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(54) **A PROCESS FOR THE CRYOGENIC TREATMENT OF ORGANIC HUMAN OR ANIMAL REMAINS CONTAINED WITHIN A CRYOMABLE CONTAINER**

(57) The present invention refers to a process for the cryogenic treatment of organic human or animal remains that includes the steps of:
i) laying the human or animal remains in a cryomable container (100) so as to form a cryomable assembly (50);
ii) providing a cryogenic treatment system (1) comprising at least one cryogenic station (2) and at least one fragmentation system (3);
iii) freezing the cryomable assembly (50) in the at least one cryogenic station (2) by lowering it to a temperature no greater than -100°C;
iv) fragmenting the frozen cryomable assembly (50) within the at least one fragmentation station (3).

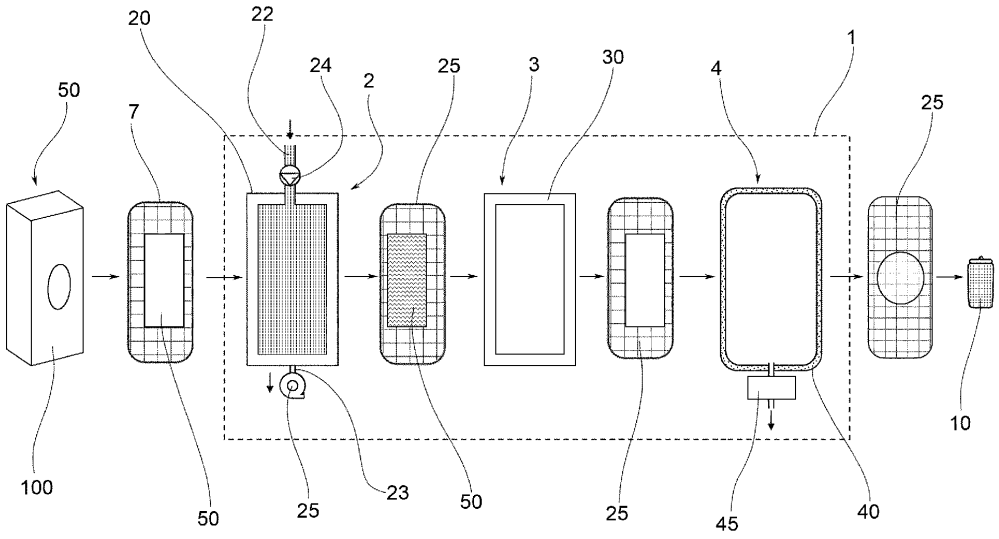

FIG.1

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Description

[0001] The object of the present invention is a process for the cryogenic treatment of organic human or animal remains and a relative cryomable container.

[0002] The definition "organic remains" refers to whole human or animal cadavers, separate parts thereof, or mortal remains, i.e. the outcome of an incomplete skeletonization process of a cadaver.

[0003] Organic human remains are currently subject to burial, interment or cremation. As regards organic animal remains, these are typically subjected to cremation.

[0004] With burial or interment, the cadaver is inserted into a casket and subsequently buried in the earth, or else in a cement niche.

[0005] Cremation, on the other hand, is an increasingly requested practice that consists of subjecting the cadaver to a combustion process so as to reduce it to ashes. Such combustion leads however to significant environmental pollution. The main environmental impact of modern cremation systems concerns the air. In fact, during cremation, the furnaces produce atmospheric pollutants, such as dusts, carbon monoxide, nitrogen and sulfur oxides, volatile organic compounds, inorganic compounds of chlorine and fluorine and heavy metals. In some cases, there may also be emissions of mercury (from the amalgam present in dental fillings), zinc, (especially in the case of exhumed grave cremations), dioxins, furans and polycyclic aromatic hydrocarbons.

[0006] A further burial technique consists in cryogenic treatment (or cryomation), which is designed primarily to abate the atmospheric pollution generated by cremation.

[0007] Cryomation is a process obtained technically using the treatment in liquid nitrogen at -196°C and subsequent freeze-drying. Compared to cremation, the cryomation process has emissions that are reduced to 0%, zero emissions of mercury, dioxins and CO2 in line with the "Total green" national and international directive.

[0008] Currently, known cryomation processes include the use of a cryomation system comprising a plurality of stations in succession therebetween. It should be noted that organic remains must be extracted from the casket before being inserted into the cryomation system. In order to perform the operation of extracting the organic remains from the casket, it is necessary to prepare, upstream of the system, an appropriate extraction station, which requires the use of means and persons to perform the operation, with a consequent increase in time and costs.

[0009] There is a further problem regarding the known cryomation processes that is strictly associated with the legislation of individual countries. In some countries, including Italy, the current legislation does not permit the opening of a casket that has already been sealed in order to extract the cadaver. Cryomation is therefore not currently feasible within these countries.

[0010] The object of the present invention is to obtain a cryogenic treatment process that is capable of overcoming the drawbacks of the prior art.

[0011] Such object is achieved by a process for the cryogenic treatment of organic human or animal remains according to claim 1, and by a cryomable container according to claim 10. The dependent claims describe preferred embodiments of the invention.

[0012] The features and advantages of the process for the cryogenic treatment of organic human or animal remains according to the present invention will appear more clearly from the following description, given as a nonlimiting example according to the appended figures, wherein:

- Figure 1 shows a system and the steps of a cryogenic treatment process, according to this invention, according to a preferred embodiment;
- Figure 2 shows a sectional view of a cryomation station of the cryogenic treatment system according to a preferred embodiment;
- Figure 3 shows a sectional view of a fragmentation station of the cryogenic treatment system according to a preferred embodiment;
- - Figure 4 is a perspective view of a cryomable container in a preferred embodiment;
- Figures 5a and 5b represent the layers of a cardboard for the walls of the cryomable container according to two embodiments;
- Figures 6a and 6b show the outlines for making a box bottom and a lid for the cryomable container.

[0013] According to the invention, the process for the cryogenic treatment of organic human or animal remains is performed through the use of a system for the cryogenic treatment of organic human or animal remains.

[0014] With reference to the aforementioned figures, a system for the cryogenic treatment of organic human or animal remains according to the invention is indicated as a whole with the reference numeral 1.

[0015] Before the cryogenic treatment process is performed, the organic human or animal remains are inserted into a cryomable container 100, thereby defining a cryomable assembly 50 to be treated within the cryogenic system 1. The cryogenic treatment process according to the present invention therefore provides for treating organic human or animal remains that are housed within a cryomable container 100.

[0016] Before the cryogenic treatment process is performed, the organic human or animal remains are inserted into a cryomable container 100, thereby defining a cryomable assembly 50 to be treated within the cryogenic system 1.

[0017] The cryogenic treatment process according to the present invention therefore provides for treating organic human or animal remains that are housed within a cryomable container 100.

[0018] The cryogenic treatment process according to the present invention provides for both the organic human or animal remains and the cryomable container 100

wherein they are housed to be subjected, together with the cryomable assembly 50, to the cryogenic treatment.

[0019] The positioning of the organic remains within the cryomable container has to be performed before such remains reach the system 1 for the cryogenic treatment. The cryomable container 100, subject of the present invention, in fact replaces traditional caskets, also during the wake, the funeral services and during the transportation and the burial or cryomation of the organic remains.

[0020] The term "cryomable" signifies that the container 100 is made from a material that is suitable for being subjected to the cryogenic treatment process. In the remainder of this discussion we will make reference to a cryomable container made of cellulose; this material, however, as per the described geometry, constitutes only one possible exemplary embodiment. Other cryomable materials may likewise be used to make the cryomable container 100, such as for example polymer materials, resins and all those organic and inorganic materials/components that, using liquid nitrogen, may reach a temperature lower than 0°C and consequently be freeze-dried until the disintegration of the molecules.

[0021] The system 1 comprises at least one cryogenic station 2 for freezing the cryogenic assembly 50.

[0022] Preferably, the cryogenic station 2 comprises a compartment 20 having a resealable opening for the insertion of the cryomable assembly 50 and, at the end of the freezing, the removal of such frozen cryomable assembly 50.

[0023] According to a preferred embodiment, the compartment 20 of the cryogenic station 2 comprises insulated walls for receiving a cryogenic fluid in the liquid state, for example liquid nitrogen, and an inlet duct 22 for feeding the cryogenic fluid inside the compartment 20 of the cryogenic station 2 by means of a pump 24.

[0024] Preferably, the compartment 20 of the cryogenic station 2 is defined within a box-shaped body 200 that is closed by a lid 250. Therefore, once the cryomable assembly 50 has been introduced into the box-shaped body 200, the box-shaped body 200 is closed by the lid 250, and the cryogenic fluid is fed internally, preferably so as to completely cover the cryomable assembly 50.

[0025] Preferably, the compartment 20 of the cryogenic station 2 further comprises an outlet duct 23. The fraction of cryogenic fluid that has passed to the gaseous state is instead evacuated from said compartment 20 by means of an aspiration device 25.

[0026] According to a preferred embodiment, the cryogenic fluid, preferably liquid nitrogen, is introduced into the compartment 20 of the cryogenic station 2 at a temperature not greater than -100°C, preferably at - 196°C, and is evacuated in gaseous form at a temperature close to about -100°C after having frozen the cryogenic assembly 50 that is present within the compartment 20.

[0027] The system 1, downstream of the cryogenic station 2, comprises a fragmentation station 3 wherein the frozen cryomable assembly 50, originating from the cryogenic station 2, is transferred.

[0028] According to one embodiment, the fragmentation station 3 comprises a support element 7 having a fragmentation grill 70 arranged above a tray 75. The fragments of the cryomable assembly 50 are collected within the tray 75 at the end of the fragmentation step within the fragmentation station 3.

[0029] Preferably, the transfer between the cryogenic station 2 and the fragmentation station 3 occurs while maintaining the cryomable assembly 50 on the support element 7, preferably on the grill 70.

[0030] According to a preferred embodiment, the fragmentation station 3 comprises a chamber 30 and a press 35, which is preferably hydraulic, provided with a pressure plate 36. Preferably, the press 35 is a electro-hydraulic press. Preferably, the pressure plate 36 of the press 35 has dimensions so as to engage the entire surface of the fragmentation grill 70 of the support element 7.

[0031] According to a preferred embodiment, the press 35 includes a cylinder 37 comprising a stem 38 which is constrained to the pressure plate 36.

[0032] According to a preferred embodiment, the chamber 30 of the fragmentation station 3 is defined within a box-shaped element 300 which is closed by a cover 350. Preferably, the cylinder 37 the press 35 is mounted on the cover 350 that closes the box-shaped element 300.

[0033] Therefore, once the frozen cryomable assembly 50 has been introduced into the chamber 30, the box-shaped element 300 is closed by the cover 350, and the pressure plate 36 is guided by the cylinder 37 so as to compress, by fragmentation, the frozen cryomable assembly 50. Preferably therefore, the pressure plate 36 presses the frozen cryomable assembly 50 against the fragmentation grill 70, thereby provoking the fragmentation of the frozen cryomable assembly 50.

[0034] Preferably, the fragments of the frozen cryomable assembly 50 are collected in the tray 75. The fragmentation 70 allows the frozen cryomable assembly 50 to be thus easily crushed into fragments of small dimensions. Preferably, the dimension of the fragments of the cryomable assembly 50 depends on the dimensions of the mesh of the fragmentation grill 70.

[0035] According to a preferred embodiment, the system 1 comprises a freeze-drying station 4 wherein the frozen and fragmented cryomable assembly 50 is subjected to the freeze-drying process.

[0036] Preferably, the transfer to the fragmentation station 3 and the freeze-drying station 4 occurs while always maintaining the frozen and crushed cryomable assembly 50 on the support element 7, preferably on the tray 75.

[0037] According to a preferred embodiment, the freeze-drying station 4 comprises a freeze-dryer 40, for example of the static type, wherein a vacuum condition is obtained. The "freeze-dryer" is an instrument that is used to remove water from a product by sublimation. The heating of the frozen cryomable assembly 50 under a vacuum condition in fact provokes the sublimation of the

water which is collected and condensed.

[0038] Preferably, the freeze-drying station 4 comprises a condenser 45 wherein the water removed by sublimation is collected which may eventually be disposed of.

[0039] Preferably, the water that is removed by sublimation is equal to about 80% of the initial mass.

[0040] Preferably the freeze-dried cryomable assembly 50 contained in the tray 75 may eventually be collected within a funerary urn 10.

[0041] Preferably, the freeze-dried cryomable assembly 50 has a mass equal to about 20% of the initial mass.

[0042] According to the invention, the process for the cryogenic treatment of organic human or animal remains includes the steps of:

i) laying the human or animal remains within a cryomable container 100 so as to form a cryomable assembly 50;
ii) providing the cryogenic treatment system 1 described herein;
iii) freezing the cryomable assembly 50 in the at least one cryogenic station by lowering it to a temperature no greater than -100°C;
iv) fragmenting the frozen cryomable assembly 50 within the at least one fragmentation station.

[0043] Preferably, the duration of the step of freezing the cryomable assembly 50 depends on the mass to be cooled and the initial temperature of the cryomable assembly to be treated.

[0044] According to a preferred embodiment, the process comprises, after step iv), the step of:
v) freeze-drying the fragmented cryomable assembly 50 within at least one freeze-drying station.

[0045] According to a preferred embodiment, the operation of the entire system 1 is controlled by a programmed control unit.

[0046] The subject of the present invention is also a cryomable container 100 that is suitable for containing therein the organic human or animal remains for the entire cryomation process, and that is also suitable for being subjected to the cryomation process.

[0047] The cryomable container 100 is box-shaped, openable and closable, and comprises an inner compartment 150 wherein the organic remains are insertable and is formed by walls 155.

[0048] The cryomable container 100 is box-shaped, openable and closable, and comprises an inner compartment 150 wherein the organic remains are insertable. The cryomable container 100 is formed by walls 155.

[0049] Preferably, the cryomable container 100 comprises a box bottom 110 that defines the inner compartment 150, and a lid 120 that is suitable for closing the box bottom 110.

[0050] According to a preferred embodiment, the walls 155 are obtained by die-cutting.

[0051] According to a preferred embodiment, the box bottom 110 and the lid 120 are self-mounting, i.e., the walls 155 comprising them may be folded along folding lines and mounted in an interlocking manner. This makes it possible to avoid the use of other mounting elements of materials of said container.

[0052] Preferably, the box bottom 110 comprises walls along the long side comprising a full overlap in order to give more resistance to torsion. In other words, the wall along the long side consists of a surface that is folded back upon itself.

[0053] Preferably, the lid 120 comprises walls along the short side comprising an overlap in order to offset the long side. In other words, the wall along the short side consists of a surface that is folded back upon itself.

[0054] According to a preferred embodiment, the walls 155 of the cryomable container 100 are made at least in part from cardboard, preferably corrugated and preferably of the triple-layer type.

[0055] According to a preferred embodiment, the cardboard comprises, at least in part, biodegradable and compostable cellulose. Preferably, the cellulose comprises cornstarch as a glue.

[0056] Preferably, the cardboard has a thickness S of between 5 and 10 mm, and preferably equal to 7 mm.

[0057] According to a preferred embodiment, the cardboard is multilayer and comprises, in sequence:

- an outer liner Ce;
- at least a first corrugation O1;
- at least a first flat member T1;
- at least a second corrugation O1;
- an inner liner Ci.

[0058] According to a preferred embodiment, the corrugations may be of type B or C. Preferably, the B corrugation has a minimal height H equal to 2.5 millimeters. Preferably, the C corrugation has a minimum height H equal to 3.5 millimeters. Preferably, the height H is measured between one liner and an adjacent flat member or else between two adjacent flat members.

[0059] According to a preferred embodiment, the outer liner and the inner liner are made from virgin paper, i.e. Kraft (K) type paper. Preferably, such liners comprise long fibers that offer a barrier to humidity.

[0060] Preferably, the corrugations and the flat member are made from recycled paper with a high-weight, i.e., respectively of the semi-chemical (S) and medium (M) type, in order to enable a level of performance that is adequate for supporting organic remains.

[0061] Preferably, the multilayer cardboard is of the triple-layer type and comprises in sequence:

- an outer liner Ce;
- at least a first corrugation O1;
- at least a first flat member T1;
- at least a second corrugation O1;
- at least a second flat member T2;
- at least a third corrugation O3;
- an inner liner Ci.

[0062] According to a preferred embodiment, the cardboard has an ECT (Edge Crush Test) resistance of between 5 Kn/m and 15 Kn/m, preferably equal to 11.02 Kn/m.

[0063] According to a preferred embodiment, the cryomable container 100 comprises an interlocking seal that is suitable for permanently closing said container. Preferably, the seal is suitable for joining therebetween the box bottom 110 and the lid 120.

[0064] According to a preferred embodiment, the seal is a mechanical seal, preferably comprising flaps that, once engaged therebetween, are only detachable by breaking the seal.

[0065] Preferably, the box bottom 110 comprises a flap that interlocks with a flap of the lid 120 so as to constitute said seal. Once closed, such seal is only eliminable by breaking it.

[0066] In order to ensure the integrity of the container 100 containing the organic remains (also said coffin), it is furthermore necessary to apply a closure seal that as a minimum reports an indication of the municipality wherein the funeral home is based and the municipal authorization number assigned to said funeral home. Once in place, such seal is only eliminable by destroying it, in order to highlight any tampering.

[0067] Innovatively, the process for the cryogenic treatment of organic human or animal remains of the present invention fully fulfills the proposed object. Moreover, the cryomable container of the present invention also fully fulfills the proposed object.

[0068] Advantageously, the organic remains contained within the cryomable container may be transported to the cryogenic treatment system and subjected to the same treatment without first having to be removed from the container.

[0069] Advantageously, the cryomable container is made of biodegradable and compostable material, thereby preventing them from affecting the biodegradability and compostability of the cryomated organic remains.

[0070] Advantageously, unlike with cremation, by using this process, it is possible to cryomate a container together with the organic remains, with an environmental impact that is much lower than with current wooden caskets.

[0071] Advantageously, the cost of a cryomable container is notably reduced compared to the current wooden boxes available on the market.

[0072] A person skilled in the art, in order to meet specific needs, may, to the embodiments of the process for the cryogenic treatment of organic human or animal remains, make several changes or substitutions of elements with other functionally equivalent ones. Such variants are also included within the scope of protection as defined by the following claims. Moreover, each variant described as belonging to a possible embodiment may be implemented independently of the other variants described.

Claims

1. A process for the cryogenic treatment of organic human or animal remains including the steps of:

   i) placing the organic human or animal remains in a cryomable container (100) defining a cryomable assembly (50) ;
   ii) providing a system (1) for the cryogenic treatment comprising:

      a) at least one cryogenic station (2);
      b) at least one fragmentation station (3);

   iii) freezing the cryomable assembly (50) in the at least one cryogenic station (2);
   iv) fragmenting the frozen cryomable assembly (50) in at least one fragmentation station (3).

2. Process according to claim 1, wherein the system (1) further comprises at least one freeze-drying station (4), and wherein the process comprises, after step iv), the step of:
   v) freeze-drying the cryomable assembly (50) fragmented in the at least one freeze-drying station (4).

3. Process according to claim 2, wherein the freeze-drying station (4) comprises a freeze-dryer (40) wherein there is obtained a vacuum condition causing the sublimation of the water which is collected and condensed.

4. Process according to any one of the preceding claims, wherein the cryomable container (100) is box-shaped, openable, and comprises an inner compartment (150) into which the organic remains are insertable.

5. Process according to any one of the preceding claims, wherein the cryomable container (100) is formed by walls (155) made at least partially of cardboard.

6. Process according to any one of the preceding claims, wherein the cryomable container (100) is formed by walls (155) made of triple-type corrugated cardboard.

7. Process according to claim 6, wherein the cardboard has a thickness (S) of between 5 and 10 millimeters, preferably of 7 millimeters.

8. Process according to claim 6 or 7, wherein the cardboard is multilayer and comprises in sequence:

   - an outer liner (Ce);
   - at least a first corrugation (O1);
   - at least a first flat member (T1);

- at least a second corrugation (O2);
- an inner liner (Ci).

9. A cryomable container (100) which is box-shaped, openable, comprising an inner compartment (150) into which organic human or animal remains are insertable.

10. Cryomable container (100) according to claim 11, made at least partially of cardboard.

11. Cryomable container (100) according to claim 11, made at least partially of polymer material, or resin, or organic or inorganic material/component which reaches a temperature below 0°C by means of liquid nitrogen and then freeze-dries until the disintegration of the molecules.

12. Cryomable container (100) according to claim 10, made of triple-type corrugated cardboard.

13. Cryomable container (100) according to claim 10 or 12, wherein the cardboard has a thickness (S) between 5 and 10 millimeters, preferably of 7 millimeters.

14. Cryomable container (100) according to claim 10, wherein the cardboard is multilayer and comprises in sequence:

- an outer liner (Ce);
- at least a first corrugation (O1);
- at least a first flat member (T1);
- at least a second corrugation (O2);
- an inner liner (Ci).

15. Cryomable container (100) according to claim 14, wherein the outer liner (Ce) and the inner liner (Ci) are made of virgin-type paper.

16. Cryomable container (100) according to claim 14 or 15, wherein the at least a first corrugation (O1), the at least a first flat member (T1) and the at least a second corrugation (O2) are made of high-weight recycled-type paper.

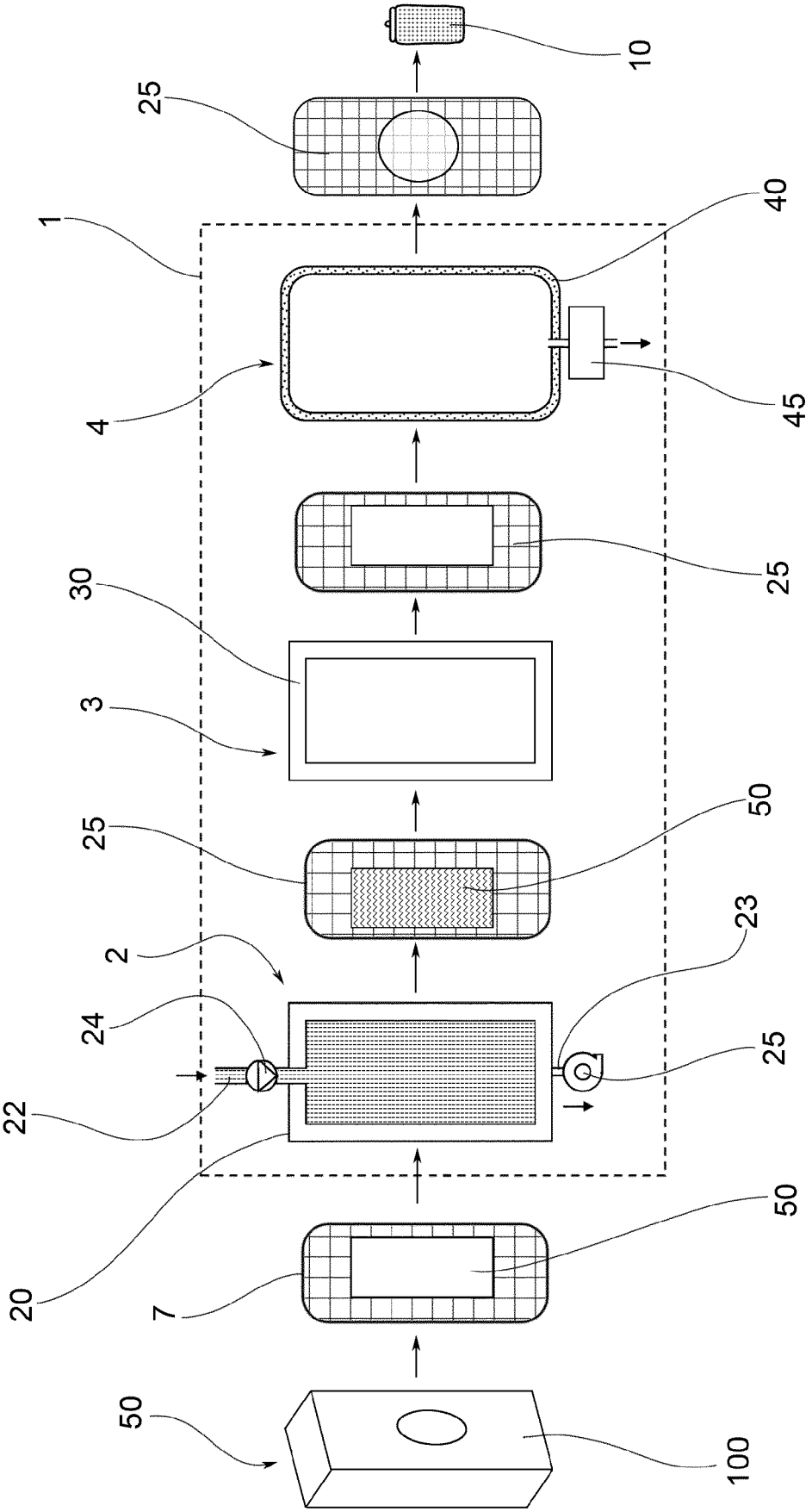

FIG.1

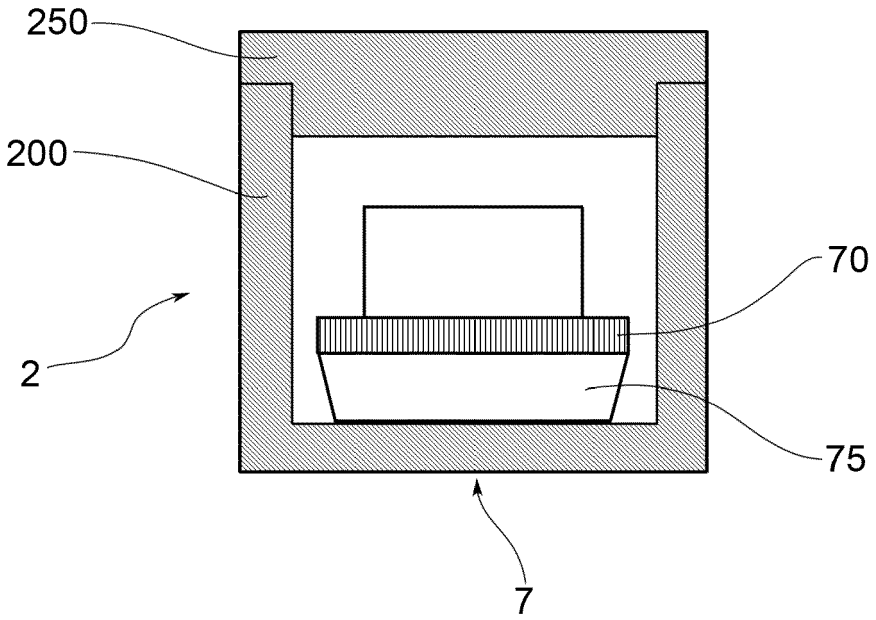

FIG.2

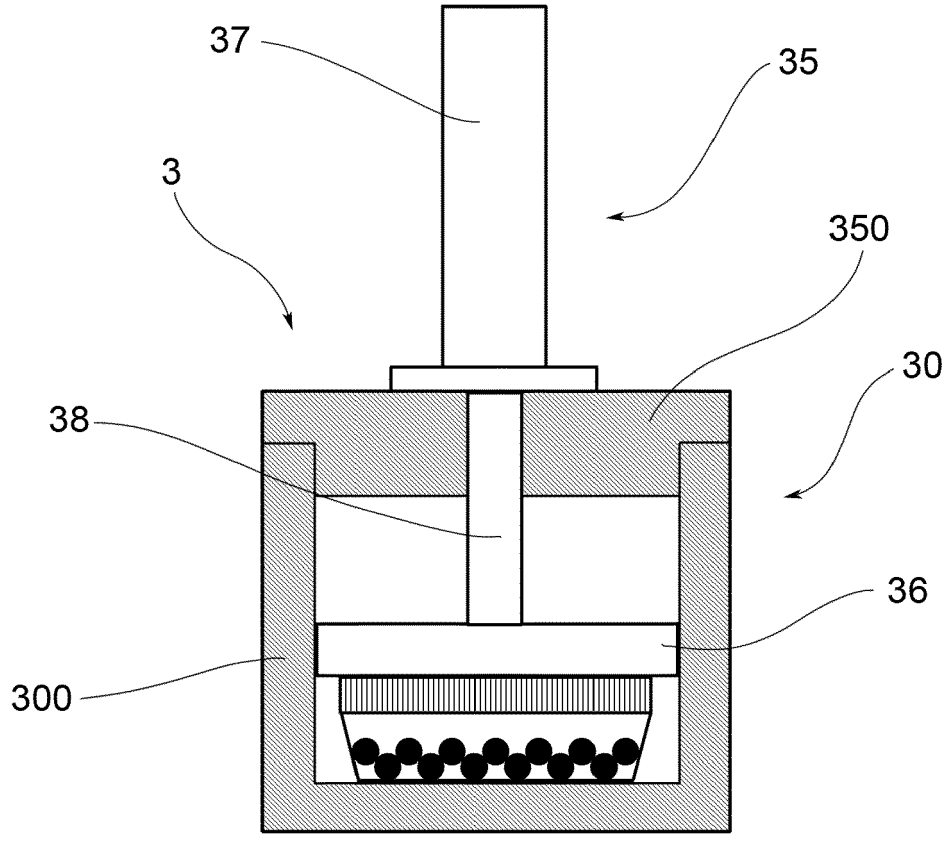

FIG.3

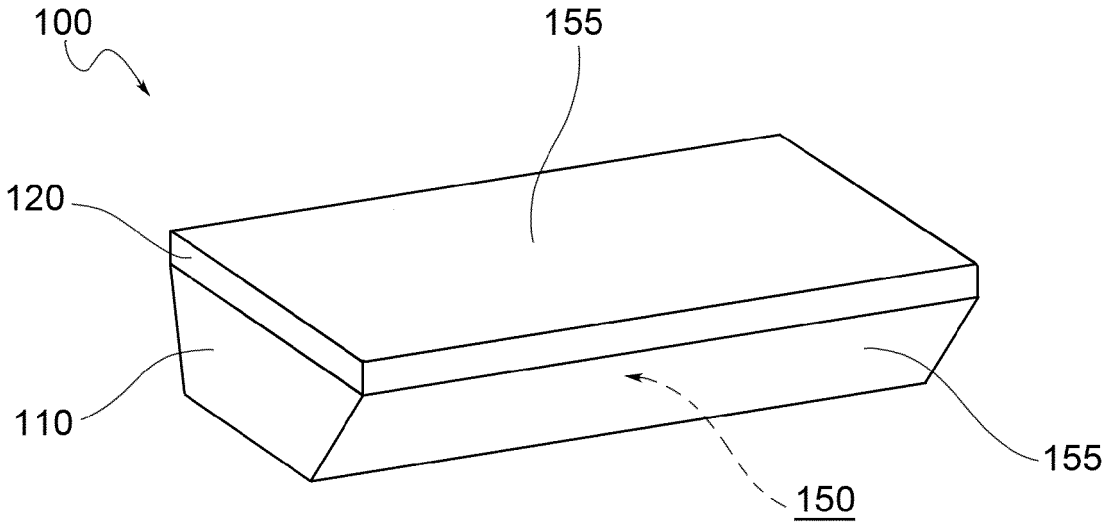

FIG.4

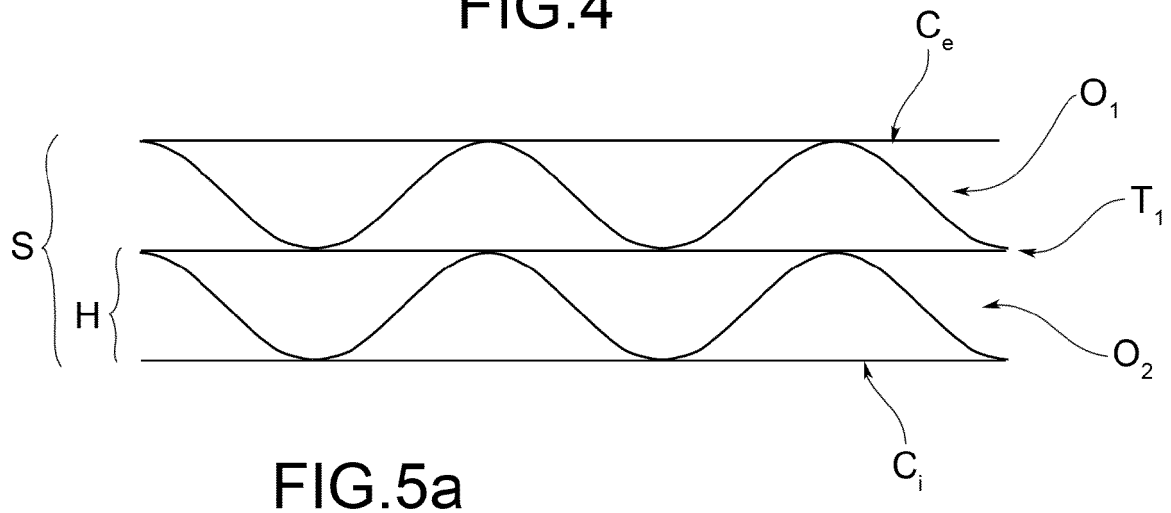

FIG.5a

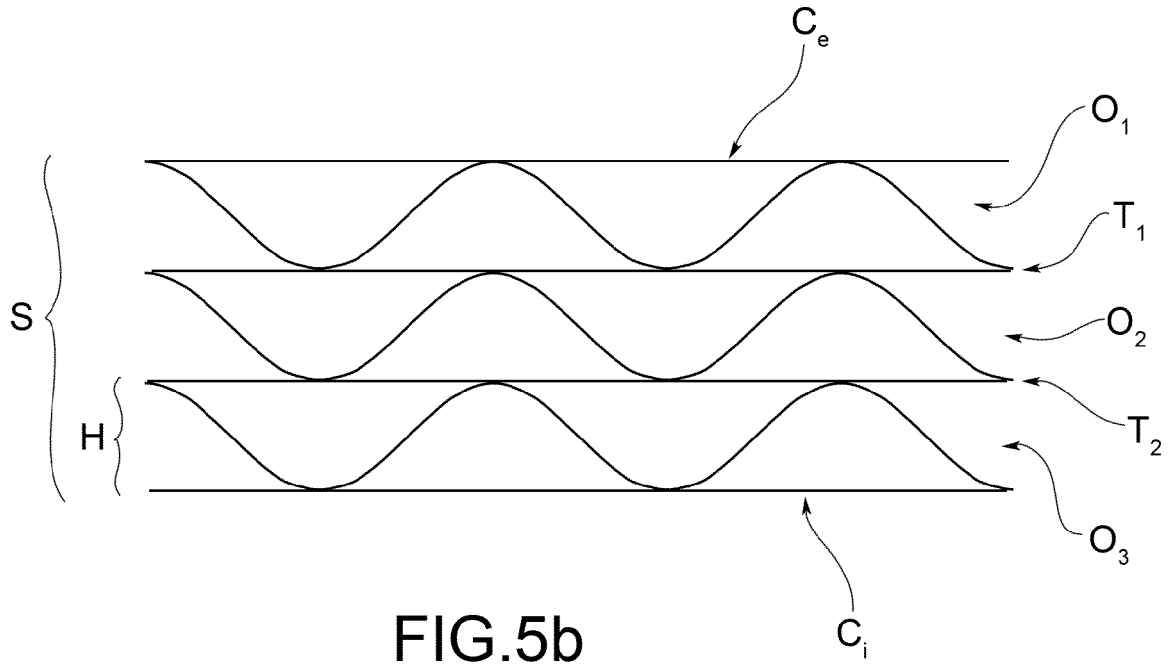

FIG.5b

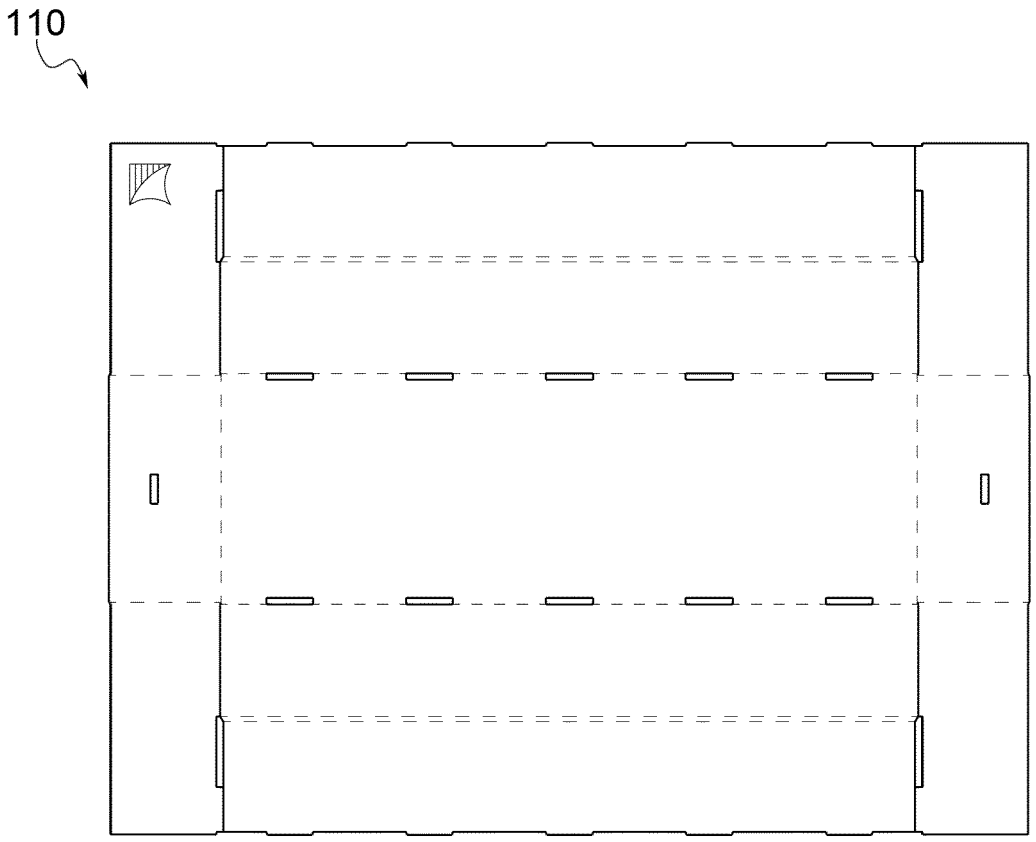

FIG.6a

FIG.6b

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 4556

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

F26B
A01N
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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
Munich	20 March 2024	Tassinari, Francesca

CATEGORY OF CITED DOCUMENTS

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