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Remarks:

- The designation of inventor does not meet the requirements laid down in Article 81 and Rule 19 EPC.
- Amended claims in accordance with Rule 137(2) EPC.

(54) **FOOD CONTAINER**

(57) A container (10) for use, for example, for beverages, has a wall (12) with an external surface (14) and an internal wall (16) of substantially uniform thickness. The wall (12) has a fractal profile which provides a series of fractal elements (18-28) on the interior and exterior surfaces (14-16), forming pits (40) and bulges (42) in the profile of the wall and in which a pit (40) as seen from

one of the exterior or interior surfaces (12, 14) forms a bulge (42) on the other of the exterior or interior surfaces (12, 14). The profile enables multiple containers to be coupled together by inter-engagement of pits and bulges on corresponding ones of the containers. The profile also improves grip, as well as heat transfer into and out of the container.

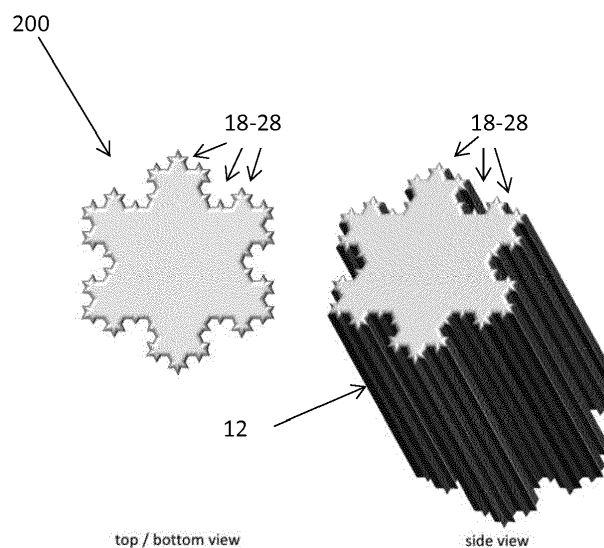


Fig. 6

**Description**Technical Field

**[0001]** The present invention relates to a food container suitable for both liquid and solid food products.

Background of the Invention

**[0002]** The packaging industry is well developed throughout the industrialised world and is subject to general norms and practices. On the whole, in the case of food or beverage packaging, this needs to be able to hold food or beverages in a food safe and hygienic condition, and to withstand storage and transportation; specifically to provide physical and barrier protection to the contents, to prevent contamination and agglomeration, to provide security including tamper control, and to be convenient. In recent years, there have been moves to reduce the amount of packaging material used and also to focus on more environmentally friendly packaging, such as by use of recyclable and biodegradable materials. Lightweighting is a concept that has been prevalent in the industry for some time, which aims to reduce the amount of packaging material utilised, its weight and also the energy required for its manufacture.

**[0003]** In the case of packaging for liquid or other flowable materials, it is common to use bottles, cans, cartons, bags and the like. Generally, such packaging has either a generally cylindrical form, such as a drinks can or bottle, or a cuboidal form, such as milk or juice cartons of the type commonly sold under the Elopak™ or Tetra Pak™ brands. This packaging is typically constituted by a smooth walled structure, often of multi-layered form, which minimises surface area and optimises the usable volume of the packaging. The contents of the packaging are often relied upon to maintain the form and integrity of the packaging, particularly during transportation and storage. For instance, a beverage container will often rely on the pressure of the beverage within the container to keep the container in its original shape. This enables the walls of the container to be made very thin, to the point that often once the container has been opened the walls become flimsy and are easy to collapse.

**[0004]** Food products are often sold in multiple units, such as cans and bottles, in which case it is common to tie these together with additional packaging, such as a sleeve, ring or yoke. This additional packaging also serves to stop individual packages from falling loose during transportation or storage, thereby reducing spoilage. However, such additional packaging adds further cost, both monetary and environmental.

**[0005]** The smooth nature of such packaging reduces a person's grip and it is not uncommon, particularly for large packages, for a person to struggle to handle the package without squashing it and causing spillage of the contents. This is particularly the case with large plastics drinks bottles.

Summary of the Present Invention

**[0006]** The present invention seeks to provide an improved container for food products. The invention is particularly suitable for, but not limited to, containers for liquids, such as beverages, and other flowable products.

**[0007]** According to an aspect of the present invention, there is provided a food or beverage container comprising: a wall defining an internal chamber of the container, the wall having interior and exterior surfaces and being of substantially uniform thickness; wherein the wall has a fractal profile with corresponding convex and concave fractal elements on corresponding ones of the interior and exterior surfaces; and wherein the convex and concave fractal elements form pits and bulges in the profile of the wall.

**[0008]** The present invention provides a food or beverage container having a container wall of different form than known in the art. The form taught herein provides a number of practical advantages over known packaging products.

**[0009]** Preferably, at least some of said pits and bulges have heads of a greater width than bases thereof.

**[0010]** Advantageously, the fractal profile of the wall permits coupling by inter-engagement of a plurality of said containers together. This feature can provide a number of practical advantages, including being able to do away with separate and additional tie elements to hold together a plurality of containers, as is necessary with currently available packages that rely on sleeves or yokes.

**[0011]** Preferably, the wall of the container is flexible, thereby permitting flexing of the fractal profile thereof. The flexibility of the wall permits disengagement of containers coupled together, by appropriate squashing of one or more of the containers to alter the fractal shape of the containers at the point of inter-engagement.

**[0012]** Advantageously, the corresponding convex and concave fractal elements provide for increased surface area of both the interior and exterior surfaces of the container relative to a volume of the chamber. An increased surface area can assist in the transfer of heat into and out of the container, for example for heating or cooling the contents thereof.

**[0013]** In preferred embodiments, the container is generally cylindrical. It may have other shapes in other embodiments, such as generally spherical, oval and so on.

**[0014]** The container wall may be formed of metal, plastics, elastomeric material or glass. It may also be made from flexible or potentially flexible food products.

**[0015]** The fractal form of the container wall can also contribute to improved holding of the container, whereas known packages with a smooth surface can be slippery particularly when wet such as when condensation forms on the outside as a result of the contents being cold.

**[0016]** It is to be understood that although the main focus of this disclosure is to a food or beverage container, the teachings are not limited to such applications and

could be used for containers for a wide variety of other uses.

#### Brief Description of the Drawings

**[0017]** Embodiments of the present invention are described below, by way of example only, in which:

Figure 1 is a schematic view in axial cross-section of a container according to an embodiment of the present invention;

Figures 2 and 3 are schematic axial partial cross-sectional views of an embodiment of two fractal containers in the process of being coupled together;

Figures 4 and 5 are schematic axial partial perspective views of the two fractal containers of Figures 2 and 3 in the process of being coupled together;

Figure 6 shows various views of another embodiment of fractal container;

Figures 7 to 9 show the coupling and uncoupling of two containers as per the embodiment of Figure 6; and

Figures 10 and 11 show, respectively, the coupling together of two further embodiments of fractal container.

#### Description of the Preferred Embodiments

**[0018]** The description that follows and its accompanying drawings disclose in broad terms the teachings herein. Elements that are common in the art are omitted for the sake of clarity, such as but not limited to the specific materials that the container may be made of, typical volumes for the container and so on. Furthermore, the drawings are not to scale.

**[0019]** The concept disclosed herein makes use of a fractal profile for the wall of the container, which has been found to provide a number of advantageous characteristics when applied to a container particularly for food and beverage products. The skilled person will appreciate that the profile of the wall will not be of pure fractal form but will have a form dictated by practical considerations such as the minimum practical or desirable size of its fractal components. Nevertheless, the relationship between elements of the profile is fractal in nature. In practical embodiments, the fractal container may exhibit a fractal interpretation over two or more size scales.

**[0020]** Referring to Figure 1, this shows in schematic form a transverse cross-sectional view of an embodiment of container 10 for use, for example, for beverages. The container has a wall 12 with an external surface 14 and an internal surface 16. The wall 12 has a substantially uniform thickness.

**[0021]** As with known containers, especially for food products, the wall 12 is preferably made of a food safe material or otherwise provided with a food safe inner lining. For this purpose, and as known in the art, the wall may be a single layer material or may be made as a

laminate of different materials. The wall may be made of or comprise a plastics material, a metal or metal alloy, an elastomeric material, and may even be made of glass. It is also envisaged that in some embodiments the wall

5 may be made from flexible or potentially flexible food product (for example pasta, dough, licorice and so on).

**[0022]** The wall 12 has a fractal profile which provides a series of fractal elements 18-28 on the interior and exterior surfaces 14, 16. It is to be understood that these fractal elements 18-28 have fractal characteristics within practical considerations determined for example by the limits of the chosen manufacturing/forming process, the material chosen for wall, the thickness the wall and so on. In practice, the fractal elements 18-28 will typically reach a minimum practical dimension determined by such constraints.

**[0023]** The fractal elements 18-28 of the wall create, as a result of the wall 12 having a generally uniform thickness, a series of pits 40 and bulges 42 in the profile of the wall, in which a pit 40 as seen from one of the exterior or interior surfaces 12, 14 forms a corresponding bulge 42 on the other of the exterior or interior surfaces 12, 14, and vice versa. This characteristic is exhibited both on a large scale, for instance with the pits 40 and bulges 42

20 identified by the reference numerals in Figure 1, but also with the smaller ones of the fractal elements 18-28. The pits 40 and bulges 42 could be described as opposite images of one another on the exterior 14 and interior 16 sides of the walls 12. Repeating features (for instance pits and bulges) across a variety of scales creates the fractal form or profile on the container surfaces. The fractal profile may extend across the entire area of the container surfaces or only over selected surfaces or surface portions. Thus, the fractal profile may in some embodiments extend over the entire container, while in other embodiments the majority of the container can be smooth with only the contact areas between containers having fractal formations.

**[0024]** It will be appreciated that Figure 1 is an axial cross-sectional view only. The fractal elements 18-28 may in some embodiments extend in linear fashion along the length of the wall 12, but in other embodiments the elements 18-28 may be of pure fractal form of a type akin, so to speak, to cauliflower or broccoli florets, so as to create an array of distinct nodules, both circumferentially and also longitudinally along the wall 12.

**[0025]** The container 10 may be of generally cylindrical form, such that the cross-section shown in Figure 1 extends into and/or out of the plane of the paper. In such embodiments, the container 10 will include a top and a base, typically of any type known in the art. In other embodiments, the container 10 may have any suitable non-cylindrical form, examples of which the person skilled in the art will be familiar with.

**[0026]** The container 10 of this embodiment, and of the other embodiments described and contemplated herein, provides a number of practical advantages. One such advantage can be seen with reference to the embodiment

shown in Figures 2 to 5.

**[0027]** Referring first to Figures 2 and 3, these are axial cross-sectional views of two containers 100, 110 similar to the view of Figure 1 but in which only a part of the circumference of the wall of each container can be seen. Each container 100, 110 has, as with the embodiment of Figure 1, a wall 12 having exterior 14 and interior 16 surfaces and fractal elements 18-28 formed in the wall and present in the exterior and interior surfaces 14, 16.

**[0028]** The containers 100, 110 have the same shapes and fractal profiles, which are also symmetrical as will be apparent from the Figures. This correspondence in shapes enables the pits 40 and corresponding bulges 42 in the walls of the two containers 100, 110 to engage into one another so as to interlock along a portion of their circumferences, as can be seen in particular in Figure 3. In this embodiment, the pits 40 and bulges 42 have the same, but opposite, shapes such that they are able to fit snugly into one another. This can be achieved, in some embodiments, by creating two identical fractal sheets and curving them in opposite directions such that one surface of one the sheet becomes the outer surface of one container and the same surface of the other sheet becomes the inner surface of the other container.

**[0029]** Furthermore, in the embodiments of Figure 1 to 3, the pits 40 and bulges 42 have what could be described as enlarged heads with narrower neck portions, in which the fractal elements extend to a smaller width or diameter  $d$  at or close to their bases compared to a larger width or diameter  $D$  further from their bases. This characteristic of enlarged heads may be prevalent in all of the pits 40 and bulges 42 but in other embodiments may be exhibited in only a portion of the fractal formations in the wall 12.

**[0030]** As can be seen in Figure 3 in particular, the coupling of the two containers 100, 110 occurs, in this example, because the containers have a generally curving or rounded form, in which case the containers will only touch, and inter-engage, at their tangents.

**[0031]** In other embodiments that have different general overall shapes, such as square or polygonal, the coupling of the fractal formations of two containers may occur across an entire side wall or a portion of one or more of the side walls of the containers.

**[0032]** When used for packaging, this characteristic enables multiple containers to be coupled together without the need for any other tie mechanism of the types commonly used in the art. In other words, two or more containers 100, 110 may be joined together solely by inter-engagement of some of the fractal formations of the container walls 12. The containers need not have tessellating shapes, as it is only necessary for one or more of the fractal formations of each of the containers to inter-engage in order to achieve coupling.

**[0033]** Figures 4 and 5 show a view of another embodiment similar to that of Figures 2 and 3, in which the fractal formations of the containers 100, 110 extend generally linearly for at least a short distance longitudinally, in other words in two-dimensional manner rather than in a three-

dimensional manner as a floret would. In this embodiment, the same fractal elements of the containers 100, 110 shown in Figures 4 and 5 will inter-engage longitudinally along their length, and if they extend along the entire length of the containers they will then inter-engage equally along the length of the containers. In the case of three-dimensional fractal elements, of what could be described as floret form, inter-engagement of two or more containers along a tangent thereof will involve the coupling of multiple fractal formations along the lengths of the containers.

**[0034]** The containers can be uncoupled by squeezing the containers 100, 110, for example from either side of the coupling zone, to cause the engaged pits 40 and bulges 42 to deform and open out. A user can in this manner separate the containers 100, 110 with relative ease.

**[0035]** Referring now to Figure 6, this shows another embodiment of fractal container 200 having a fractal form similar to that of the embodiments of Figures 1 to 5. In this embodiment, the fractal formations extend in linear manner along the length of the container 200, as can be seen in particular in the perspective view of Figure 6. The container 200 can have any of the characteristics described elsewhere herein.

**[0036]** With reference to Figure 7, in this embodiment the pits 240 and bulges 242 are not the same shape or size to fit one within the other precisely, as is the case with the embodiments shown in Figures 2 to 5. Nevertheless, the pits 240 and bulges 242 are still able to engage partially, as will be apparent in the Figure. The two containers can be tied to one another by adhesive posited into the interstice or pocket 244 between the partially engaged pits 240 and bulges 242. More than two containers may be coupled together in this manner, in a fully or partially tessellating manner depending upon the shapes of the containers.

**[0037]** The containers 200 can be separated from one another by applying pressure to one or both of the containers, as shown in Figure 8. In the example shown in this Figure, the pressure may be applied diametrically opposite the adhesive coupling 244, as per the arrow in the Figure. This pressure will cause deformation of the walls 12 of the containers and, as a consequence, apply shear stress (and typically also compressive and tensile forces) to the adhesive in the pocket 244, which will break or loosen. It will be appreciated that the containers could be squeezed from other directions and achieve the same result.

**[0038]** Once the adhesive coupling has been released, the containers 200 can be separate from one another as shown in Figure 9.

**[0039]** Referring now to Figure 10, this shows in schematic form partial wall profiles of two fractal containers 300, 300' according to another embodiment of the present invention. In this embodiment, the wall has what could be described as a fractal random walk profile, with zig-zag wall elements of different lengths  $\ell_1$ - $\ell_n$ .

**[0040]** The two container profiles 300, 300' preferably

have substantially identical reversed or replicated profiles in at least a part of their extent, such that they can couple together in a precise nesting arrangement, as shown in Figure 10B. The two fractal elements 300, 300' can thus be coupled together, typically by a combination of mechanical inter-engagement and friction. The skilled person will appreciate that in this embodiment, as with the following embodiment shown in Figure 11, the profile does not include any fractal elements having bulges or pits with enlarged heads, as occurs with the embodiments of Figures 1 to 9, although it is not excluded that in some embodiments they may have such characteristics.

**[0041]** Figure 11 shows another example, in which the profiles of the two containers 400, 400' only partially nest one into the other. It will be appreciated that the degree of coupling of the containers together can be altered by adjusting the fractal profiles of the two inter-engaging surfaces to one another.

**[0042]** In the preferred embodiments, the lengths  $\ell_1$ - $\ell_n$  of the zig-zag wall elements are advantageously determined as statistical fractals whose dimensions may be tuned via random walk parameters to optimize the interlocking of two or more fractal containers. Bonding between containers can be relatively strong with an increased number and size of capture points and weaker with fewer capture points.

**[0043]** In the embodiments of Figures 10 and 11, inter-engagement can be provided by the profiles themselves and optionally, as per the above described embodiments, assisted by the use of adhesive between adjacent containers.

**[0044]** The forms of container disclosed herein provide a number of other advantages in addition to an increased ability to couple multiple containers together.

**[0045]** First, the fractal nature of the outer surface of the container provides a better grip of the container compared to a container having a smooth outer surface. This can be advantageous particularly with larger or heavier containers, in respect of which a good grip can be obtained with less holding pressure on the container wall.

**[0046]** Moreover, the corresponding convex and concave fractal elements provide for increased surface area of both the interior and exterior surfaces of the container relative to a volume of the chamber. This can be useful in increasing the heat transfer characteristics of the container, for instance to cool or heat its contents.

**[0047]** The skilled person will appreciate that the teachings herein can provide other advantages and characteristics not exhibited in containers known in the art.

## Claims

1. A food or beverage container comprising:

a wall defining an internal chamber of the container, the wall having interior and exterior sur-

faces and being of substantially uniform thickness;

wherein the wall has a fractal profile with corresponding convex and concave fractal elements on corresponding ones of the interior and exterior surfaces; and

wherein the convex and concave fractal elements form pits and bulges in the profile of the wall.

2. A food or beverage container according to claim 1, wherein at least some of said pits and bulges have heads of a greater width than bases thereof.

3. A food or beverage container according to claim 1 or 2, wherein the fractal profile of the wall permits coupling by inter-engagement of a plurality of said containers together.

4. A food or beverage container according to claim 1, 2 or 3, wherein the wall of the container is flexible, permitting flexing of the fractal profile thereof.

5. A food or beverage container according to claim 4, wherein the flexibility of the wall permits disengagement of said or any coupling of a plurality of said containers together by flexing of inter-engaged fractal elements of coupled containers.

6. A food or beverage container according to any preceding claim, wherein at least some of the pits and bulges have inter-engaging or corresponding shapes and sizes such that a bulge of one container can fit within a pit of an equivalent container, thereby to couple two containers together.

7. A food or beverage container according to claim 6, wherein the pits and bulges of said two containers nest precisely within one another.

8. A food or beverage container according to claim 6, wherein the pits and bulges of said two containers nest partially within one another.

9. A food or beverage container according to any preceding claim, wherein two or more said containers can be coupled together by an adhesive disposed between facing pits and bulges of adjacent containers.

10. A food or beverage container according to any preceding claim, wherein the corresponding convex and concave fractal elements provide for increased surface area of both the interior and exterior surfaces of the container relative to a volume of the chamber.

11. A food or beverage container according to any preceding claim, wherein the container is generally cy-

lindrical.

12. A food or beverage container according to any preceding claim, wherein the wall is formed of metal, plastics, elastomeric material or glass.

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13. A food or beverage container according to any one of claims 1 to 11, wherein the wall is formed from flexible food product.

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**Amended claims in accordance with Rule 137(2) EPC.**

1. A food or beverage (10) container comprising:

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a generally cylindrical wall (12) defining an internal chamber of the container, the wall having interior (16) and exterior (14) surfaces and being of uniform thickness;

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a top and a base either end of the generally cylindrical wall;

wherein the wall (12) has a fractal profile with corresponding convex and concave fractal elements (18-28) on corresponding ones of the interior and exterior surfaces(14, 16);

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wherein the convex and concave fractal elements form pits (40) and bulges (42) in the profile of the wall (12);

wherein the wall of the container is flexible, permitting flexing of the fractal profile thereof; the fractal profile of the wall permits coupling by inter-engagement of a plurality of said containers together; and

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the flexibility of the wall permits disengagement of said or any coupling of a plurality of said containers.

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2. A food or beverage container according to claim 1, wherein at least some of said pits (40) and bulges (42) each have heads and bases, wherein the heads are of a greater width than bases thereof.

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3. A food or beverage container according to any preceding claim, wherein at least some of the pits (40) and bulges (42) have inter-engaging or corresponding shapes and sizes such that a bulge (42) of one container can fit within a pit (40) of an identical container, thereby to couple two containers together.

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4. A food or beverage container according to claim 3, wherein the pits (40) and bulges (42) of said two containers fit precisely within one another.

5. A food or beverage container according to claim 1 or 2, wherein the pits (40) and bulges (42) of said two containers fit partially within one another.

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6. A food or beverage container according to any preceding claim, wherein two or more said containers can be coupled together by an adhesive disposed between facing pits (40) and bulges (42) of adjacent containers.

7. A food or beverage container according to any preceding claim, wherein the corresponding convex and concave fractal elements (18-28) provide for increased surface area of both the interior and exterior surfaces of the container (10) relative to a volume of the chamber.

8. A food or beverage container according to any preceding claim, wherein the wall is formed of metal, plastics, or elastomeric material.

9. A food or beverage container according to any one of claims 1 to 7, wherein the wall is formed from flexible food product.

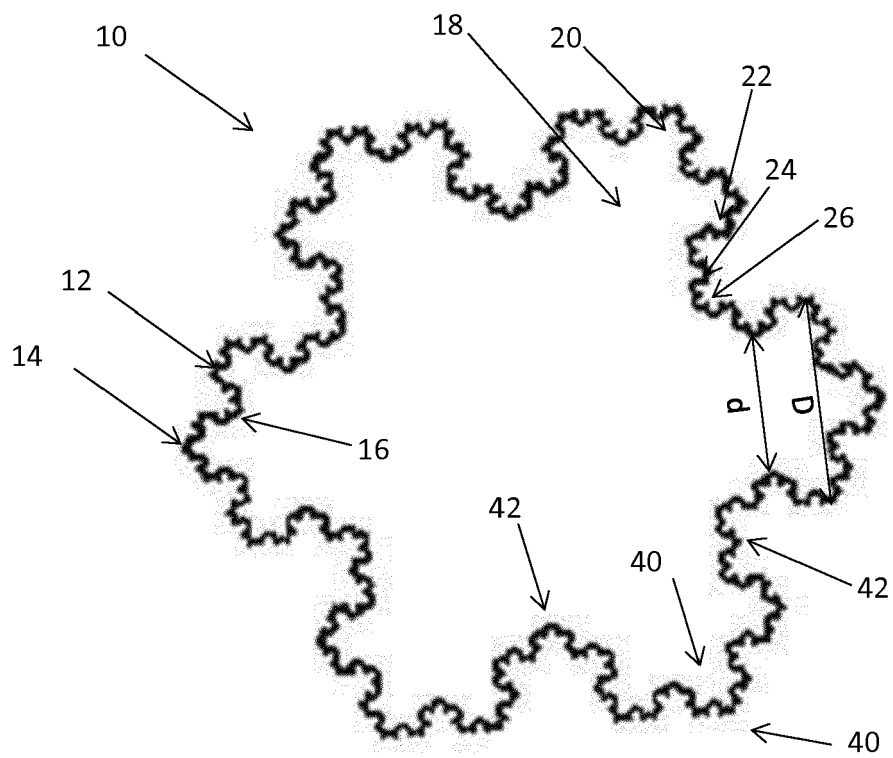


Fig. 1

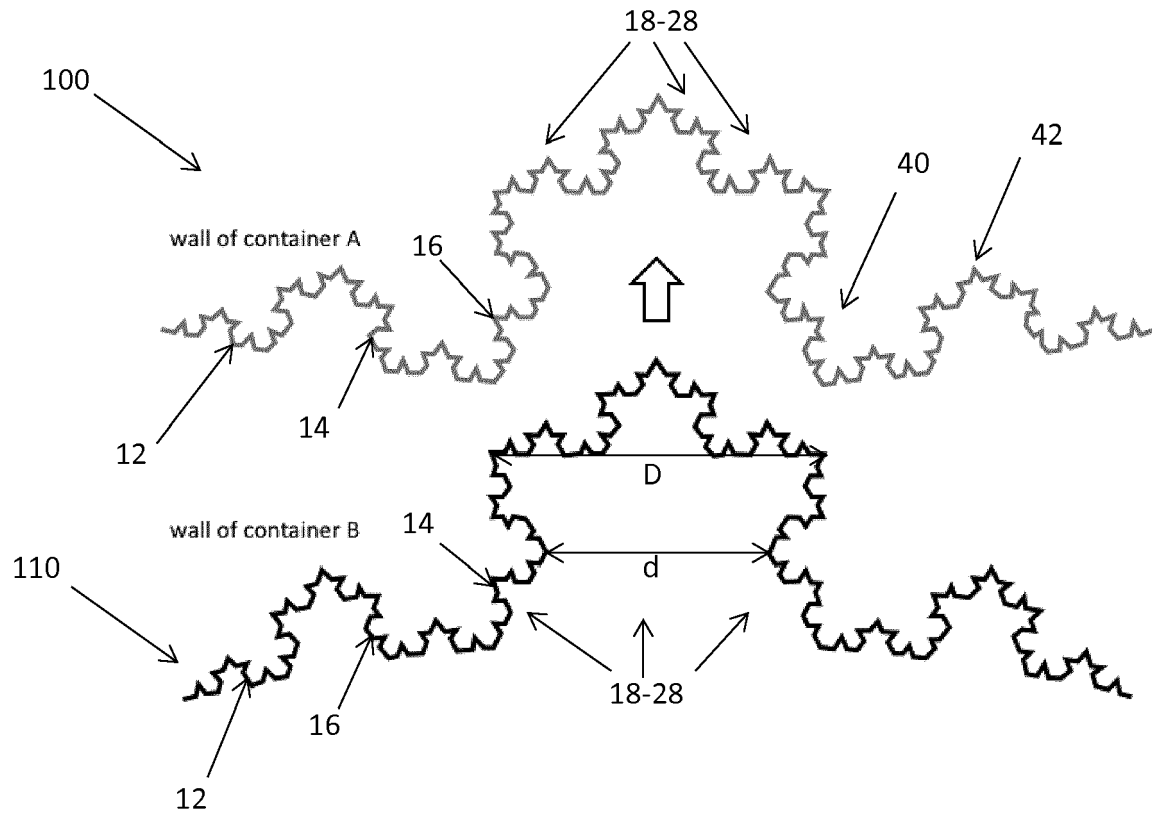


Fig. 2

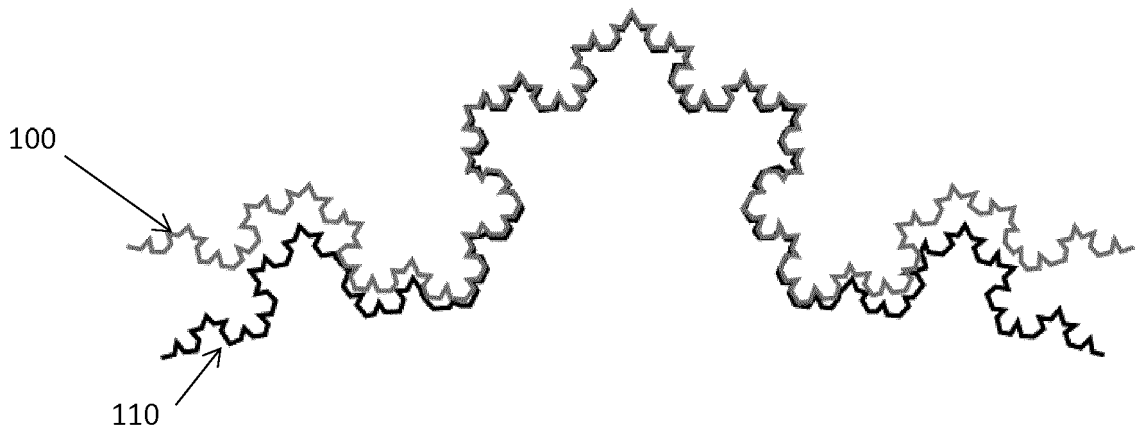
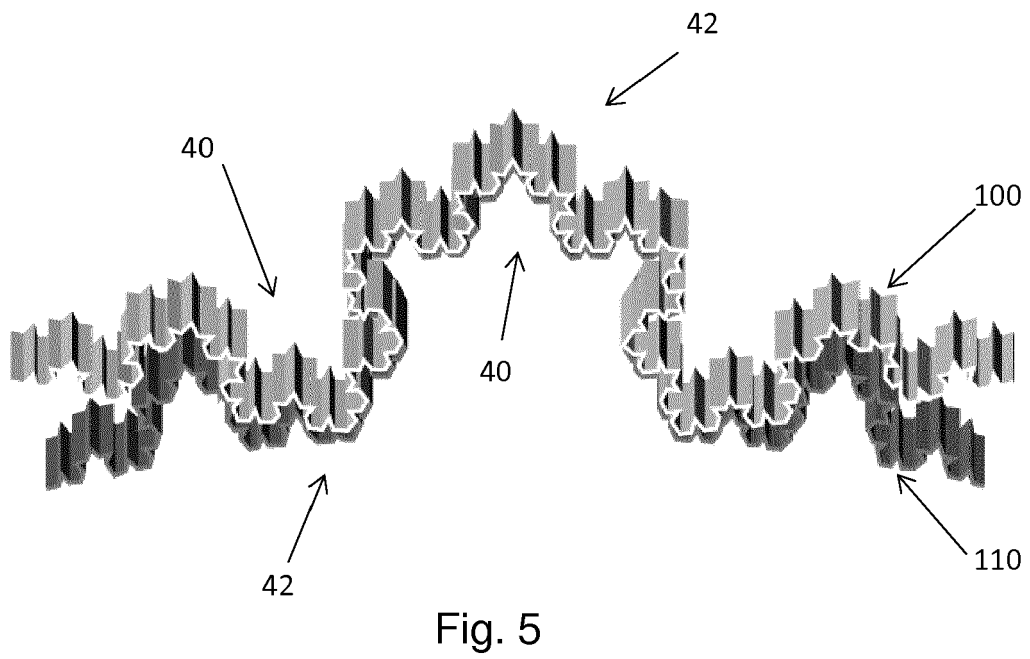
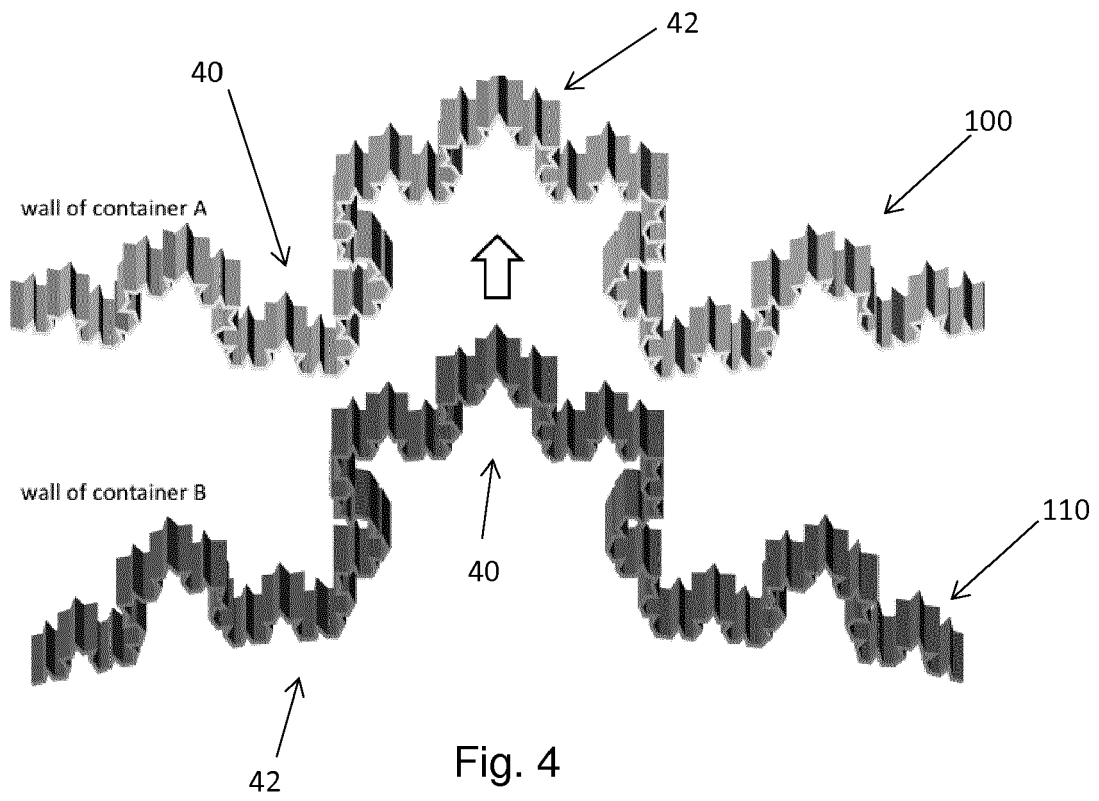


Fig. 3





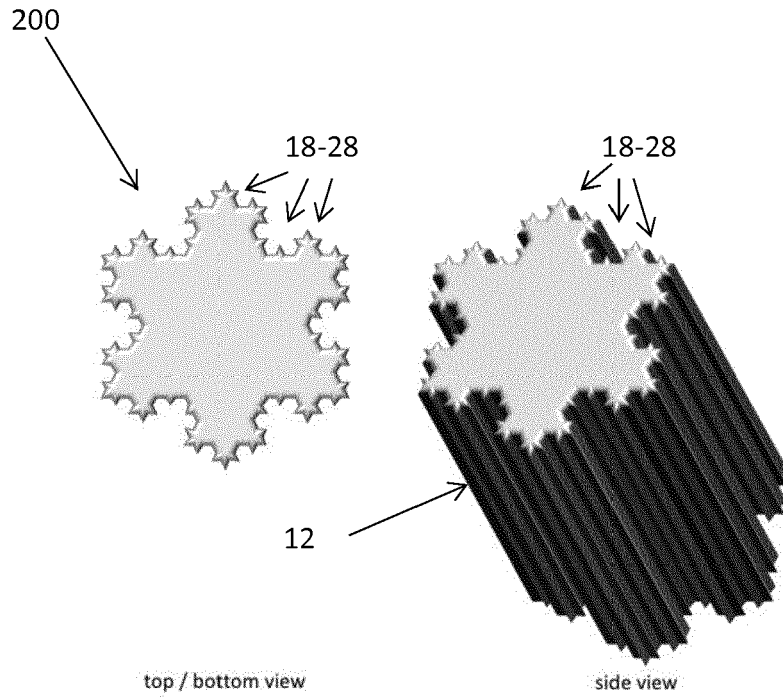


Fig. 6

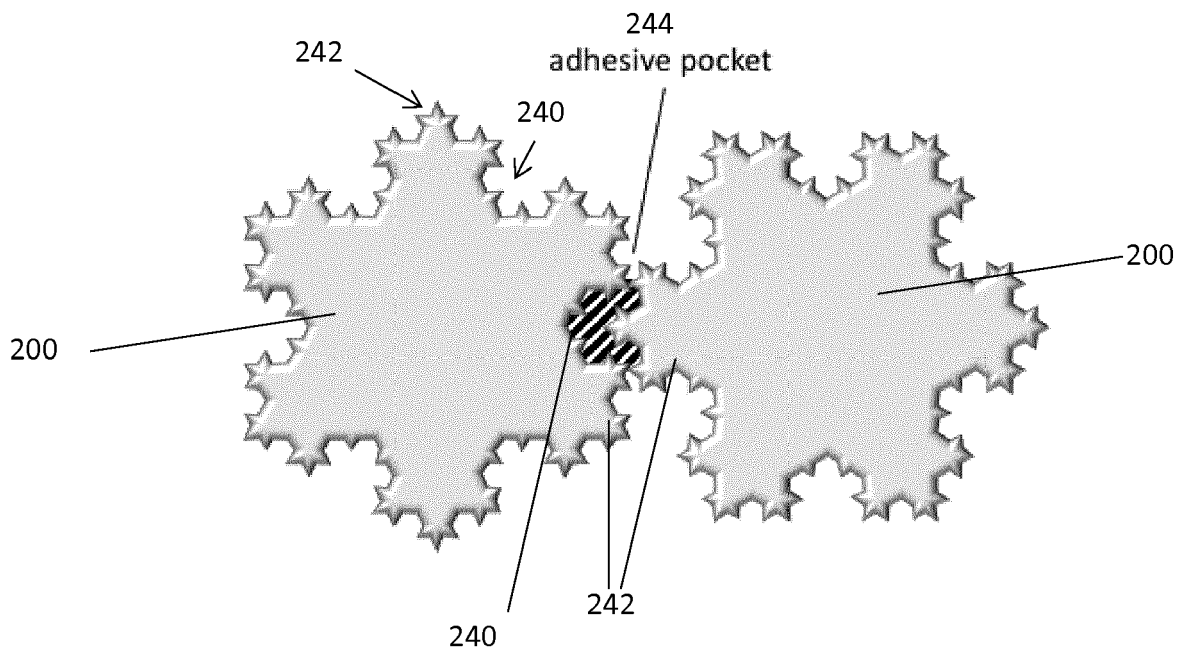


Fig. 7

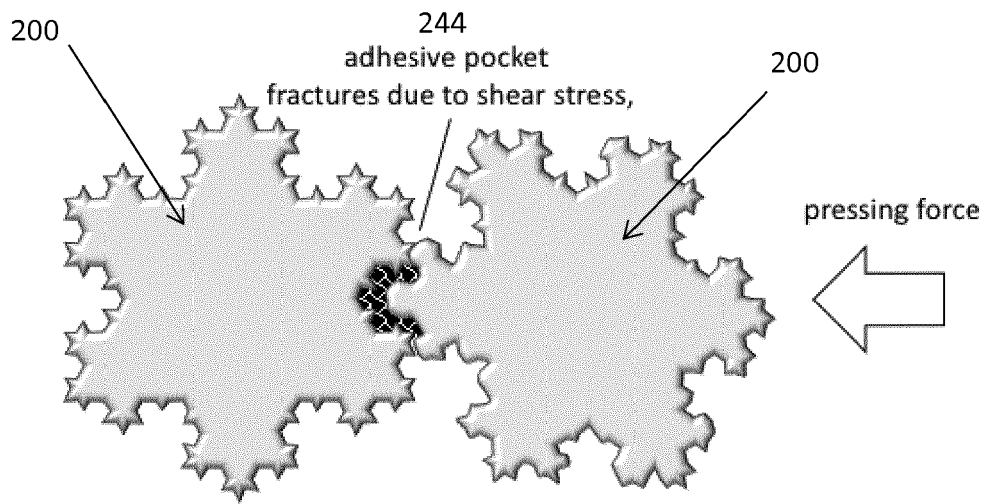


Fig. 8

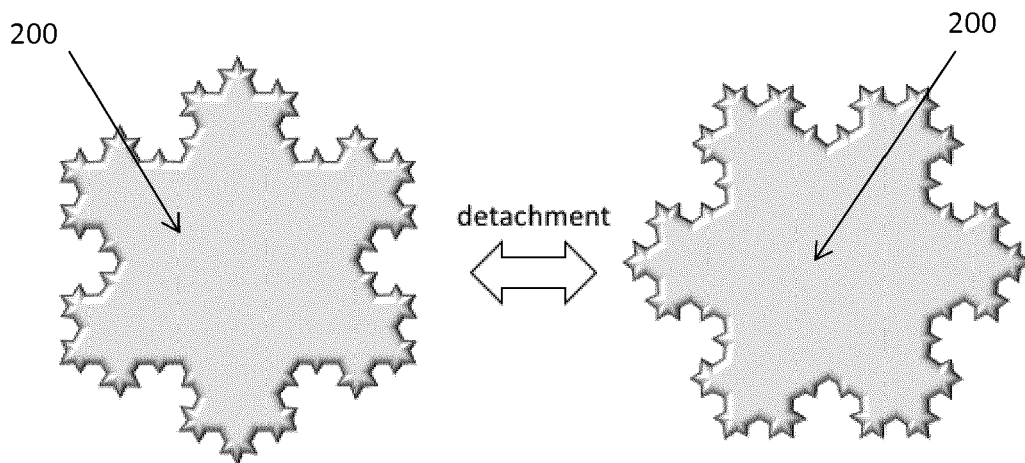


Fig. 9

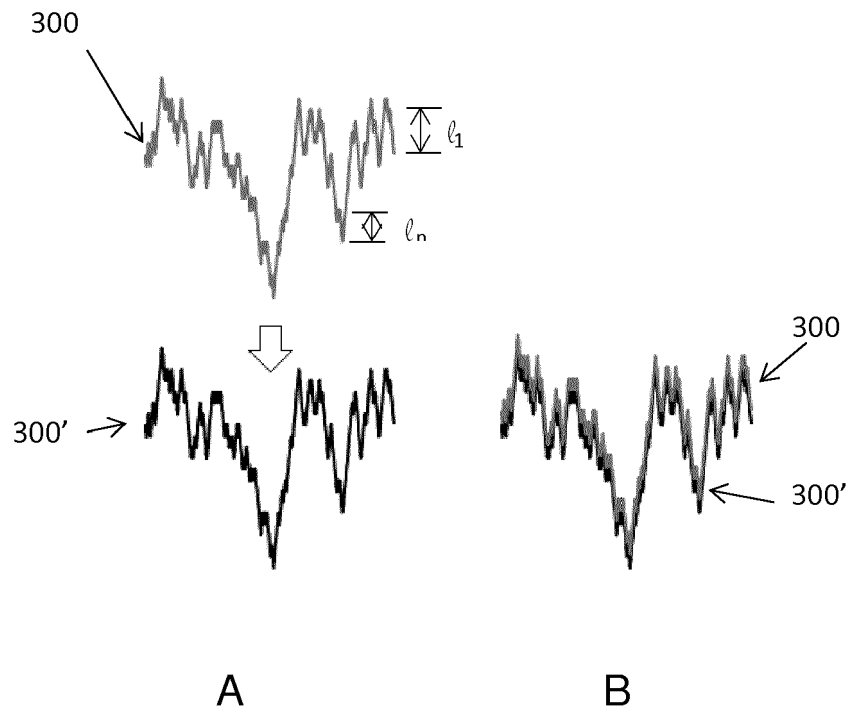


Fig. 10

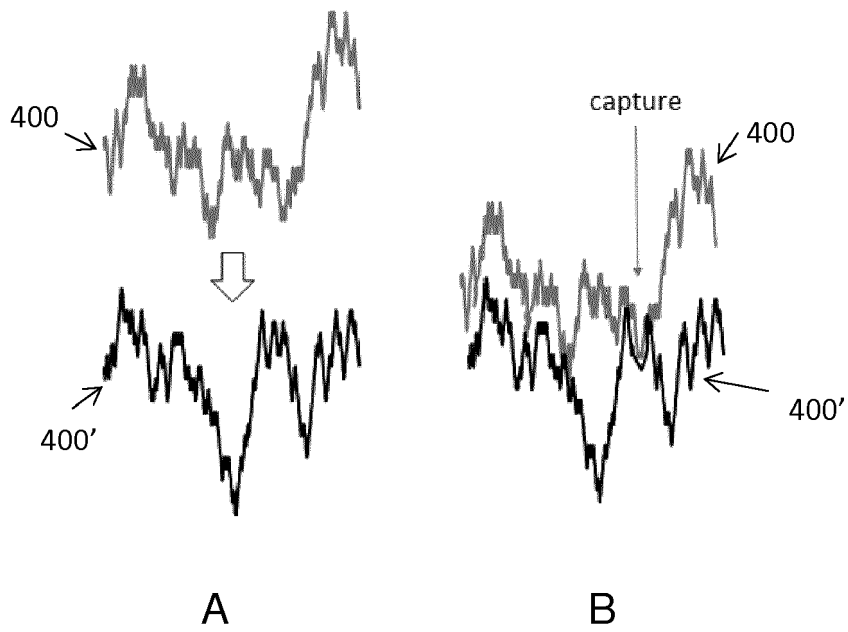


Fig. 11



EUROPEAN SEARCH REPORT

Application Number  
EP 18 27 5163

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 803 301 A (SATO KAZUHIRO [JP] ET AL) 8 September 1998 (1998-09-08) * column 2, line 42 - line 52 * * column 8, line 16 - line 23 * -----	1,9,11,12	INV. B65D6/02 B65D8/00 B65D6/00 B65D13/02 B65D21/02 B65D1/02
X	DE 100 04 386 A1 (EICHMANN JOSEF ALEXANDER [ZA]) 9 August 2001 (2001-08-09) * claim 1; figures * -----	1-12	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B65D
Place of search		Date of completion of the search	Examiner
The Hague		16 April 2019	Bridault, Alain
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 27 5163

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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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5803301	A	08-09-1998	NONE
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DE 10004386	A1	09-08-2001	NONE
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82