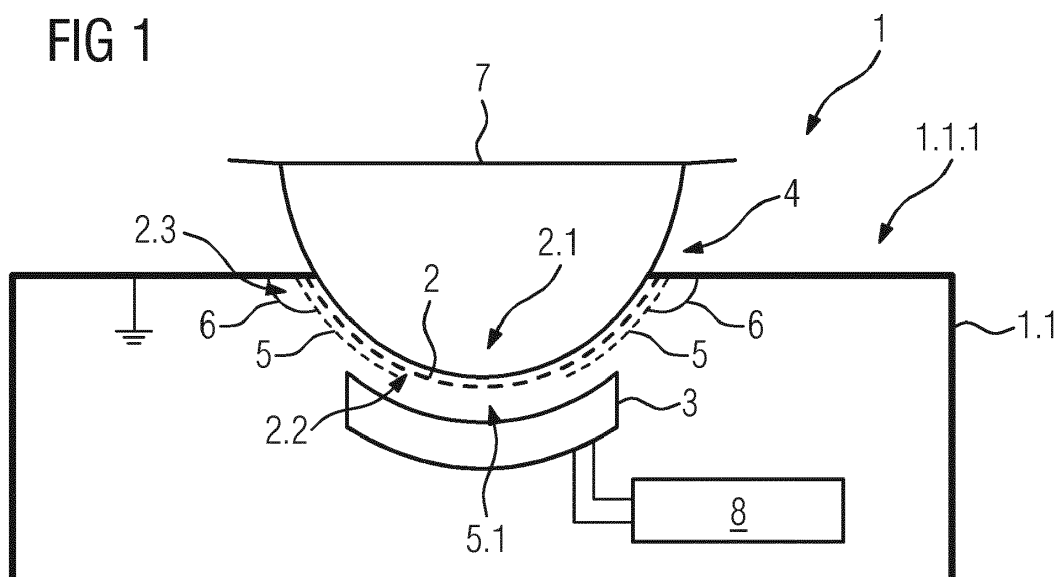
(74) Representative: **Electrolux Group Patents AB Electrolux**
S:t Göransgatan 143
10545 Stockholm (SE)

(54) **METHOD FOR OPERATING AN INDUCTION HOB AND INDUCTION HOB**

(57) The invention relates to an induction hob comprising a glass or glass-ceramic element (2) and an induction coil (3) in order to provide a heating zone (4) at said glass or glass-ceramic element (2), wherein said glass or glass-ceramic element (2) comprises at its lower surface a conductive layer (5) or a group of conductive

layers, said conductive layer (5) or group of conductive layers being made of an electrically conductive material, wherein said glass or glass-ceramic element (2) comprises a concavely-shaped portion (2.1) or recess below which said induction coil (3) is arranged.

FIG 1



Description

[0001] The present invention relates generally to the field of induction hobs.

BACKGROUND OF THE INVENTION

[0002] Induction hobs for preparing food are well known in prior art. Induction hobs typically comprise at least one induction coil placed below a glass or glass-ceramic element in order to provide heat to a piece of cookware.

[0003] Induction hobs are known which comprise means for reducing electrical charging of the piece of cookware placed above the glass or glass-ceramic element.

[0004] German Patent Application DE 10 2004 053 963 A1 discloses an induction-heated stove. A glass-ceramic plate of said stove comprises an electrically conductive layer for reducing electrical charging of the piece of cookware.

SUMMARY OF THE INVENTION

[0005] It is an objective of the embodiments of the invention to provide an induction hob for convexly-shaped pieces of cookware comprising shielding capabilities for reducing electrical charging of said piece of cookware. The objective is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims. If not explicitly indicated otherwise, embodiments of the invention can be freely combined with each other.

[0006] According to an aspect, the invention relates to an induction hob. The induction hob comprises a glass or glass-ceramic element and an induction coil in order to provide a heating zone at said glass or glass-ceramic element. Said glass or glass-ceramic element comprises at its lower surface a conductive layer or a group of conductive layers, said conductive layer or group of conductive layers being made of an electrically conductive material. Said glass or glass-ceramic element comprises a concavely-shaped portion or recess below which said induction coil is arranged.

[0007] Said induction hob is advantageous because said conductive layer provided at the lower side of the glass or glass-ceramic element significantly reduces the electrical charging of the piece of cookware which comprise a convex lower portion, in order to be received in said concavely-shaped portion of said glass or glass-ceramic element.

[0008] According to embodiments, said conductive layer or group of conductive layers is directly arranged at the lower surface of the glass or glass-ceramic element. So, in other words, there is no gap between the lower surface of the glass or glass-ceramic element and the conductive layer or group of conductive layers. Thereby the shielding effect is significantly improved.

[0009] According to embodiments, said conductive layer or group of conductive layers comprise a central portion which is not covered by said electrically conductive material. Thereby the coil temperature is reduced during the cooking process.

[0010] According to embodiments, said group of conductive layers comprises multiple conductive layer sections, said conductive layer sections being associated to a single induction coil in order to provide an electromagnetic shield to said induction coil. Adjacent conductive layer sections may be at least partially separated by one or more gaps at which no electrically conductive material is provided. Thereby the coupling efficiency is enhanced and the quantity of conductive material can be reduced.

[0011] According to embodiments, said conductive layer comprises a ring-like shape. Said conductive ring-shaped layer may be centred with respect to the induction coil arranged below said conductive layer. Thereby, an integrally formed conductive layer with high shielding capabilities is obtained.

[0012] According to embodiments, said group of conductive layers comprises multiple conductive layer sections, wherein longitudinal axes of said conductive layer sections are radially arranged with respect to a centre of the induction coil associated with said group of conductive layers. Said sectioned conductive layer can be manufactured with reduced technical effort.

[0013] According to embodiments, said group of conductive layers comprises multiple concentrically arranged ring sections, wherein adjacent ring sections are separated from each other by ring-shaped or ring section-shaped areas which are not covered by said electrically conductive material. Said segmented conductive layer comprising multiple concentric rings provides effective shielding capabilities.

[0014] According to embodiments, said conductive layer or group of conductive layers is coupled to ground potential or earth connection of the induction hob, specifically, to the chassis of the induction hob. Preferably, the chassis provides a circular cut-out at its upper portion in which said glass or glass-ceramic element is inserted. Said conductive layer or group of conductive layers is preferably coupled with ground by providing an electrical connection between the conductive layer or group of conductive layers and a portion of the chassis which is arranged in close proximity to said circular cut-out.

[0015] According to embodiments, said electric coupling between said conductive layer or group of conductive layers and ground potential or earth connection of the induction hob is performed by means of electrically conductive brackets. Said brackets provide an electrical coupling between the conductive layer or group of conductive layers and a portion of the chassis which is arranged next to said circular cut-out in which said glass or glass-ceramic element is inserted. Preferably, said metallic brackets are also used for mechanically coupling the glass or glass-ceramic element with the chassis.

[0016] According to embodiments, the group of con-

ductive layers are coupled between each other by means of bridging portions arranged at the lower surface of said glass or glass-ceramic element and made of electrically conductive material. By means of said bridging portions it is possible to electrically couple multiple conductive layer sections. Thereby, when coupling one conductive layer section with ground, all conductive layer sections are grounded via said bridging portions.

[0017] According to embodiments, said electrically conductive material arranged at the lower surface of said glass or glass-ceramic element is an electrically conductive painting. Said electrically conductive painting may be digitally printed (e.g. ink-jet printing), sprayed or sputtered to said lower surface.

[0018] According to embodiments, said electrically conductive material comprises or contains graphite or silver. According to other embodiments, any conductive material can be used, for example copper, aluminium etc.

[0019] According to embodiments, said conductive layer or said group of conductive layers at least partially extends at slanted side portions which laterally confine said concavely-shaped portion or recess of said glass or glass-ceramic element. More in detail, said conductive layer or said group of conductive layers is provided at side portions, which are in close proximity to the edge of the cut-out of the chassis in which said glass or glass-ceramic element is included. Thereby, an electrical coupling between the conductive layer or said group of conductive layers and the chassis can be obtained with reduced effort.

[0020] According to embodiments, said conductive layer or said group of conductive layers is spatially associated to an area covered by said induction coil and an outer edge of said conductive layer or said group of conductive layers is adapted to the shape of the induction coil and surrounds the outer edge of the inductive coil at a certain radial distance. Such arrangement of said conductive layer or said group of conductive layers achieves a sufficient shielding effect with reduced technical effort.

[0021] According to a further aspect, the invention relates to a method for reducing electrical charging of a piece of cookware arranged at an induction hob. The induction hob comprises a glass or glass-ceramic element and an induction coil. A conductive layer or a group of conductive layers is applied to a lower surface of said glass or glass-ceramic element, said conductive layer or group of conductive layers being made of an electrically conductive material. Said electrical charging is reduced by said conductive layer or a group of conductive layers which is applied to a concavely-shaped section of said glass or glass-ceramic element below which said induction coil is arranged.

[0022] The term "essentially" or "approximately" as used in the invention means deviations from the exact value by +/- 10%, preferably by +/- 5% and/or deviations in the form of changes that are insignificant for the function.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The various aspects of the invention, including its particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 shows an example block diagram of an induction hob;

Fig. 2 shows a top view of a conductive layer comprising multiple conductive layer sections in form of circle segments;

Fig. 3 shows a top view of a ring-shaped conductive layer; and

Fig. 4 shows a top view of a conductive layer comprising multiple conductive layer sections in form of different-sized, concentric rings.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] The present invention will now be described more fully with reference to the accompanying drawings, in which example embodiments are shown. However, this invention should not be construed as limited to the embodiments set forth herein. Throughout the following description similar reference numerals have been used to denote similar elements, parts, items or features, when applicable.

[0025] Fig. 1 discloses a schematic diagram of an induction hob 1. The induction hob 1 comprises a chassis 1.1, in the following also referred to as housing. At the upper side of the external chassis 1.1, a glass-ceramic element 2 is provided in order to provide a heating zone 4. Below said glass-ceramic element 2, one or more induction coils 3 are provided. The induction coil 3 is electrically coupled with a power circuit 8 which provides high-frequency electric power to the induction coil 3 in order to provide heat at a piece of cookware 7. More in detail, said power circuit 8 is adapted to provide electric power to a resonant circuit in which the induction coil 3 is included and which is electrically and/or magnetically coupled with the cookware 7. In order to generate said electric power, the power circuit 8 comprises one or more switching elements. Said switching elements may be, for example, IGBTs and transistors of any constructive technology.

[0026] As shown in Fig. 1, in the area of the heating zone 4, the glass-ceramic element 2 at least partially comprises a concavely-shaped portion thereby forming a recess which opens upwardly. Said recess is adapted to receive a portion of a piece of cookware 7 which comprises a convexly-shaped lower portion. Said piece of cookware 7 may be, for example, a wok or a wok-like pan.

[0027] In order to obtain an effective induction heating

effect, the shape of the induction coil 3 corresponds to the shape of the glass-ceramic element 2. In other words, also the induction coil 3 may comprise a concave shape which is adapted to the concave shape of the glass-ceramic element 2.

[0028] In order to avoid or reduce electrical charging of the piece of cookware 7 during induction heating, the glass-ceramic element 2 comprises an electrically conductive layer 5. The term "conductive layer" may refer to an integrally formed, contiguous layer or a group of conductive layers which are separated from each other or interconnected by bridging portions.

[0029] The electrically conductive layer 5 is arranged at the lower surface 2.2 of the glass-ceramic element 2, specifically, at the lower surface 2.2 of the concavely-shaped portion 2.1 of the glass-ceramic element 2. More in detail, the electrically conductive layer 5 is directly attached to said lower surface 2.2 of the glass-ceramic element 2.

[0030] The electrically conductive layer 5 comprises an electrically conductive material. Said material may be applied as a painting to said glass-ceramic element 2, for example, by spraying, other printing techniques or thermal transfer techniques. According to other embodiments, the electrically conductive material may be applied by a sputtering process or by adhering a metallic foil to the glass-ceramic element 2.

[0031] In order to achieve a shielding effect, the electrically conductive layer 5 is electrically coupled with ground (earth potential). Said grounding may be achieved by coupling the electrically conductive layer 5 to the ground wire or earth connection.

[0032] In the present embodiment, said electrical connection between the electrically conductive layer 5 and ground is achieved by means of brackets 6, specifically electrically conductive brackets 6 (e.g. metallic brackets). Said brackets 6 may be arranged between the glass-ceramic element 2 and the chassis 1.1 of the induction hob 1. More in detail, said brackets 6 may be arranged at a lower side of the glass-ceramic element 2 and may additionally provide a fixing of glass-ceramic element 2 at the chassis 1.1. Due to the coupling of the chassis 1.1 with ground, the electrically conductive layer 5 is connected via said brackets 6 and said chassis 1.1 to ground. However, it is worth mentioning that there are also other possibilities for coupling the electrically conductive layer 5 with ground.

[0033] As shown in Fig. 1, the chassis 1.1 or a grounded chassis portion surrounds the glass-ceramic element 2. In the present embodiment, the glass-ceramic element 2 is included in a recess or cut-out provided in the upper portion 1.1.1 of the chassis 1.1. More in detail, the chassis 1.1 may comprise an upper portion 1.1.1 which is not integrally formed with the glass-ceramic element 2. For example, said upper portion may be made of stainless steel. Said upper portion 1.1.1 comprises a recess or cut-out in which said glass-ceramic element 2 is received. At least the lower section of the upper portion 1.1.1 may

be electrically conductive and grounded in order to enable a grounding of the electrically conductive layer 5 via said brackets 6.

[0034] The area, at which said electrically conductive layer 5 is provided, is essentially limited to the area below which the induction coil 3 is provided. More in detail, the electrically conductive layer 5 at least partially overlaps with the cross-sectional area of the induction coil 3 and extends laterally beyond said cross-sectional area.

[0035] The electrically conductive layer 5 is spatially associated with the cross-sectional area of the induction coil 3. More in detail, said electrically conductive layer 5 comprises an outer edge 5.4, wherein said outer edge 5.4 is adapted to the cross-sectional shape of the induction coil 3 and said outer edge 5.4 at least partially surrounds an outer edge of the induction coil 3 at a certain radial distance r . Thereby a well-confined electrically conductive layer 5 is provided which provides a sufficient shield for the piece of cookware 7 and which can be manufactured at reasonable costs.

[0036] As shown in Fig. 1, said electrically conductive layer 5 is provided at one or more side portions 2.3 of the glass-ceramic element 2, said side portions 2.3 may be slanted with respect to the horizontal direction, respectively, slanted with respect to the tangential direction at the lowest section of the concavely-shaped portion 2.1. However, in other embodiments, no electrically conductive layer 5 is provided at the central portion of the glass-ceramic element 2 (which is the lowest portion of the concavely-shaped portion 2.1). So, in other words, the electrically conductive layer 5 may comprise at least a gap in an area directly above the centre 3.1 of the induction coil 3.

[0037] Fig. 2 to 4 show different configurations of said electrically conductive layer 5. The outer edge of the induction coil 3 is indicated in said figures by means of a dashed circle.

[0038] In Fig. 3, the electrically conductive layer 5 is integrally formed and comprises a ring-like shape with a central gap.

[0039] The configurations in Fig. 2 and 4 comprise groups of conductive layers, i.e. multiple conductive layer sections 5.2 which are associated with a single induction coil 3.

[0040] The embodiment according to Fig. 2 comprises multiple conductive layer sections 5.2 comprising the shape of circle segments. However, said conductive layer sections 5.2 may also have another shape, for example, a strip-like shape. The longitudinal axes of said conductive layer sections 5.2 may be radially arranged with respect to the centre 3.1 of the induction coil 3.

[0041] The conductive layer sections 5.2 according to Fig. 4 comprise a ring-like shape and are arranged concentrically with respect to the centre 3.1 of the induction coil 3. Due to the different radii of the ring-shaped conductive layer sections 5.2, the conductive layer sections 5.2 are at least partially separated from each other by gaps which also have a ring-like or ring-section-like

shape.

[0042] As shown in Fig. 4, the conductive layer sections 5.2 can be coupled by bridging portions order to electrically couple said conductive layer sections 5.2 with each other. Thereby, by connecting one conductive layer section 5.2 with ground, all other conductive layer sections 5.2 are grounded, too.

[0043] It is worth mentioning that the design of the conductive layer 5 or conductive layer sections 5.2 is not limited to the shown embodiments. In contrary thereto, a plurality of modifications may be possible which are also covered by the invention as claimed.

[0044] The thickness and resistance of conductive layer may be chosen according to the given requirements, specifically based on the chosen conductive material.

[0045] It should be noted that the description and drawings merely illustrate the principles of the proposed invention. Those skilled in the art will be able to implement various arrangements that, although not explicitly described or shown herein, embody the principles of the invention.

List of reference numerals

[0046]

- 1 induction hob
- 1.1 chassis / housing
- 1.1.1 upper portion
- 2 glass / glass-ceramic element
- 2.1 concavely-shaped portion / recess
- 2.2 lower surface
- 2.3 side portion
- 3 induction coil
- 3.1 centre of induction coil
- 4 heating zone
- 5 conductive layer
- 5.1 central portion
- 5.2 conductive layer section
- 5.3 bridging portion
- 5.4 outer edge
- 6 bracket
- 7 piece of cookware
- 8 power circuit

r radial distance

Claims

1. Induction hob comprising a glass or glass-ceramic element (2) and an induction coil (3) in order to provide a heating zone (4) at said glass or glass-ceramic element (2), wherein said glass or glass-ceramic element (2) comprises at its lower surface a conductive layer (5) or a group of conductive layers, said conductive layer (5) or group of conductive layers being made of an electrically conductive material, wherein

said glass or glass-ceramic element (2) comprises a concavely-shaped portion (2.1) or recess below which said induction coil (3) is arranged.

2. Induction hob according to claim 1, wherein said conductive layer (5) or group of conductive layers is directly arranged at the lower surface of the glass or glass-ceramic element (2) .
3. Induction hob according to claim 1 or 2, wherein said conductive layer (5) or group of conductive layers comprise a central portion (5.1) which is not covered by said electrically conductive material.
4. Induction hob according to anyone of the preceding claims, wherein said group of conductive layers comprises multiple conductive layer sections (5.2), said conductive layer sections (5.2) being associated to an induction coil (3), specifically to a single induction coil in order to provide an electromagnetic shield to said induction coil (3).
5. Induction hob according to anyone of the claims 1 to 3, wherein said conductive layer (5) comprises a ring-like shape.
6. Induction hob according to anyone of the claims 1 to 4, wherein said group of conductive layers comprises multiple conductive layer sections (5.2), wherein longitudinal axes of said conductive layer sections (5.2) are radially arranged with respect to a centre (3.1) of the induction coil (3) associated with said group of conductive layers.
7. Induction hob according to anyone of the claims 1 to 4, wherein said group of conductive layers comprises multiple concentrically arranged ring sections, wherein adjacent ring sections are separated from each other by ring-shaped or ring section-shaped areas which are not covered by said electrically conductive material.
8. Induction hob according to anyone of the preceding claims, wherein said conductive layer (5) or group of conductive layers is coupled to ground potential of the induction hob (1), specifically to the chassis (1.1) of the induction hob (1).
9. Induction hob according to claim 8, wherein said electric coupling between said conductive layer (5) or group of conductive layers and ground potential of the induction hob (1) is performed by means of electrically conductive brackets (6) .
10. Induction hob according to anyone of the preceding claims, wherein the group of conductive layers are coupled between each other by means of bridging portions (5.3) arranged at the lower surface (2.2) of

said glass or glass-ceramic element (2) and made of electrically conductive material.

11. Induction hob according to anyone of the preceding claims, wherein said electrically conductive material arranged at the lower surface (2.2) of said glass or glass-ceramic element (2) is an electrically conductive painting. 5
12. Induction hob according to anyone of the preceding claims, wherein said electrically conductive material comprises or contains graphite, silver or copper. 10
13. Induction hob according to anyone of the preceding claims, wherein said conductive layer (5) or said group of conductive layer at least partially extends at slanted side portions (2.3) which laterally confine said concavely-shaped portion (2.1) or recess of said glass or glass-ceramic element (2). 15
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14. Induction hob according to anyone of the preceding claims, wherein said conductive layer (5) or said group of conductive layers is spatially associated to an area covered by said induction coil (3) and an outer edge (5.4) of said conductive layer (5) or said group of conductive layers is adapted to the shape of the induction coil (3) and surrounds the outer edge of the inductive coil (3) at a certain radial distance (r) . 25
15. Method for reducing electrical charging of a piece of cookware (7) arranged at an induction hob (1), the induction hob (1) comprising a glass or glass-ceramic element (2) and an induction coil (3), wherein a conductive layer (5) or a group of conductive layers is applied to a lower surface (2.2) of said glass or glass-ceramic element (2), said conductive layer (5) or group of conductive layers being made of an electrically conductive material, wherein said electrical charging is reduced by said conductive layer (5) or a group of conductive layers which is applied to a concavely-shaped section (5.2) of said glass or glass-ceramic element (2) below which said induction coil (3) is arranged. 30
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FIG 1

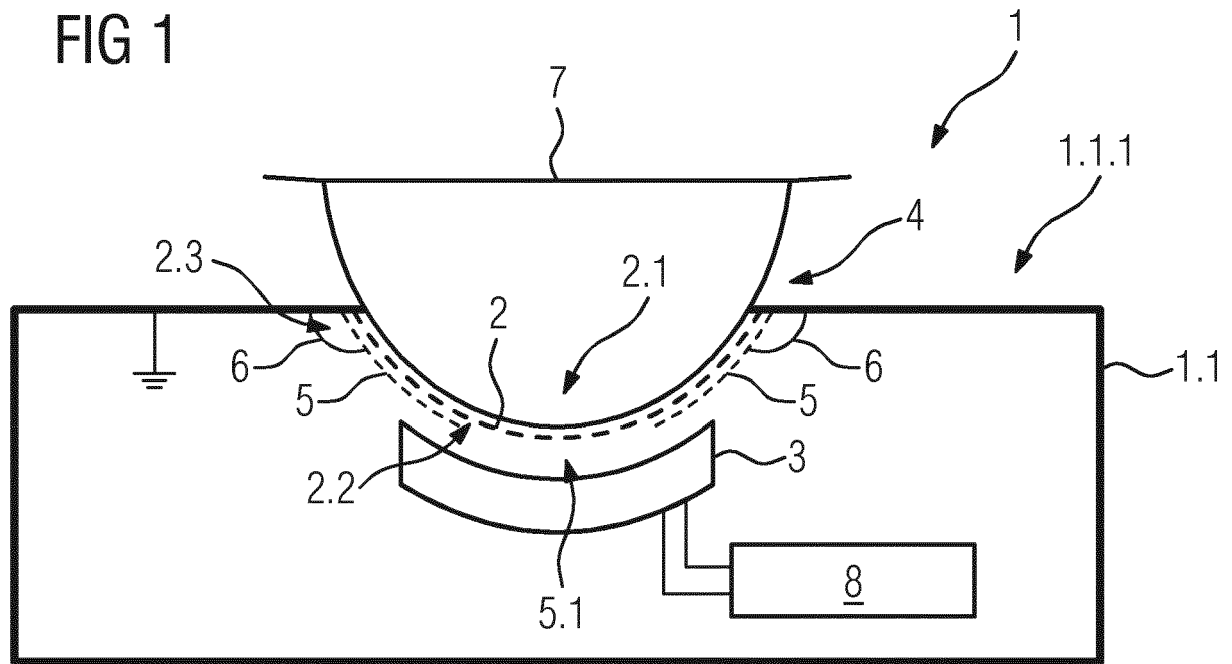


FIG 2

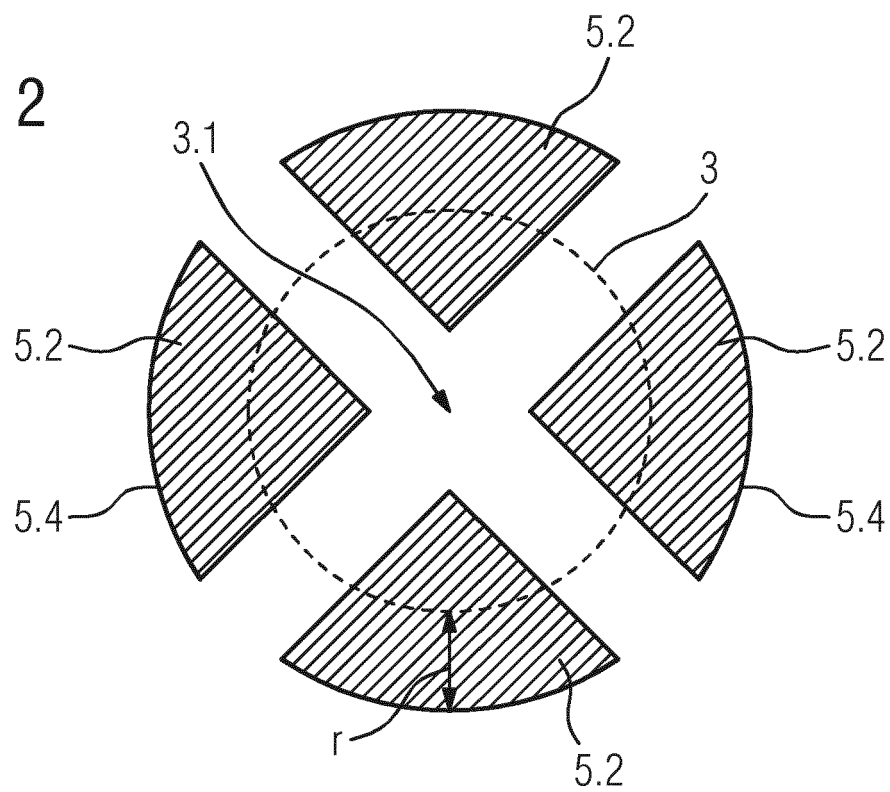


FIG 3

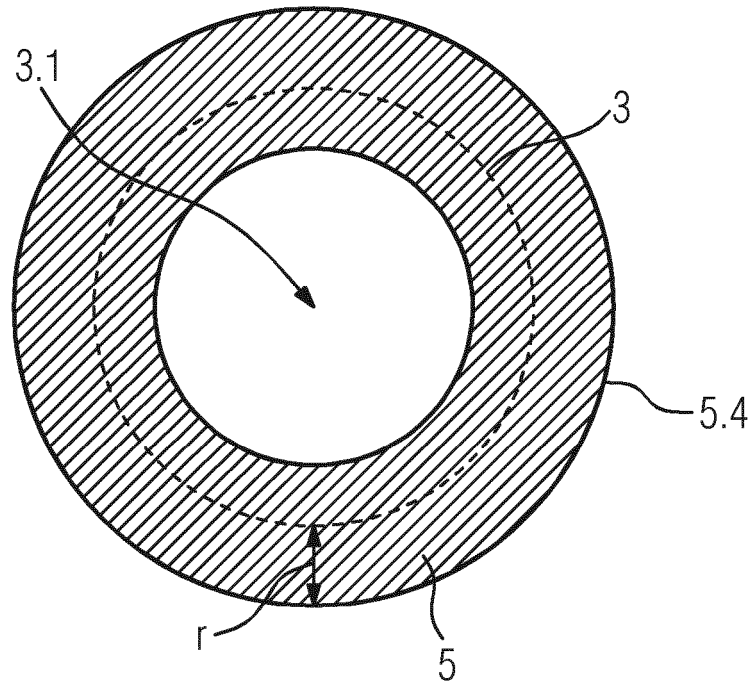
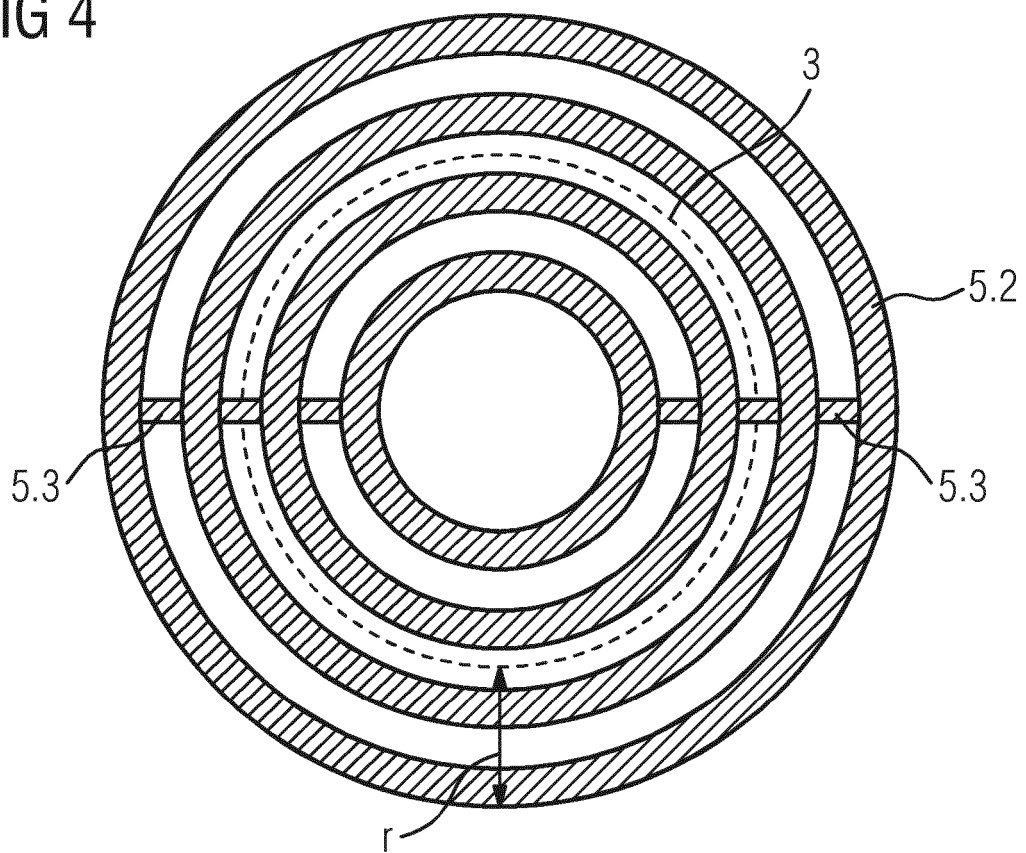


FIG 4





EUROPEAN SEARCH REPORT

 Application Number
 EP 18 18 2343

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Place of search Munich		Date of completion of the search 11 January 2019	Examiner Pierron, Christophe
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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