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(54) Method for thermal insulation of the muffle of an oven for cooking food

(57) A method for thermal insulation of the muffle of a household oven for cooking food comprises the steps of:
i) providing a muffle body made of metal material defining a cooking chamber;
ii) providing an insulating material; and
iii) applying the insulating material on outer surfaces of the muffle body.

Step ii) comprises providing a particulate compound, including at least one light aggregate and at least one binder, and spraying it on the aforesaid outer surfaces of the muffle body.

The light aggregate is preferably selected from among expanded clays, expanded-clay schists, vermiculite, and perlite. The binder is preferably a hydraulic binder, such as cement, very preferably a Portland cement.

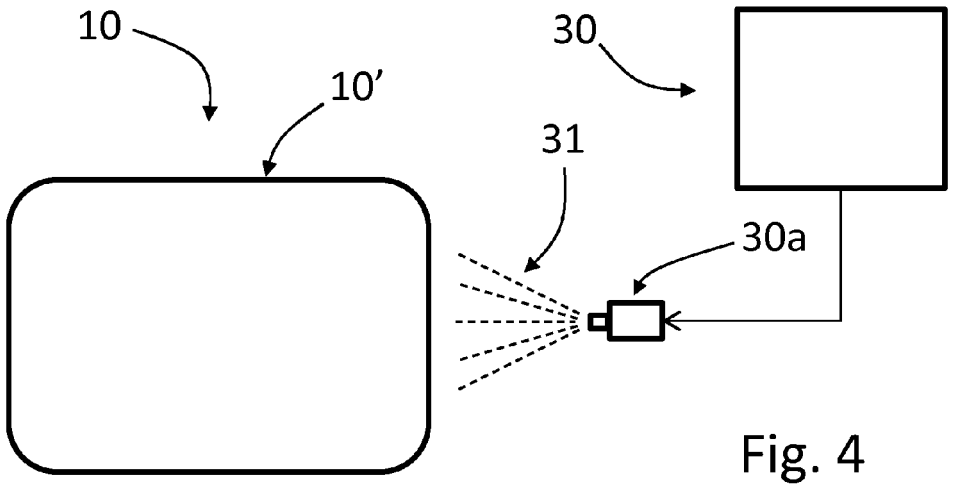

Fig. 4

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Description

Field of the invention

[0001] The present invention relates to household appliances for the preparation of food and has been developed with particular reference to cooking ovens having a thermally insulated muffle.

Prior art

[0002] Household ovens for cooking food typically comprise a metal casing, with an enamelled muffle delimiting a cooking chamber, associated to which is a door. Ovens of the type referred to above are provided with elements for heating the food set in the cooking chamber, typically represented by metal electrical resistances or by gas burners. Given that the running temperatures can assume even high values (for example, between 250°C and 600°C approximately), these ovens must be provided with an adequate insulation, having the purpose of preventing dispersion of heat by the muffle, both in order to reduce consumption of the electrical household appliance during the cycles of operation and increase energy efficiency thereof and in order to enable the temperatures of the parts in contact with the surrounding kitchen furniture and the internal components sensitive to high temperatures (such as an electronic control card) to be kept under control.

[0003] The aforesaid thermal insulation traditionally comprises a flexible mantle having a fibrous structure with a base of refractory inorganic substances, such as glass fibres or mineral fibres or ceramic fibres, for instance, glass wool or rock wool. These fibres are aggregated using thermosetting resins or inorganic binders and in some cases via the mechanical process of needling. The fibrous structure is usually coated with a sheet of a heat-resistant material, typically aluminium foil.

[0004] The above fibrous materials are safe as long as they remain confined (for example, coated with other elements) but, in the case of exposure to air, in the surrounding environment there may be dispersed extremely fine particles of the materials. More in particular, the structure of the insulation has the tendency, when handled, to release particles having characteristic dimensions even smaller than 15 μm, which may be dangerous for health. Inhalation of these particles can cause irritation of the airways, disturbance to eyesight in the case of contact with the eyes, abrasions, and irritation of the skin. There hence arises the need in factories for the staff to work using protections for the airways and the eyes during assembly of the components, with all that this entails in terms of quality, costs, and efficiency.

[0005] The flexible mantle, which has a thickness of approximately 20-30 mm, is wrapped around the side, upper, and lower walls of the muffle so as to surround it on four sides, and is held in position around the muffle itself via heat-resistant tapes, typically adhesive aluminium tapes, or via fasteners and/or metal wires. Possibly, a further flexible mantle of the same type, but of smaller dimensions, can be associated to the rear wall of the muffle, for insulating the latter.

[0006] There have also been proposed insulating arrangements obtained by means of mantles in a single body or made up of a number of rigid panels arranged so as to gird the muffle of the oven. The production of these mantles and their installation on the muffle are generally complicated and costly. These panels frequently entail in any case the use of chemical binders, such as bituminous binders, which are potentially harmful for health or difficult to dispose of at the end of the useful service life of the oven.

Summary and aim of the invention

[0007] The main object of the present invention is basically to solve the above drawbacks. In this context, the main aim of the present invention is to indicate a methodology for thermal insulation of a muffle of a cooking oven that will be simple, inexpensive, and not harmful for people and the environment. A correlated aim of the present invention is to provide a muffle thermally insulated according to this methodology, as well as an oven for cooking food using a muffle of this sort.

[0008] One or more of the above aims are achieved, according to the present invention, by a method for thermal insulation of a muffle for an oven for cooking food, as well as by a muffle and by an oven having the characteristics indicated in the annexed claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

Brief description of the drawings

[0009] Further objects, characteristics, and advantages of the invention will emerge from the ensuing description and from the attached drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a perspective view of a household cooking oven according to the invention;
- Figure 2 is a perspective cross sectional view of the oven of Figure 1;
- Figure 3 is a schematic perspective view of a muffle body; and
- Figures 4 and 5 are schematic representations aimed at illustrating the methodology according to the invention for thermal insulation of the muffle body of Figure 3.

Description of preferred embodiments of the invention

[0010] In Figures 1 and 2, designated as a whole by 1 is a cooking appliance according to the invention, in particular a household cooking oven. The oven 1 is of the built-in type and has a load-bearing structure or casing,

designated by 2, comprising a front frame 3, positioned in the upper part of which are some control means 3a, to provide a control panel of the oven. The casing further comprises a plurality of walls, namely, a lower wall 4, two side walls 5, and an upper wall 6, there being associated to the latter a bulkhead 7, provided with a channelling for discharge of fumes and/or cooling of a door, of a conception in itself known, with a corresponding tangential fan 8. Hinged to the front part of the casing 2, in particular to a respective lower edge, is a door 9, having at least one frame 9a for a window 9b formed by two or more parallel glass panes.

[0011] Housed within the casing 2 is a muffle 10. The muffle 10 has a rigid metal body, having two side walls 10a, a lower wall 10b, an upper wall 10c and a rear wall 10d. The muffle 10 delimits a chamber for cooking food (not illustrated), which can be opened and closed at the front by means of the door 9. As may be seen in Figure 2, mounted within the muffle 8 are heating elements, here comprising an upper electrical resistance or grill 13. In the embodiment exemplified in the figures the oven 1 is a ventilated oven. At the rear wall 10d of the muffle 8, shaped according to techniques in themselves known, there are hence mounted a fan 14 and an annular resistance 15 of a traditional type, and the wall itself is provided with suitable passages for air.

[0012] The muffle 10 is thermally insulated via an insulating mantle, designated as a whole by 20 in Figures 2 and 5. According to the main aspect of the invention, the insulating mantle 20 comprises a monolithic body formed by a material sprayed on outer surfaces of the body of the muffle 10 and having a structure that includes at least one light aggregate and at least one hydraulic binder.

[0013] The term "light aggregate" is here meant to designate an inert mineral having a low specific weight as compared to the aggregates normally used for obtaining concrete. In general terms, it is intended to include in the definition of "light aggregate" those aggregates of mineral origin having a volumic mass of the granular/laminar particles dried in a stove $\leq$ 2000 kg/m^3 (if determined according to the norm UNI EN 1097-6) or else a volumic mass dried in an oven $\leq$ 1200 kg/m^3 (if determined according to the norm UNI EN 1097-3). Preferentially, the light aggregate is an artificial aggregate selected from among expanded clays, expanded-clay schists, vermiculite, and perlite.

[0014] The term "binder" is meant to designate a material that, possibly mixed with water, develops adhesive properties or, more in general, forms a paste that sets and hardens following upon chemical reactions that occur during the processes of hydration (in the case of mixing with water) or polymerization (in the absence of mixing with water). Preferentially, the binder used is a hydraulic binder comprising a ground inorganic material, such as for example a cement. Very preferably, the cement used is a Portland cement.

[0015] The advantages of the monolithic insulating body or coating 20 provided according to the invention are multiple.

[0016] In the first place, the body 20 is non-toxic, is non-fibrous, and is not subject to dusting and erosion in the normal operating conditions of the oven, and is hence without any release of harmful particles into the atmosphere. The muffle carrying an insulating body of this sort can be handled without the need for particular protections, and this leads to advantages from the standpoint of safety for the staff, of quality of the assembled product, of process costs, and of efficiency of production.

[0017] In the second place, the monolithic insulating body 20 is relatively light (roughly about 400 - 800 kg/m^3 according to the amount of light aggregate used and to the type of binder), stable over time, and perfectly suitable for protection and thermal insulation of metal structures against high temperatures, without any emission of fumes and toxic gases.

[0018] In the third place, the structure of the insulation proposed is self-bearing, given that it is itself sprayed onto the body of the muffle, and hence without any need for additional specific means for anchorage or fixing, as instead typically is the case for insulating mantles according to the known art. An associated advantage of the invention is that the monolithic insulating body adheres precisely to the profile of the walls of the muffle body, without occasional gaps between the parts, as instead is the case with known insulating mantles, and hence without creation of thermal bridges.

[0019] Application of the insulation can be carried out in an automated way. An example of the corresponding methodology is illustrated schematically in Figures 3-5.

[0020] Figure 3 represents in an extremely schematic form a muffle 10, the body 10' of which is made of metal material, according to techniques in themselves known. The inside of the muffle body 10', i.e., its internal surfaces that delimit the cooking chamber 11, may be conveniently enamelled, also in this case according to techniques in themselves known.

[0021] For the purposes of application of the insulating body 20 to outer surfaces of the muffle body 10', the particulate compound is provided, which may be constituted only by the light aggregate and the binder, for example a hydraulic binder, pre-mixed together. It is pointed out that the term "particulate" is hence meant to designate indifferently a material that is substantially powdery, or granular, or containing flakes, or the like. The binder may have a substantially powdery appearance, for example when represented by cement, or else be relatively fluid (like glue), for example when represented by a material that is to undergo polymerization, whereas the light aggregate or aggregates used may present in different forms, provided that it/they has/have a loose or particulate appearance (for example, perlite, expanded clay, and expanded-clay schist present in the form of small spheres or granules, whereas vermiculite presents in the form of minute flakes or lamellar crystals).

[0022] It will be assumed, in what follows, that the pre-

mixed aggregate-binder compound is constituted by perlite and Portland cement.

[0023] The pre-mixed compound is mixed with water and feeds an apparatus for spraying the insulating coating. Mixing may be carried out directly within the aforesaid apparatus, represented schematically by block 30 of Figure 4.

[0024] The water-compound mixture thus obtained, designated by 31, is hence sprayed, via one or more spray heads or nozzles 30a of the apparatus 30, on outer surfaces of the muffle body 10', for example on its side walls 10a, lower wall 10b, and upper wall 10c. A spray head of the type indicated may be, for example, carried by a robot, for spraying the mixture 31 on the outer surfaces of the muffle body 10', for example using technologies known in the sector of automated painting.

[0025] The apparatus 30 may have a functional structure akin to that of known spray-plastering machines used in building sector, which use, for example, a rotor-stator pump and a pre-kneading mixer or a mixer with direct intake of water. These machines are usually configured for spraying materials having grain size compatible with that of the light aggregates considered herein.

[0026] The average thickness of the insulating material sprayed and hardened, i.e., of the monolithic body or coating 20, is in general comprised between 8 mm and 60 mm, preferably between 15 mm and 45 mm. Very preferably, the above thickness is comprised between approximately 20 mm and approximately 30 mm, i.e., a thickness similar to that of insulating mantles used according to the known art. For these thicknesses, the insulating body 20 provided according to the invention has a behaviour, in terms of thermal insulation, comparable to those of traditional fibrous insulating mantles.

[0027] Preferentially, spraying is carried out in a number of passes, i.e., by laying a number of layers of the water-compound mixture 31. In this way, a better quality and certainty of setting of the material is guaranteed.

[0028] Preferentially, prior to spraying of the mixture 31, the surfaces to be treated of the muffle body are carefully cleaned, in particular in order to remove any possible substances that might jeopardize the adherence of the insulating material, such as oils, greases, and rust. Once again preferentially, prior to spraying of the material, the aforesaid surfaces of the muffle body 10' are treated with an anchoring primer of the material itself. In addition or as an alternative, an anti-corrosion primer may be used.

[0029] After spraying of the mixture 31, the muffle body 10' is subject to a step of setting of the material, preferably in an environment at constant temperature, for a period of time comprised between 1.5 and 8 h, preferably between 2 and 6 h. Once the material sprayed has dried and hardened, it gives rise to the monolithic coating or body 20, as exemplified in Figure 5, fixedly adherent to the muffle body 10'. After a resting time, the muffle body 10' can be assembled in the structure 2 of the oven.

[0030] In view of the practical tests conducted by the present applicant, it emerged that the best results are obtained with spraying of the mixture 31 carried out at an ambient temperature constantly not lower than +4°C and not higher than 45°C; similar values of temperature apply for the mixture sprayed and the muffle body. Likewise, also the step of setting of the insulating material is optimal if carried out at an ambient temperature constantly not lower than +4°C and not higher than 45°C. In general terms, moreover, it is preferable for the temperature of the surfaces of the muffle body 10 to be treated to be kept above 4°C also before and after application of the material, for example in the 24 h prior to and in the 24 h following upon application.

[0031] In the course of spraying it is preferable for the mixture not to reach the inside of the muffle body 10', i.e., its surfaces that delimit the cooking chamber 11. For this purpose, prior to application of the insulating material, the muffle body 11 is appropriately masked, with modalities and means that will appear clear to a person skilled of the branch. In other words, hence, all the openings that set the chamber 11 in communication with the outside of the body 10' will be appropriately occluded (such as its front mouth, any possible openings provided for lamps for lighting purposes, for temperature sensors, or for fixing of resistances or burners, or again a chimney for discharge of the cooking fumes/vapours, of the type designated by 10e in Figure 2, etc.).

[0032] Of course, also the rear wall 10d of the muffle 10 may be insulated on its outer surface with the material sprayed. In the case of ventilated ovens, of course, the rear wall 10d will be appropriately masked, given the presence therein of numerous through openings (for installation of the fan 14 and for passage of the forced air). Of course, in the case of static ovens, i.e., without a fan 14 (as exemplified for the muffle 10 of Figure 3), the wall 10d does not need to be masked (unless one or more openings are provided for purposes different from forced ventilation).

[0033] It should be emphasized that, frequently, defined in the side walls of a muffle body are slide guides for supports present inside the cooking chamber, such as for example grills or dripping pans. Some of these guides are exemplified in Figure 2, where they are designated by 12. These guides are obtained substantially by deep drawing, extend in the direction of the depth of the muffle 10, and give rise on the inside and on the outside of the walls 10a to an alternation of projecting parts and parts that are plane and/or recessed. It will be understood that, thanks to the type of application of the insulating material envisaged according to the invention, the recessed parts present on the outside of the muffle body may be completely filled with the sprayed material, thus eliminating the presence of gaps and thermal bridges, which are typical, instead, of the known art, and thus in practice improving the quality of the thermal insulation.

[0034] In the cases exemplified in Figures 2 and 5, the thickness of the monolithic body 20 is substantially constant, but it is clear that this does not constitute an es-

sential characteristic of the invention. Thanks to the modalities of application of the mixture 31, in fact, it is possible to obtain different thicknesses of the body 20 in different areas of the outside of the muffle body, for example greater thicknesses in regions in which the heating elements are located and smaller thicknesses in other regions.

[0035] Previously, reference has been made to an embodiment in which at least the lateral insulation (i.e., the insulation of the walls 10a, 10b and 10c), and possibly the rear insulation (i.e., the insulation of the wall 10d), of the muffle body 10' is obtained by means of a single monolithic body, formed by the sprayed material. It is on the other hand clear that, in possible variant embodiments, the insulating material may be applied only to one or some of the walls of the muffle body, or else in a sequential way to a number of walls (i.e., first to the side walls, then to the upper wall, then to the lower wall, and so on).

[0036] It is moreover emphasized that the thermally insulating material and the methodology of application envisaged according to the invention may be used to advantage also for the purposes of thermal insulation of the door 9, in the regions alongside the glass window, and the control panel, obviously in positions corresponding to internal surfaces (i.e., the ones not in view) of the structure of the door and of the control panel. Application of the invention may be extended in general to other household appliances, such as for example cooking hobs and boilers, where there is the need for thermal insulation of metal parts of the structure of such appliances.

Claims

1. A method for thermally insulating a household oven muffle, comprising the steps of:

   i) providing a muffle body (10') made of metal material defining a cooking chamber (11);
   ii) providing a thermally insulating material (31); and
   iii) applying the insulating material (31) to outer surfaces of the muffle body (10'),
   said method being **characterized in that** step ii) comprises providing a particulate compound including at least one light aggregate and at least one binder and **in that** step iii) comprises mixing the particulate compound with the binder and spraying the corresponding mixture (31) on said outer surfaces of the muffle body (10').

2. The method according to Claim 1, wherein the light aggregate is selected from among expanded clays, expanded-clay schists, vermiculite, and perlite.

3. The method according to Claim 1 or Claim 2, wherein the binder is a hydraulic binder, in particular a cement, and step iii) comprises using water as hydrating agent of the binder.

4. The method according to Claims 2 and 3, wherein the light aggregate is perlite and the hydraulic binder is Portland cement.

5. The method according to any one of the preceding claims, wherein the insulating material applied has an average thickness of between 8 mm and 60 mm, preferably between 15 mm and 45 mm, very preferably between 20 mm and 30 mm.

6. The method according to any one of the preceding claims, wherein step iii) comprises spraying a number of layers of the mixture (31).

7. The method according to any one of the preceding claims, wherein, after application of the mixture (31), the insulating material is subject to a setting time comprised between 1.5 and 8 h.

8. The method according to any one of the preceding claims, wherein, prior to step iii), said surfaces of the muffle body (10'):

   - are cleaned, in particular for the purpose of removing possible substances that might jeopardize adherence of the insulating material, such as oils, greases, rust; and/or
   - are treated with at least one between an anticorrosion primer and an anchoring primer.

9. The method according to one or more of the preceding claims, wherein:

   - spraying of the mixture (31) is carried out at an ambient temperature constantly not lower than +4°C and not higher than 45°C; and/or
   - the step of setting of the insulating material is carried out at an ambient temperature constantly not lower than +4°C and not higher than 45°C.

10. The method according to one or more of the preceding claims, wherein, prior to step iii), the muffle body (10') is masked to prevent entry of the mixture (31) into the cooking chamber (11).

11. A household oven muffle, for cooking food, comprising a muffle body made of metal material (10'), associated to which is a thermally insulating coating (20), wherein the insulating coating is a monolithic body (20) formed by a material sprayed on outer surfaces of the muffle body (10') and having a structure that includes at least one light aggregate and at least one binder.

12. The muffle according to Claim 11, wherein:

- the light aggregate is selected from among expanded clays, expanded-clay schists, vermiculite, and perlite; and/or
- the binder is a hydraulic binder, preferably a cement.

13. The muffle according to Claim 12, wherein the light aggregate is perlite and the hydraulic binder is Portland cement.

14. A household oven for cooking food, having a load-bearing structure, a muffle (10) that defines a cooking chamber (11), and means (13-15) for heating the cooking chamber (11), wherein the muffle (10) is according to one or more of Claims 11-13 or is thermally insulated with the method according to one or more of Claims 1-10.

15. Use of a particulate compound including at least one light aggregate and at least one binder, for obtaining via spraying a thermally insulating monolithic coating of metal parts of a household cooking appliance.

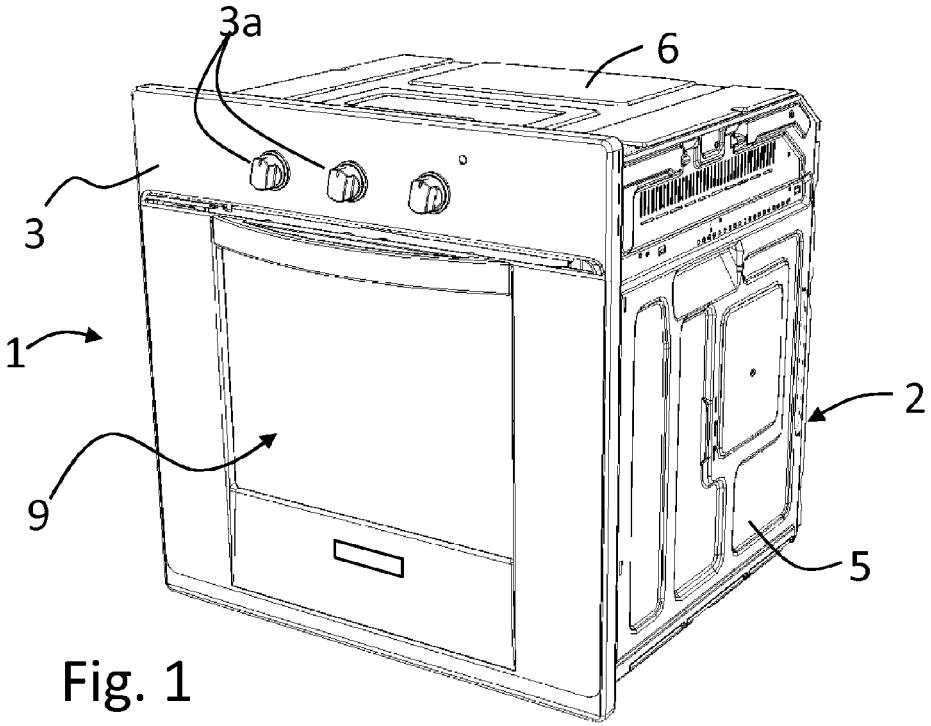
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Fig. 1

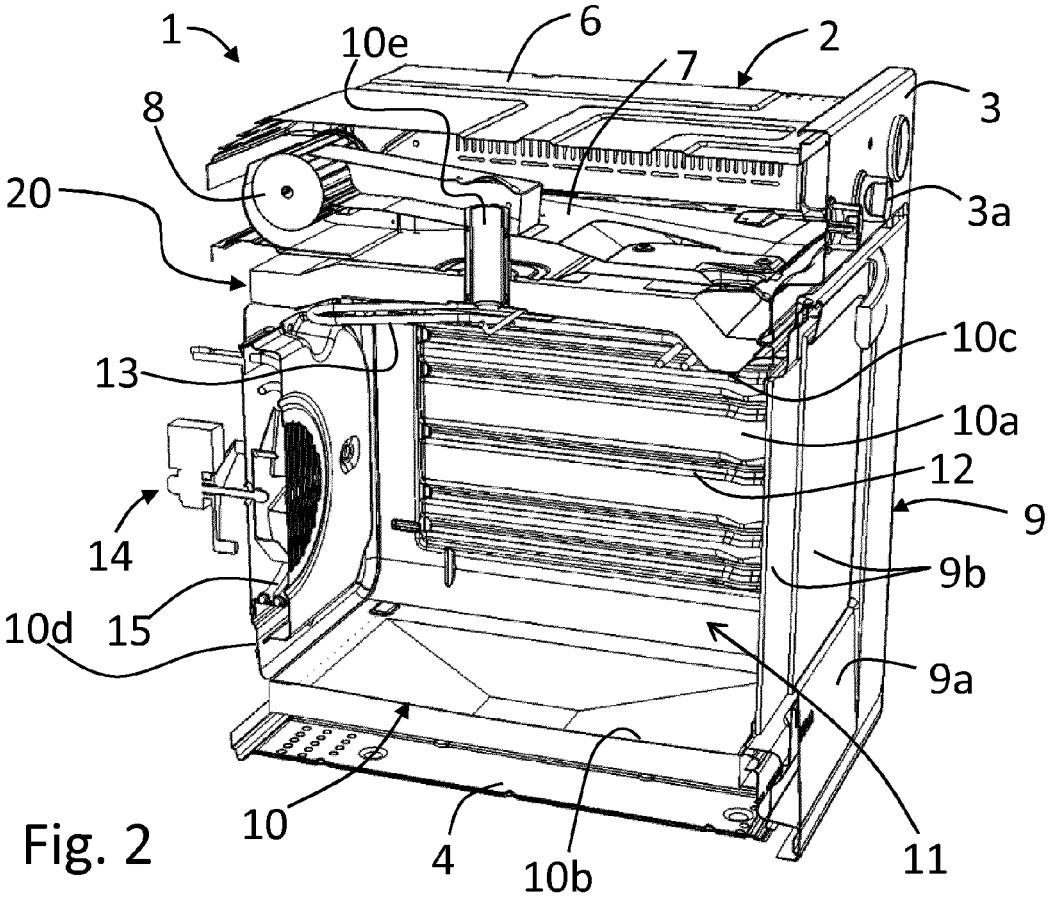
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Fig. 2

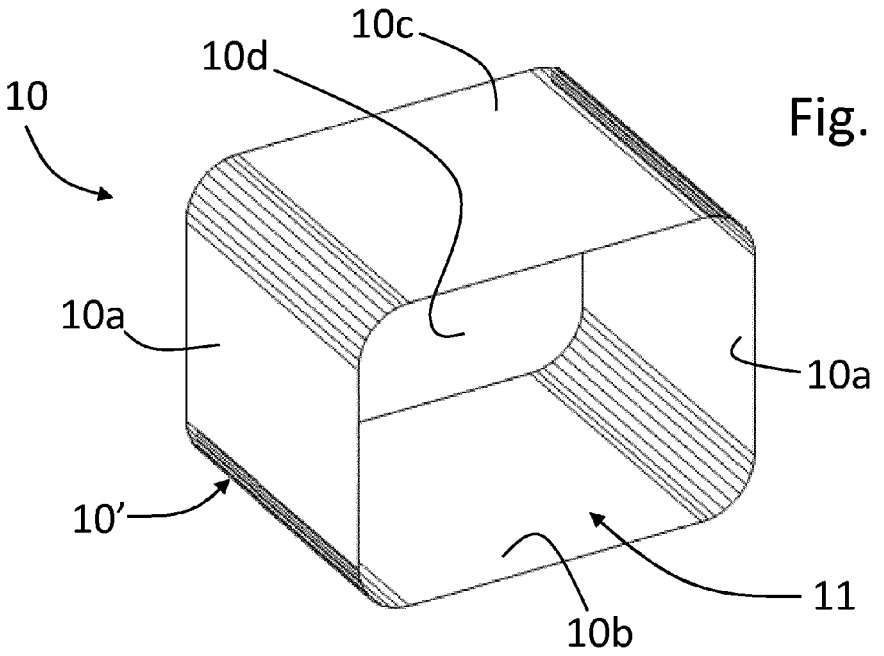

Fig. 3

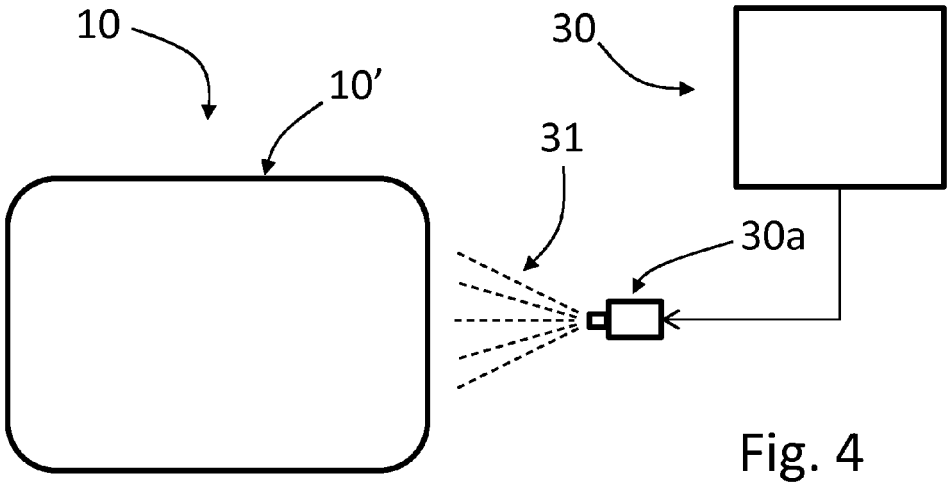

Fig. 4

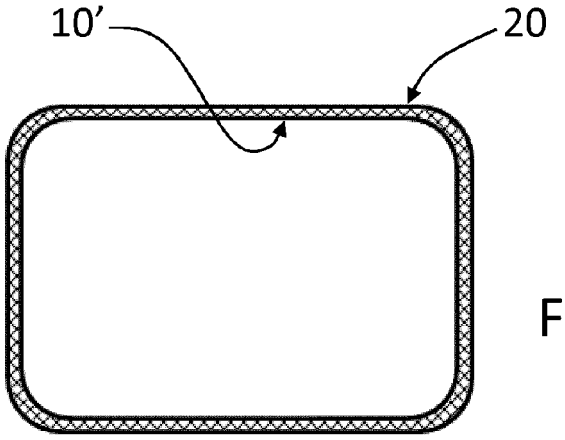

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 4387

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F24C
F25D
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 January 2014	Verdoodt, Luk

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