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(54) COOKING APPLIANCE HAVING A COVER ELEMENT WITH HIGH REFLECTIVITY SURFACE

(57) A cooking appliance (1), in particular a domestic cooking oven, comprising:
- a cavity (2) comprising at least one cavity wall defining a cooking chamber (4) for cooking foodstuff therein and an opening for placing foodstuff into the cooking chamber (4),
- at least one thermal radiation emitting heating element (5) for heating said cavity (2), wherein the at least one heating element (5) is arranged within said cavity (2) adjacent to or in contact with the cavity wall (3),
- at least one cover element (6) being arranged within the cavity (2), wherein the cover element (6) forms a partition wall between the cooking chamber (4) and a hot air chamber (7) in which hot air for heating the cooking chamber (4) can be generated by heating the at least one heating element (5), the cover element (6) comprises a first surface (6a) being directed to the cooking chamber (4) and a second surface (6b) being directed to the hot air chamber (7),
characterised in that
the second surface (6b) comprises a reflectivity for thermal radiation that is higher than a reflectivity for thermal radiation of the first surface (6a).

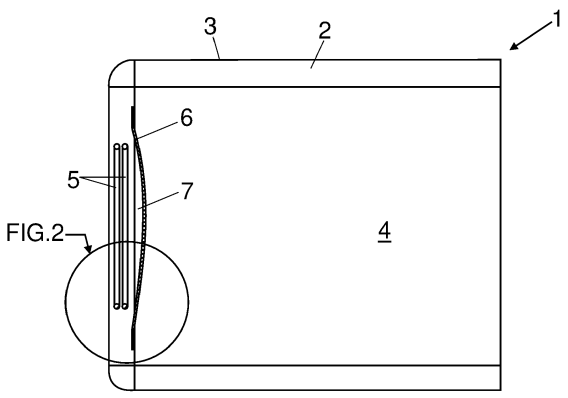

FIG.1

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Description

[0001] The present invention relates to a cooking appliance, in particular a domestic cooking oven.

[0002] US 2014/0110392 A1 discloses a baffle for directing air in a convection oven. The baffle comprises vents and conduits to produce airflow throughout the cooking chamber and to evenly distribute cooking temperatures.

[0003] WO 2006/122118 A2 discloses radiant convection baffles for ovens that may comprise a fan, catalysts and a heater. The fan is arranged to circulate air over the heater and the catalysts. A support structure is formed to the baffle to deflect air circulated by the fan in opposite direction.

[0004] Baffles known in the art have slots, openings and gaps through which hot air can stream and which are subject to staining from contaminants solved in the hot air stream or moved by the hot air stream, such as hot fat drops, vapor or the like. Such baffles are difficult to clean for a user of the cooking appliance, since the openings are difficult to be manually reached and remains of foodstuff previously cooked may adhere tenaciously to the surfaces of the baffle and/or to the cooking chamber walls.

[0005] The object of the present invention is to provide a cooking appliance that can be advantageously cleaned.

[0006] This object is solved by a cooking appliance, in particular a domestic cooking oven, comprising:

- a cavity comprising at least one cavity wall defining a cooking chamber for cooking foodstuff therein and an opening for placing foodstuff into the cooking chamber,
- at least one thermal radiation emitting heating element for heating said cavity, wherein the at least one heating element is arranged within said cavity adjacent to or in contact with the cavity wall,
- at least one cover element being arranged within the cavity, wherein the cover element forms a partition wall between the cooking chamber and a hot air chamber in which hot air for heating the cooking chamber can be generated by heating the at least one heating element, the cover element comprises a first surface being directed to the cooking chamber and a second surface being directed to the hot air chamber. According to the invention, the second surface comprises a reflectivity for thermal radiation that is higher than a reflectivity for thermal radiation of the first surface.

[0007] Thus, the surface temperature of the second surface can be reduced under normal operation conditions of the cooking appliance. This results in a decreased temperature of the cover element and, consequently, in a decreased surface temperature of the first surface being directed to the cooking chamber. Therefore, by reducing the surface temperature of the first surface during operation of the cooking appliance, it is possible to coat the first surface with an easy-to-clean coating that is temperature sensitive and that does not tolerate a surface temperature above 300°C to 350°C. Reflectivity shall be understood as the ability of the surface to reflect a portion of the incoming radiation back from the surface. The portion of the radiation that is not reflected is absorbed by the body, i.e. the cover element.

[0008] According to an advantageous embodiment of the invention, the heating element is positioned within the hot air chamber and is configured such that at least a portion of the thermal radiation emitted by the at least one heating element hits the second surface of the cover element, wherein the second surface is configured to reflect at least 30% of the portion of the thermal radiation that hits the second surface.

[0009] It is particularly advantageous, if the second surface reflects at least 30% if the incoming thermal radiation.

[0010] According to a further advantageous embodiment of the invention, the second surface is configured to reflect at least 40% or at least 50%, in particular at least 55%, preferably at least 60% or at least 65% or at least 70% or at least 75% or at least 80% of the portion of the thermal radiation that hits the second surface.

[0011] Reflectivity for infrared or thermal radiation, e. g. the reflectivity of a stainless steel material surface can be increased by providing a surface with increased gloss, e.g. by sanding and/or polishing. It has been found by the applicant that under normal operation conditions of a cooking oven, a second surface being provided as a stainless steel surface or as a surface having a comparable reflectivity for thermal radiation can reduce the surface temperature of the first surface by about 30°C to 40°C compared to a cast iron surface or a conventional enamel surface. The reflectivity of a stainless steel surface without specific surface treatment is in the range of 50% to 55%.

[0012] Further advantageously, the first surface has an emissivity for thermal radiation higher than an emissivity for thermal radiation of the second surface.

[0013] Thus, the emission of thermal radiation towards the cooking chamber by the first surface can be increased. Additionally, the effect of a reduced surface temperature of the first surface is increased also. It shall be appreciated that emissivity of a surface of a material is its effectiveness in emitting energy as thermal radiation. Thermal radiation is electromagnetic radiation that may include both visible radiation (light) and infrared radiation, which is not visible to human eyes. Quantitatively, emissivity is the ratio of the thermal radiation emitted from a surface to the radiation emitted from an ideal black surface at the same temperature as given by the Stefan-Boltzmann law.

[0014] Particularly advantageous, the emissivity of the first surface may be equal or higher than 0,7. Additionally or alternatively, the emissivity of the second surface may be equal or lower than 0,3.

[0015] Such a ratio of emissivity of the first surface and emissivity of the second surface results in a relatively high emissivity of the first surface. Consequently, the surface temperature of the first surface can be maintained relatively low under normal operation conditions of the cooking appliance, which allows the advantageous use of a temperature sensitive easy-to-clean coating on the first surface.

[0016] It is also advantageous if the second surface is provided as a coating-free surface, in particular as a surface of a steel material, preferably a polished steel material or a stainless steel material or a polished stainless steel material, or in particular as a surface of an aluminium material or an aluminium compound material.

[0017] Specifically, the use of a stainless steel material allows preforming of the cover element from stainless steel and subsequent coating on the cooking chamber side of the cover element with an easy-to-clean coating.

[0018] Further advantageously, the second surface may be provided by a coating. In particular the second surface may be provided by a coating having an emissivity equal or lower than 0,3. Additionally or alternatively, the second surface may be provided by a coating applied to a steel material or an aluminium material or an aluminium compound material comprised by the cover element. Preferably the coating may be an aluminium coating.

[0019] Thus, the cover element can be made from a cheaper material than stainless steel, e.g. from cast iron or another iron optionally having an enamel coating. The coating having a low emissivity, e.g. an aluminium coating which has also a high reflectivity for thermal radiation, may be applied to such a material.

[0020] Additionally, the steel material or the aluminium material or the aluminium compound material comprised by the cover element may be coated by an intermediate coating, in particular comprising an enamel material or a ceramic base material or a non-stick and/or non-wetting coating material, forming a layer between the steel material or the aluminium material or the aluminium compound material and the coating forming the first surface, wherein the intermediate coating has a higher emissivity than the emissivity of the coating forming the first surface.

[0021] Thus, pre-fabrication of the cover element is enabled, wherein the cover element is provided from a specific material being coated with the intermediated coating, e.g. on the first surface side as well as on the second surface side. Subsequently, the coating, e.g. the aluminium coating, forming the second surface is applied on the hot air chamber side of the cover element only. As a result, a cover element is achieved, that comprises a first surface formed by an enamel material or a ceramic base material or a non-stick and/or non-wetting coating material and a second surface formed by the coating having a low emissivity and being applied on the intermediate coating.

[0022] Advantageously, the first surface is provided by a coating comprising an enamel material or a ceramic base material or a non-stick and/or non-wetting coating material.

[0023] Specifically a non-stick and/or non-wetting coating material which has easy to clean properties allows simple cleaning of the cover element.

[0024] Further advantageous, the cover element may be arranged at a distance to the at least one heating element, wherein the distance is within a range from 2mm to 20mm, in particular within 4mm to 10mm, preferably within 5mm to 7mm, more preferably within 5mm to 6mm.

[0025] The surface temperature of the first surface may be further decreased by increasing the distance of the cover element from the heating element. However, a large distance negatively affects the hot air generation within the hot air chamber. The claimed ranges have been found to show the best results for a low surface temperature of the first surface and efficient hot air generation within the hot air chamber. Particularly advantageous is a distance between 5mm and 6mm.

[0026] Furthermore advantageous is a cover element comprising a sheet-like cover section separating the cooking chamber from the hot air chamber, wherein the thickness of the cover section is within a range of 0,3mm to 2mm, in particular within a range of 0,5mm to 1,2mm, preferably within a range of 0,5mm to 0,7mm. Specifically for such a cover element, the surface temperature of the first surface can be maintained in a range tolerable for an easy-to-clean coating.

[0027] The invention will be explained in further detail with reference to the accompanying drawings, in which:

Fig. 1 is a cross-sectional side view of a cavity of a cooking appliance according to an exemplary embodiment of the invention;

Fig. 2 is an enlarged view of the detail as indicated in Fig. 1;

[0028] Fig. 1 illustrates a cooking appliance 1 such as a domestic cooking oven comprising a cavity 2. Further commonly known parts of the cooking appliance 1 such as a housing, an operation panel and a door are not shown. The cavity 2 defines a cooking chamber 4. Foodstuff to be cooking can be disposed within the cooking chamber 4. A heating element 5 is arranged within the cavity 2 close to a rear wall of the cavity 2 being part of a cavity wall 3.

[0029] A cover element 6 is arranged within the cavity 2, separating the cooking chamber 4 from a hot air chamber 7 in which the heating element 5 is placed. The heating element 5 is configured to heat up air within the hot air chamber 7 which can be conveyed from the hot air chamber 7 into the cooking chamber 4, e.g. by means a fan that may be arranged within the hot air chamber 7 or, alternatively, outside of the hot air chamber 7.

[0030] The cover element 6 comprises a first surface 6a and a second surface 6b, wherein the first surface 6a is directed to the cooking chamber 4 and the second surface 6b is directed to the hot air chamber 7. The second

surface 6b is configured to have a relatively high reflectivity for thermal radiation in order to reflect a large portion of the thermal radiation emitted by the heating element 5 and hitting the cover element 6. This has the effect that the surface temperature of the cover element 6 on the cooking chamber side, i.e. the surface temperature of the first surface 6a can be decreased.

[0031] Further, the first surface 6a is configured to a have a high emissivity ε_1 for thermal radiation. At least, the emissivity ε_1 of the first surface 6a is selected to be higher than the emissivity ε_2 of the second surface 6b. A particularly advantageous ratio has been found to be ε_1 equal or higher than 0,7 and ε_2 to be equal or lower than 0,3.

[0032] The technical effect of the first surface 6a having a relatively high emissivity ε_1 is that the emission of thermal radiation of from the cover element 6 towards the cooking chamber 4 is high. During operation of the heating element 5, the cover element 6 is heated up and efficiently emits thermal radiation on the cooking chamber side. This also contributes in maintaining the first surface 6a at a relatively low surface temperature.

[0033] Keeping the first surface 6a, i.e. the cooking chamber side surface of the cover element 6 at a relatively low surface temperature allows the use of a temperature sensitive coating to be applied on the first surface 6a, such as an easy-to-clean coating.

[0034] An example for an easy-to-clean coating is a ceramic non-stick and/or non-wetting coating comprising at least a first and a second layer, wherein the first layer is applied to a pretreated substrate surface of the cover element 6 or a surface of a ground layer or a pretreated surface of a protective layer that is intended to be arranged on the cooking chamber side. The second layer is applied to the first layer, so that a cover element 6 comprising a coating having base layer and top layer is obtained.

[0035] Particularly, the second layer is obtained by a sol-gel process from a second composition comprising a silica sol, a silane and a siloxane, in particular a polydimethylsiloxane. Such a coating having at least a second layer is also known from EP 2 177 580 B1.

[0036] In other words: The second layer, hereinafter also referred to as top layer, is composed of a matrix comprising the condensation reaction product of a silica sol, a silane and a siloxane. Obtained by a sol-gel process from a second composition has therefore to be understood in such a way, that the second layer is obtained by means of hydrolysis and (poly-)condensation of an aqueous mixture comprising at least a silica sol, a silane and a siloxane. Thus, the starting materials of the second composition, namely at least silica sol, silane, siloxane and water if needed, are mixed together and stirred. The mixture obtained thereof is then applied to the inner surface of the first layer and dried to obtain the second layer.

[0037] Preferably, the silica sol is present in an amount of 15 to 70wt%, in particular in an amount of 30 to 70wt% and/or the silane is present in an amount of 2 to 70wt%, in particular in an amount of 10 to 40wt%, both in the first and/or the second composition and/or in the first and/or second layer.

[0038] In particular the silane in the first and/or the second composition and/or in the first and/or second layer is an organoalkoxysilane, in particular a methyltrimethyoxysilane and/or a fluoralkoxysilane.

[0039] The first and/or the second composition and/or in the first and/or second layer may comprise a catalyst, in particular an acidic catalyst, more preferably an organic compound containing one or more carboxyl groups and/or a mineral acid, e.g. hydrochloric acid, sulfuric acid or nitric acid. Different monocarboxylic or dicarboxylic acids like formic acid, acetic acid or oxalic acid may be mentioned here as an example for suitable catalysts.

[0040] It has been shown, that it is advantageous, if the catalyst is present in an amount of 0,1 to 5 wt%, in particular in an amount of 0,1 to 2 wt%, both in the first and the second composition and/or in the first and/or second layer. The catalyst generally acts as a catalyst in the hydrolysis and condensation reaction and prevents too slow crosslinking.

In another preferred embodiment, the first and/or the second composition and/or in the first and/or second layer comprise or comprises a solvent, in particular an organic solvent. Examples for organic solvents are alcoholic solvents, for example methanol, ethanol or propanol.

[0041] In particular, the solvent is present in an amount of 10 to 60wt%, in particular in an amount of 10 to 40wt%.

[0042] Like the second composition or second layer, the first composition or first layer may also comprise a siloxane in a preferred embodiment. Said siloxane is in particular a polydimethylsiloxane.

[0043] An advantageous amount of siloxane in the first composition or first layer as well as in the second composition or second layer is between 0,1 to 2 wt%.

[0044] The first composition or first layer and/or the second composition or second layer may comprise pigments and/or dyes and/or filling materials and/or further additives. In particular, temperature resistant anorganic pigments are favourable.

[0045] In addition, water may be added to the first composition and/or the second composition, if needed.

[0046] Typically, such a ceramic non-stick and/or non-wetting coating is able to tolerate a surface temperature of about 300°C to 350°C, but decomposes when being exposed to higher temperatures. Therefore, the first surface 6a of the cover element 6 is required to not exceed a surface temperature of 350°C or prefereably of 300°C.

List of reference numerals

[0047]

1	Cooking appliance
2	Cavity
3	Cavity wall
4	Cooking chamber

5 Heating element
6 Cover element
6a First surface
6b Second surface
7 Hot air chamber

ε_1 Emissivity of first surface
ε_2 Emissivity of second surface

Claims

1. A cooking appliance (1), in particular a domestic cooking oven, comprising:

- a cavity (2) comprising at least one cavity wall defining a cooking chamber (4) for cooking foodstuff therein and an opening for placing foodstuff into the cooking chamber (4),
- at least one thermal radiation emitting heating element (5) for heating said cavity (2), wherein the at least one heating element (5) is arranged within said cavity (2) adjacent to or in contact with the cavity wall (3),
- at least one cover element (6) being arranged within the cavity (2), wherein the cover element (6) forms a partition wall between the cooking chamber (4) and a hot air chamber (7) in which hot air for heating the cooking chamber (4) can be generated by heating the at least one heating element (5), the cover element (6) comprises a first surface (6a) being directed to the cooking chamber (4) and a second surface (6b) being directed to the hot air chamber (7), **characterised in that**

the second surface (6b) comprises a reflectivity for thermal radiation that is higher than a reflectivity for thermal radiation of the first surface (6a).

2. Cooking appliance (1) according to claim 1, **characterized in that** the heating element (5) is positioned within the hot air chamber (7) and is configured such that at least a portion of the thermal radiation emitted by the at least one heating element (5) hits the second surface (6b) of the cover element (6), wherein the second surface (6b) is configured to reflect at least 30% of the portion of the thermal radiation that hits the second surface (6b).

3. Cooking appliance (1) according to claim 2, **characterized in that** the second surface (6b) is configured to reflect at least 40% or at least 50%, in particular at least 55%, preferably at least 60% or at least 65% or at least 70% or at least 75% or at least 80% of the portion of the thermal radiation that hits the second surface (6b).

4. Cooking appliance (1) according to any one of the preceding claims, **characterized in that** the first surface (6a) has an emissivity (ε_1) for thermal radiation higher than an emissivity (ε_2) for thermal radiation of the second surface (6b) .

5. Cooking appliance (1) according to claim 4, **characterized in that** the emissivity (ε_1) of the first surface (6a) is equal or higher than 0,7 and/or **in that** the emissivity (ε_2) of the second surface (6b) is equal or lower than 0,3.

6. Cooking appliance (1) according to any one of the preceding claims, **characterized in that** the second surface (6b) is provided as a coating-free surface, in particular as a surface of a steel material, preferably a polished steel material or a stainless steel material or a polished stainless steel material, or in particular as a surface of an aluminium material or an aluminium compound material.

7. Cooking appliance (1) according to any one of the claims 1 to 5, **characterized in that** the second surface (6b) is provided by a coating,
in particular wherein the second surface (6b) is provided by a coating having an emissivity equal or lower than 0,3 and/or in particular wherein the second surface (6b) is provided by a coating applied to a steel material or an aluminium material or an aluminium compound material comprised by the cover element (6), preferably wherein the coating is an aluminium coating.

8. Cooking appliance (1) according to claim 7, **characterized in that** the steel material or the aluminium material or the aluminium compound material comprised by the cover element (6) are coated by an intermediate coating, in particular comprising an enamel material or a ceramic base material or a non-stick and/or non-wetting coating material, forming a layer between the steel material or the aluminium material or the aluminium compound material and the coating forming the second surface (6b), wherein the intermediate coating has a higher emissivity than the emissivity (ε_2) of the coating forming the second surface (6b).

9. Cooking appliance (1) according to any one of the preceding claims, **characterized in that** the first surface (6a) is provided by a coating comprising an enamel material or a ceramic base material or a non-stick and/or non-wetting coating material.

10. Cooking appliance (1) according to any one of the preceding claims, **characterized in that** the cover element (6) is arranged at a distance to the at least one heating element (5), wherein the distance is within a range from 2mm to 20mm, in particular within

4mm to 10mm, preferably within 5mm to 7mm, more preferably within 5mm to 6mm.

11. Cooking appliance (1) according to any one of the preceding claims, **characterized in that** the cover element (6) comprises a sheet-like cover section separating the cooking chamber (4) from the hot air chamber (7), wherein the thickness of the cover section is within a range of 0,3mm to 2mm, in particular within a range of 0,5mm to 1,2mm, preferably within a range of 0,5mm to 0,7mm.

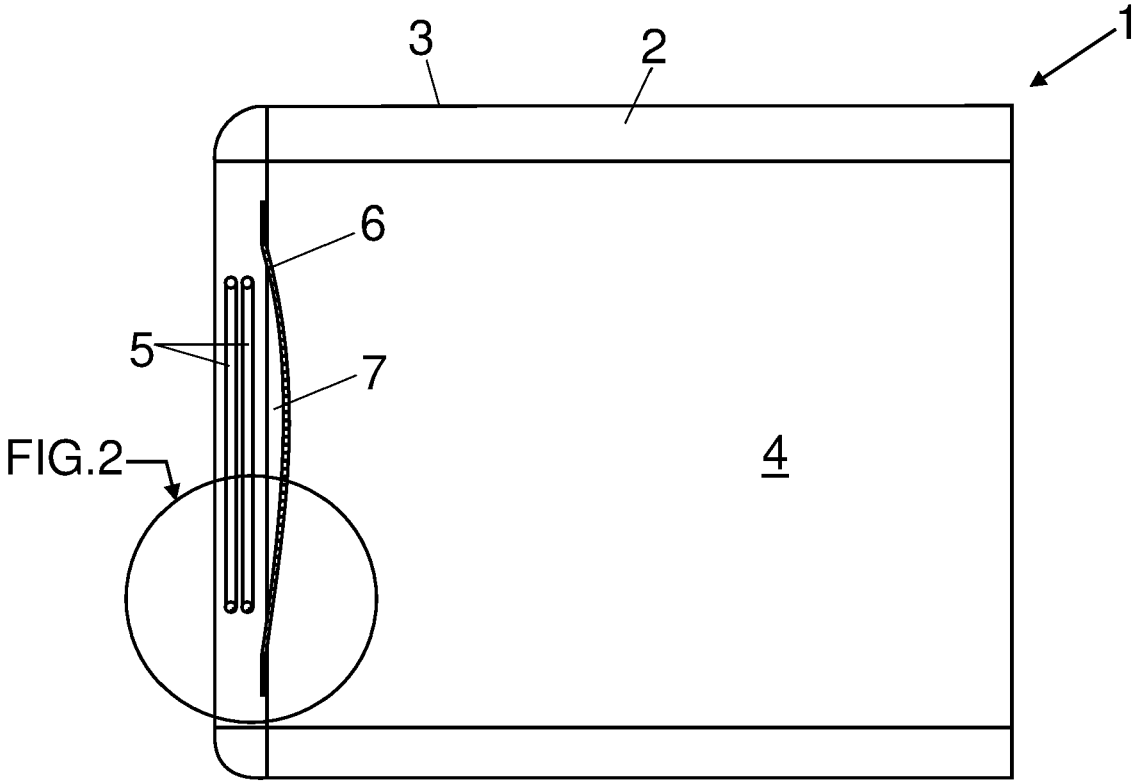

FIG.1

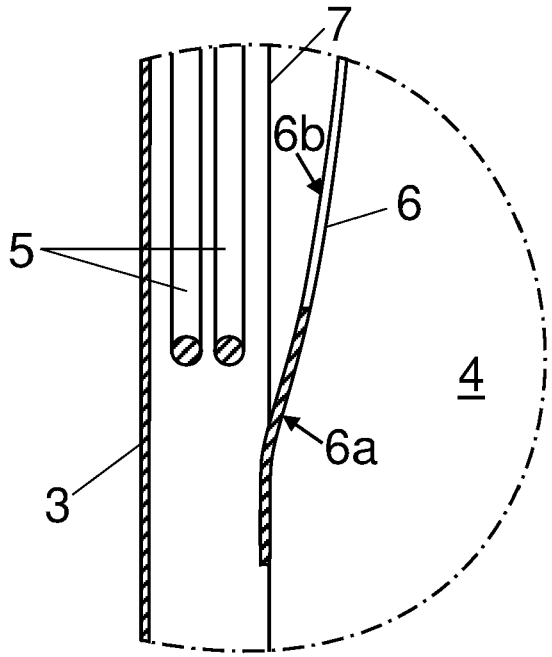

FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 0068

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TECHNICAL FIELDS SEARCHED (IPC)

F24C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 August 2021	Adant, Vincent

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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