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(54) METHOD OF PRODUCTION OF VERSATILE PAPER LID FOR BEVERAGE CONTAINER AND PAPER LIDS

(57) A method of production of a lid with a central wall, a skirt with a fold pivoting around an edge of the skirt is produced from a single paperboard piece. Production includes application of pressure to create creases in an annular portion of the paperboard piece, heating the paperboard piece to remove the moisture and folding the paperboard piece to form the central wall and the skirt. The versatile lid **(10)** is for a cup **(20)** or any other container. The lid **(10)** does not contain any substance that would have had rendered the lid a single-use plastic product according to the EU Directive EU 2019/904. The configuration of the lid hinders unwished spillage of the liquid that is contained in the cup on one hand and is appropriate to co-operate with various shapes of cups on the other.

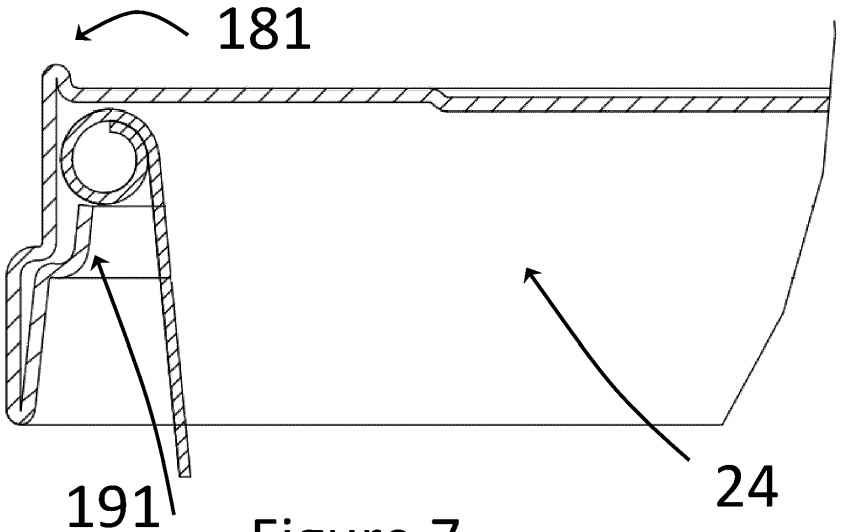

Figure 7

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Description

[0001] The invention refers to methods of production of eco-friendly products used for beverages and to such eco-friendly products.

[0002] Such known products are usually made of paper mixed with plastic (polymers). There may be cups, containers, utensils mainly for liquids that are consumed while the lid is placed on the container. The terms cup, container or utensil are used for a container with an opening that may be closed by a lid.

[0003] EP0459017 describes a closing lid made of cardboard for cans or can-like containers, with a circumferential stabilizing ring reinforcing the edge of a circumferential flange of the lid. The stabilizing ring is fixed on the inside and/or the outside of the circumferential flange by gluing and/or welding.

[0004] EP3943409 describes a paper lid for a container. The lid comprises a central and flat lid panel and an outer fitting flange with two legs to interlock with an upper rim of the container. In one example the one leg has an inwardly folded end portion in abutment with an inner surface of the unfolded portion and connected to the same

[0005] EP3403944 describes a lid made from a paper- or a cardboard material for closing a container. The lid comprises a top wall, which covers the opening of the container and a sidewall directed at an angle relative to the top wall. One end of the sidewall with a rolled edge can engage with the top end of the container.

[0006] The object of the invention is a method of manufacture of eco-friendly lids for cup. Another object of the invention is a method of manufacture of eco-friendly lids for cup, which lids do not contain any substance that would have had rendered the lid a *single-use plastic product* according to the EU Directive EU 2019/904 on the reduction of the impact of certain plastic products on the environment that came into force on 3 July 2021 and the related Commission guidelines on *single-use plastic products:* 2021/C 216/01. A further object of the invention is a method of manufacture of such lids, which is effective and applicable for mass production of lids. A further object of the invention is the production of eco-friendly lids.

[0007] The invention is defined in the independent claims.

[0008] Dependent claims describe characteristics that offer further advantages to the invention.

[0009] A method of production of a lid with a central wall, a skirt with an outer wall and a fold pivoting around an edge of the skirt is produced from a single paperboard piece.

[0010] Production includes application of pressure to create creases in an annular portion of the paperboard piece, heating the paper piece to remove the moisture and bending the paper piece to form the central wall and the skirt. Optionally, after the removal of the moisture the weight content of moisture within the paperboard is within the range of 5% to 10%.

[0011] Optionally, the creases are created by application of pressure that are within a range of 4.4 bars and 5.5 bars. In some examples the pressure is within a narrower range from 4.8 bars to 5.2 bars.

[0012] The annular portion with the creases has an inner portion and an outer portion that surrounds the inner portion and corresponds to the fold of the lid under production. The creases in the outer portion are in some examples denser than the creases in the inner portion to further facilitate the folding and the pivoting of the fold around the pivoting edge. The creases may be radial, i.e. normal to the tangent to the perimeter of the paperboard piece. When the paperboard piece and consequently the lid are circular, the creases extend along radiuses of the paperboard piece.

[0013] In some embodiments of the method, the skirt is folded along a line to create the edge, the outer wall and the fold that extends from the edge towards the central wall.

[0014] Optionally, the method includes creating of the fold, whereby the flap has a free edge configured to hinge along a hinge line provided on the fold.

[0015] The method may further include applying forming the fid by applying pressure. The pressure may within a range of 4.7 bars and 6.2 bars. This pressure is usually higher than the pressure applied to form plastic cups for similar uses.

[0016] Lids of cups that are produce by a method that is according to the invention have a central wall with a perimeter and a skirt extending along the perimeter. The skirt extends laterally and at an angle to the central wall and has an outer wall and a fold. The fold extends from the outer wall towards the central wall. The outer wall and the fold are rotatable around an edge provided on the skirt, where they converge, to change the angle between them. The lid is formed from a single piece of paperboard of recyclable material.

[0017] The geometry of the lid offers excellent properties and hinders unwished spillage of the liquid that is contained in the cup that is closed by the lid. The configuration of the lid does not require a particular geometry of the lip of the cup or container and is appropriate to cooperate with various cups. At least towards the edge, the fold is flat, i.e. it is not rolled as it is in some known lids. The design of the lid makes it easy to store multiple lids in a relatively small space.

[0018] The geometry of a lid according to the invention is effective, even if the paperboard does not contain any substance that would have had rendered the lid a *single-use plastic product* according to the EU Directive EU 2019/904 on the reduction of the impact of certain plastic products on the environment that came into force on 3 July 2021 and the related Commission guidelines on *single-use plastic products:* 2021/C 216/01.

[0019] Optionally, the paperboard is multi-ply, preferably with three plies. The plies of the paperboard include cellulose fibers and may also include other substances

such as minerals, lignine, binding agent or any other substances, which do not render the lid *single-use plastic product.* The layered structure of the paper enhances the technically acceptable and stable forming process that reduces shape memory effects.

[0020] The skirt may be normal or almost normal to the central wall.

[0021] In some examples the fold may have a flap with a free end that may rotate about a hinge line other than the edge of the skirt, which is provided on the fold. The rotation of the flap further facilitates the locking of the lid to a cup and the use of the lid with cups having various shapes.

[0022] For connecting the lid to a cup, the cup may feature a lip around an opening. In use the lid traps a lip of a cup or container between the skirt and the central wall. The configuration of a lid according to the invention renders the lid versatile, since it allows the closure of cups with various shapes of lips, for example lips with circular, oval or other cross-section, channel type lips etc.

[0023] When the lid is attached to the cup, the lip is trapped and secured between the outer wall of the skirt and the flat fold.

[0024] In some examples the outer wall has a lower portion that is disposed radially and axially from the central wall and is connected to the fold at the edge of the skirt. The outer wall may have an upper portion, a lower portion and a shoulder therebetween.

[0025] The lower portion is disposed radially and axially from the central wall and is connected to the fold at the edge of the skirt. The upper portion extends and the shoulder is disposed at a distance axially from the central wall. The widening of the skirt away from the central wall further facilitates the relative rotation of the fold and the outer wall and the use of the lid with cups of different dimensions and configurations of the edge of their opening.

[0026] In case the cups or containers have a circular cross-section, the central wall is also circular. In these cases, the skirt has a circular cross-section and if the outer wall has an upper portion and a lower portion, the diameter the cross-section of the former is larger than the diameter of the cross-section of the latter.

[0027] The lid may be provided in the central wall with a hole for the flow of liquid or for placing a straw.

[0028] The outer wall has a tip that projects from the central wall and is opposite to the edge of the skirt. This configuration offers further stability and robustness to the lid. The height of the tip is minimal.

[0029] For connecting the lid to a cup, the cup may feature a lip around an opening. In use the lid traps a lip of a cup or container between the skirt and the central wall. The configuration of a lid according to the invention renders the lid versatile, since it allows the closure of cups with various shapes of lips, for example lips with circular, oval or other cross-section, channel type lips etc.

[0030] When the lid is attached to the cup, the lip is trapped and secured between the outer wall of the skirt and the flat fold.

[0031] The description of examples of the invention follows, with reference to **Figures 1 to 13:**

- **Figure 1** shows a lid applied to a cup
- **Figure 2** shows lids stacked on each other
- **Figure 3** shows one of the lids of **Figure 2**
- **Figure 4** shows the cross-section of a lid of **Figure 2**
- **Figure 5** shows, in cross-section, a lid and a cup
- **Figure 6** shows, in cross-section, the attachment between a lid and a cup
- **Figure 7** shows, in cross-section, the attachment between of the lid with another cup
- **Figure 8** shows the exploded view of the wall of a circular lid with the creases formed on an annular portion of the skirt during production
- **Figure 9** shows in cross-section, another example of attachment between a lid and a cup
- **Figure 10** shows a further example of an attachment between of a lid and a cup
- **Figure 11** shows a further example of a lid and the attachment between of a lid and a cup
- **Figure 12** shows the lid of **Figure 11** without the cup
- **Figure 13** shows as an example only, a lid with its dimensions

[0032] **Figure 1** shows a lid **(10)** formed from a sheet **(33)** of paperboard, placed on a cup **(20).**

[0033] The cup **(20)** - see also **Figure 5** - has a base **(26)** and a lateral side jacket **(24).** At the free edge **(27)** of the side jacket **(24),** a lip **(22)** protrudes towards the outer space of the cup **(20)** defining an opening of the cup **(20).** The protruding lip **(22)** may have any form of cross-section, e.g. circular, oval, triangular, trapezoidal, channel-like or other. In some examples the lip **(22)** is formed by rolling the edge of the opening.

[0034] **Figure 3** shows the lid **(10)** with a central wall **(13)** and a skirt **(16)** at an angle with respect to the central wall **(13).** In this condition, the angle may be equal or about equal to 90 deg. The skirt **(16)** extends along the entire perimeter **(18)** of the central wall **(13).**

[0035] The central wall **(13)** has an annular portion and a central portion that lie parallel to each other with a slight offset.

[0036] The skirt **(16)** starts from the perimeter **(18)** of the central wall **(13).** As shown in **Figures 4 and 6,** the skirt **(16)** folds and forms an outer wall **(12)** and an inner flat wall, i.e. the fold **(19),** rather than rolled, which is observed in known lids. The fold **(19)** folds to the interior of the space defined by the skirt **(16),** extends to the central wall **(13)** and ends at a short distance from it. In the area where the sheet **(33)** is folded, there is a pivoting edge **(17),** around which the outer wall **(12)** and the fold **(19)** rotate around each other. The skirt **(16)** is continuous around the perimeter **(18),** i.e. with no with no discontinuities, openings or cuts through the thickness of the paperboard.

[0037] As shown in **Figure 4** the outer wall **(12)** has two

end portions **(121), (123)** and a mid- portion, i.e. shoulder **(122).** The one of the two end portions **(121), (123)** is designated as upper portion **(121)** and projects from the central wall **(13).** The other of the two end portions **(121), (123)** is designated as lower portion **(123)** and is connected directly with the fold **(19).** The shoulder **(122)** is in between and connects the two end portions **(121), (123).** In some embodiments the shoulder **(122)** is at a distance from the central wall. In general, the lower portion **(123)** extends radially outwards from the upper portion **(121),** i.e. the projection of the upper portion **(121)** on a plane that is parallel to the central wall **(13)** lies within the projection of the lower portion **(123)** on the same plane, with the projection of the shoulder **(122)** lying in-between.

[0038] The fold **(19)** has three portions disposed in a series: a pivoting portion **(193),** a connector **(192)** and a flap **(191),** whereby the pivoting portion **(193)** is connected to the lower portion **(123),** the flap **(191)** has a free edge and the connector **(192)** is between the pivoting portion **(193)** and the flap **(191).** The connector **(192)** may be a hinge line between the pivoting portion **(193)** and the flap **(191).**

[0039] When the outer wall **(12)** abuts the fold **(19)** an inner face of the lower portion **(123)** is in contact with an inner face of the pivoting portion **(193),** an inner face of the shoulder **(122)** is in contact with an inner face of the connector **(192)** and an inner face of the upper portion **(121)** is in contact with an inner face of the flap **(191).** However, in use the pivoting portion **(193)** and the lower portion **(123)** may rotate along the pivoting edge **(17)** and the pivoting portion **(193)** and the flap **(191)** may rotate relative to each other along the hinge line.

[0040] The flap **(191)** has a length that is smaller than the length of the corresponding upper portion of the outer wall **(121).** The length of the outer wall, the fold and the corresponding portions are measured along a line that is normal to the central wall **(13),** which coincides with the direction of the axis of the cup **(20)** when the lid **(10)** is placed on the cup **(20).**

[0041] **Figure 8** shows the exploded view of the skirt **(16),** where the width of the outer wall **(12)** and the fold **(19)** is denoted by the letter «α». The width of the skirt **(16),** i.e. the outer wall **(12)** and the fold **(19)** is defined as its dimension that is vertical to the perimeter **(18)** of the central wall **(13).** In the case of circular lids, the width is measured along the radius of the circle. The width of the fold **(19)** may be less than the width of the outer wall **(12).**

[0042] When the lid **(10)** is placed at the cup opening **(20),** the lip **(22)** of the cup **(20)** is located between the outer wall **(12)** of the lid **(10)** and the fold **(19),** securing in this way the lid **(10)** on the cup **(20).** When the fold (19) has a flap (191), it is the flap (191) that comes in contact with the lip **(22)** of the cup **(20)** - see **Figure 7. Figure 9** and **Figure 10** show the use of the lid **(10)** with cups **(20)** having lips **(22)** of different shapes. The cup **(20)** of **Figure 9** has a lip **(10)** with oval cross-section and that of **Figure 10** has a lip **(22)** with a channel shaped cross-section, that received the tip of the fold **(19),** in **Figure 10** the tip of the flap **(191).**

[0043] To secure the lid **(10)** on the cup **(20),** the user presses the lid **(10)** onto the cup **(20).** By pressing the lid **(10)** onto the cup **(20),** the fold **(19)** is first pressed by the lip **(22)** and when the lip **(22)** of the cup **(20)** contacts the flap **(191),** the fold **(19)** is hinged away from the outer wall **(12),** trapping the lip **(22)** between the fold **(19),** and the central wall **(16).** In this position the lid **(10)** is secured on the cup **(20),** closes effectively the opening of the cup **(20)** and prohibits undesired spill of the liquid to be consumed.

[0044] The raw material used for the production of the lids is a roll of recyclable paperboard. The paperboard may be multi-ply and in some embodiments has three distinct layers of paper. The material of the paperboard is recyclable and does not include any substance, either plastic or other, which would have had rendered the products including said paperboard *single-use plastic product* according to the EU Directive EU 2019/904 on the reduction of the impact of certain plastic products on the environment that came into force on 3 July 2021 and the related Commission guidelines on single-use plastic products: 2021/C 216/01. The plies of the paperboard may also include other substances such as minerals, lignine, binding agent or any other substances, which do not render the lid *single-use plastic product.* The selection of paperboard raw material (which may be constituted by a 3-layer structure) further contributes to the production of a paper lid, which provides an excellent fit on a cup containing fluid, using the method described below. In some examples the papeboard has the following properties;

- thickness of the paperboard - preferable in the range of 400-500 μm (micrometer) for example 450 μm or about 450 μm
- weight --preferably in the range of 320-370 gsm for example 350 gsm (gram per square meter) or about 350 gsm
- individual fiber length - preferably in the range of 1-2 mm
- moisture content in the paperboard - preferably in the range of 7-10% for example 9.5% or about 9.5%

[0045] In some examples of methods for production of the lid **(10)** the roll is fed to the production line, where there are pieces **(33)** of paperboard cut from the roll. Each such piece **(33)** of paperboard corresponds to a lid **(10)** under production. The piece **(33)** of paperboard is drawn to create the skirt **(16)** and the fold **(19).** During production, creases **(15)** are created on the outer wall **(12)** and on the fold **(19)** of the skirt **(16).** These creases **(15)** are formed by breaking fibers of the paperboard. **Figure 8** shows the exploded view of the wall of a circular lid, where the creases can be seen scattered over the entire surface of the outer wall **(12)** and the fold **(19).** In some examples the creases **(15)** on the fold **(19)** are denser than the creases **(15)** on the outer wall **(12).**

[0046] An example of the method of production of

paper lids includes the following steps:

a. Introduce the recyclable paperboard and feed it into the production line of the lids. For efficient production the paperboard is in the form of a reel. As an example, a reel may have a diameter of 1100 mm and width of 137 mm. Other dimensions are anticipated.
b. Perforate, engrave and/or make slits on the paperboard to form the opening for a straw on each lid under production. This step may be also performed after the detachment of a piece of paperboard, which corresponds to a lid under production, from the reel.
c. Apply pressure to annular portions, whereby each annular portion corresponds to the skirt of a lid under production. During this method step the applied pressure breaks the fibers of the paperboard. This results in the creation of creases **(15),** preferably radial creases **(15).** When the lid is circular the creases **(15)** are preferably along the radius of the circle. The formation of the creases **(15)** allows the paperboard to deform without maintaining "memory effects", so that the lid with the skirt, which will be produced, will not spring-back to a flat piece of paperboard. In some examples the pressure is higher than 4.4 bar preferably 4.8 bar. Optionally, the pressure does not exceed 5.5 bar, preferably 5.2 bar. The application of this pressure level contributes to eliminate the memory effect of the paperboard. The memory effect is the natural tendency of the paperboard to return to its original 2-dimensional form. The creases **(15)** may be denser towards the outer periphery of the annular portion. This configuration facilities the folding of the skirt so as to create an outer wall and a fold, i.e. an inner wall. The creases **(15)** in the paper are introduced when the paper is still in the 2-dimensional shape. This step may be also performed after the detachment of a piece of paperboard, which corresponds to a lid under production, from the reel. **Figure 8** shows the exploded view of the wall of a circular lid with the creases formed on an annular portion of the skirt during production. The annular portion is defined in **Figure 8** by the dash-dotted perimeter.
d. Optionally apply coating on the lid. The coating may be applied solely on portions of the piece of paperboard, for example on the face of the annular portion where the creases **(15)** are formed and/or on the external face of the central wall. The substance, which is used for coating may be or include minerals, lignine, binding agent or any other substance, which does not render the lid *single-use plastic product.*
e. Separate or detach the piece of paperboard that corresponds to a lid under production from the reel. The paperboard piece is in the form of a 2-dimensional disc and in the case of a circular lid the disc is round disc.
f. Bend the annular portion that corresponds to the skirt around a line to create the skirt **(16)** and the central wall **(13).** Bending is effected by applying pressure along a line that corresponds to the inner perimeter of the annular portion.
g. Folding the skirt to create the shoulder **(122)** of the outer wall **(12)** by applying pressure. This is performed in a pre-folding station of the machine.
h. Heat the piece of paperboard at a temperature within a range 240°C to 370°C, preferably within a range between 260°C to 350°C to remove moisture trapped within the paperboard by evaporation. The applicant observed that the steam created by the evaporation of moisture within the paperboard relaxes the memory effect of the paper and at the same time creates the conditions for the 3- dimensional form to have a permanent shape. We believe that this is because the steam contributes to heat transfer throughout the paperboard structure. The paperboard material may contain moisture with weight content within the range of 7-10%, or even between 5% to 10%. The desired humidity content may be achieved during processing of the paperboard before production of the lids. During this method step the residual stresses developed during the forming and which further contribute to the memory effect, are eliminated.
i. Fold the annular portion that corresponds to the fold **(19)** around a line that corresponds to the pivoting edge **(17),** to form the outer wall **(12)** and the fold **(19).**
j. Optionally create tip (181) along the perimeter (18) of the central wall (13), which corresponds to the boundary of the skirt (16) and the central wall (13). The tip (181) is created by applying pressure either simultaneous with the creation of the pivoting edge (17) or not.
k. Forming of the inner feature of the folded skirt, i.e. the flap **(191)** of the fold by applying pressure. The pressure that is applied is preferably higher than the pressure applied to form the creases **(15),** in some examples approximately 10% to 30% higher. Optionally the pressure is within a range of 5.7 bar and 6.2 bar. With the application of pressure during this step the lid is permanently deformed.
l. Eject the final product, i.e. the lid with the central wall and the skirt.

[0047] The pressures applied for the creation of the creases and/or the formation of the lid are in most cases higher that the pressures needed for the production of plastic lids for cups.

[0048] During production, the humidity of the ambient air of the production line is preferably within the range of 45% to 65%.

[0049] **Figure 2** shows lids **(10)** stacked one on top of each other. The formation of the skirt **(16)** with the fold **(19)** facilitates stacking, as the lid **(10)** that fits inside another, pushes the fold **(19)** of the other lid to the outer wall **(12).**

[0050] **Figure 6** shows a lid **(10)** with the fold **(19)** forming an angle with respect to the outer wall **(12).** The Figure shows the lid **(10)** applied to the cup **(20),** with the lip **(22)** of the cup **(20)** trapped between the outer wall **(12)** and the fold **(19)** of the skirt **(16). Figure 7** shows a lid **(10)** with the fold **(19)** with a flap **(191)** that is in contact with the lip **(22).** As it can be easily seen, the lids are not permanently attached to the cups.

[0051] **Figure 11** another example of a lid **(10)** attached to a cup **(20).** In this example the folding of the skirt is effected along a line that is between the pivoting edge **(17)** and the line that corresponds to the inner perimeter of the annular portion and at the vicinity of the pivoting edge **(17).** Figure 12 shows the lid of Figure 11 without the cup (20).

[0052] The single-use paper lid may have different shapes and diametres. A nonlimiting example of a circular lid with internal diameter of 90 mm is shown in **Figure 13.** The dimensions and tolerances in **Figure 13** are given only as an example, since the single-use paper lid may have different shapes and internal diameters, including but not limited to 90 mm & 95 mm. The features of the paper lids are such that may close under an oval-, flat- or snap-rim of paper or plastic cups on one hand and deliver secure closure at the cup rim, preventing spill-over of the cup content, on the other.

Claims

1. Method of production of a lid (10) with a central wall (13), a skirt (16) with an outer wall (12) and a fold (19) pivoting around an edge (17) of the skirt (16), which skirt (16) extends along a perimeter of the central wall (13) and at an angle with respect to the central wall (13), the lid (10) being produced from a single paperboard piece (33), whereby production includes application of pressure to create creases (15) on an annular portion of the paperboard piece, heating the paperboard piece to remove the moisture and bending the paperboard piece to form the central wall (13) and the skirt (16), which skirt (16) includes the creases (15).

2. Method according to claim 1, whereby the pressure applied to create the creases (15) is within a range of 4.4 bars and 5.5 bars, preferably within a range of 4.8 bars and 5.2 bars.

3. Method according to claim 1 or claim 2, whereby the annular portion has an inner portion and an outer portion that surrounds the inner portion and corresponds to the fold (19) of the lid (10) under production, and the creases (15) in the outer portion are denser than the creases (15) in the inner portion.

4. Method according to any one of claims 1 to 3, whereby the paperboard piece (33) is circular and the creases (15) extend along radiuses of the paperboard piece (33).

5. Method according to any one of claims 1 to 4, including folding the skirt along a line to create the edge (17), the outer wall (12) and the fold (19) that extends from the edge (17) towards the central wall (13), whereby the outer wall and the fold (19) are configured to rotate with respect to each other around the edge (17).

6. Method according to any one of claims 1 to 5, including forming the lid (10) and creating a flap (191) with a free edge configured to hinge along a hinge line provided on the fold.

7. Method according to claim 6, whereby forming the fold includes applying pressure to the fold (19), preferably within a range of 4.7 bars and 6.2 bars.

8. Method according to any one of claims 1 to 7, whereby the skirt (16) is normal or almost normal to the central wall (13).

9. Method according to any one of claims 1 to 8, whereby heating is effected to a temperature within a range between 240°C to 370°C, preferably within a range between 260°C to 350°C

10. Method according to claims 9, whereby the before production of the lids the paperboard has a moisture weight content of 5% to 10% , optionally from 5% to 7 % or from 7% to 10%.

11. Method according to any one of claims 1 to 10, including feeding a reel of recyclable paperboard in a production line and cutting flat pieces of the paperboard pieces from the reel, whereby each paperboard piece corresponds to a lid under production.

12. Method according to any one of claims 1 to 11, whereby the paperboard does not contain any plastic that would have had rendered the lid a single-use plastic product according to the EU Directive EU 2019/904.

13. Lid **(10)** for a cup **(20)** or any other container with a central wall **(13)** with a perimeter **(18)** and a continuous skirt **(16)** with no discontinuities extending along the perimeter **(18)** and at an angle to the central wall **(13),** which skirt **(16)** has an outer wall **(12)** and a fold **(19)** that extends from the outer wall **(12)** towards the central wall **(13),** whereby the lid **(10)** is formed from a single piece **(33)** of paperboard of recyclable material, whereby the outer wall **(12)** and the fold **(19)** converge at an edge **(17)** of the skirt **(16)** and define an angle therebetween and whereby

the outer wall **(12)** and the fold **(19)** are rotatable around the edge **(17),** so as to change the angle between them.

14. Lid according to claim 13, whereby the thickness of the paperboard is within the range of 400-500 μm.

15. Lid according to claim 13 or claim 14, whereby the weight of the paperboard is within the range of 320-370 gsm.

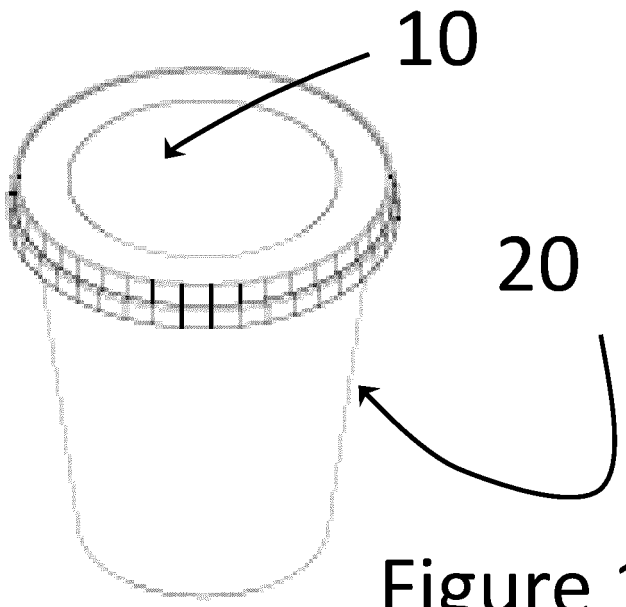


Figure 1

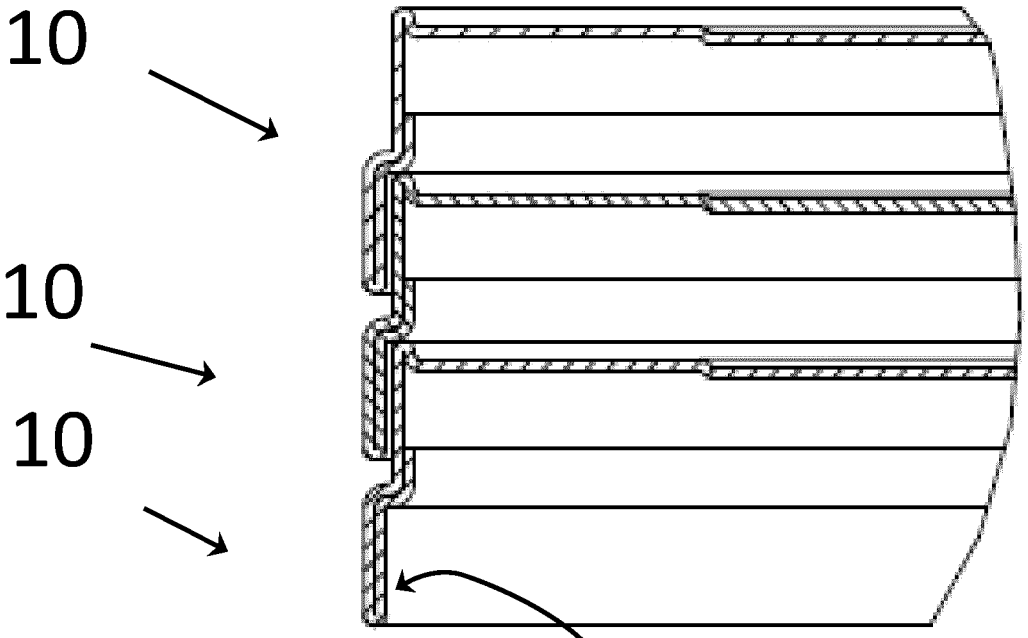
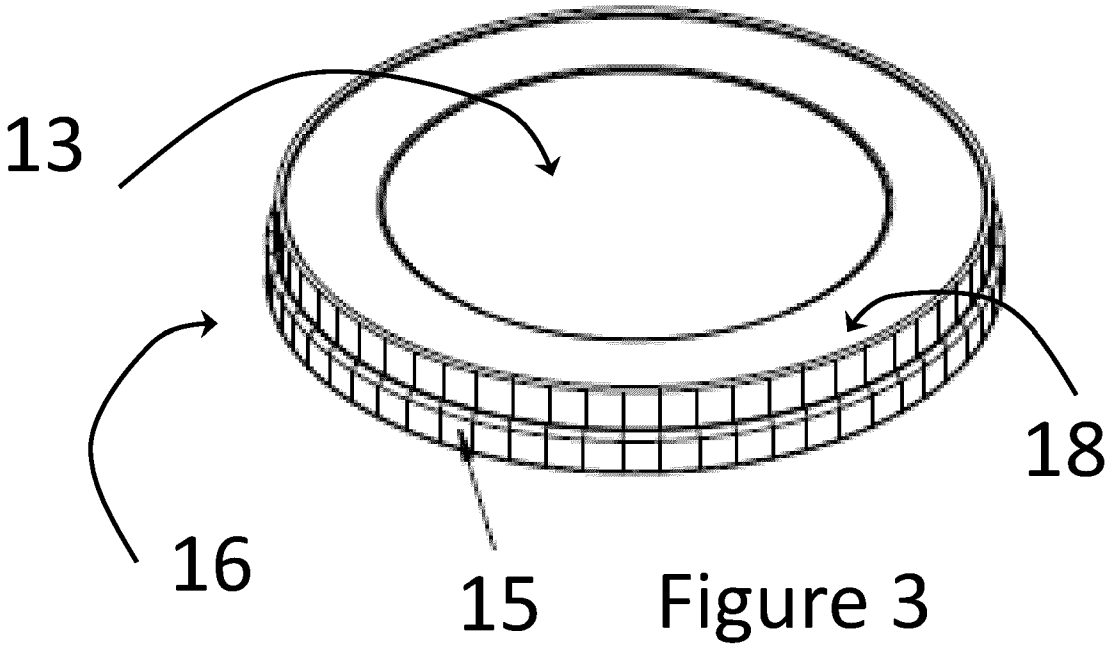


Figure 2



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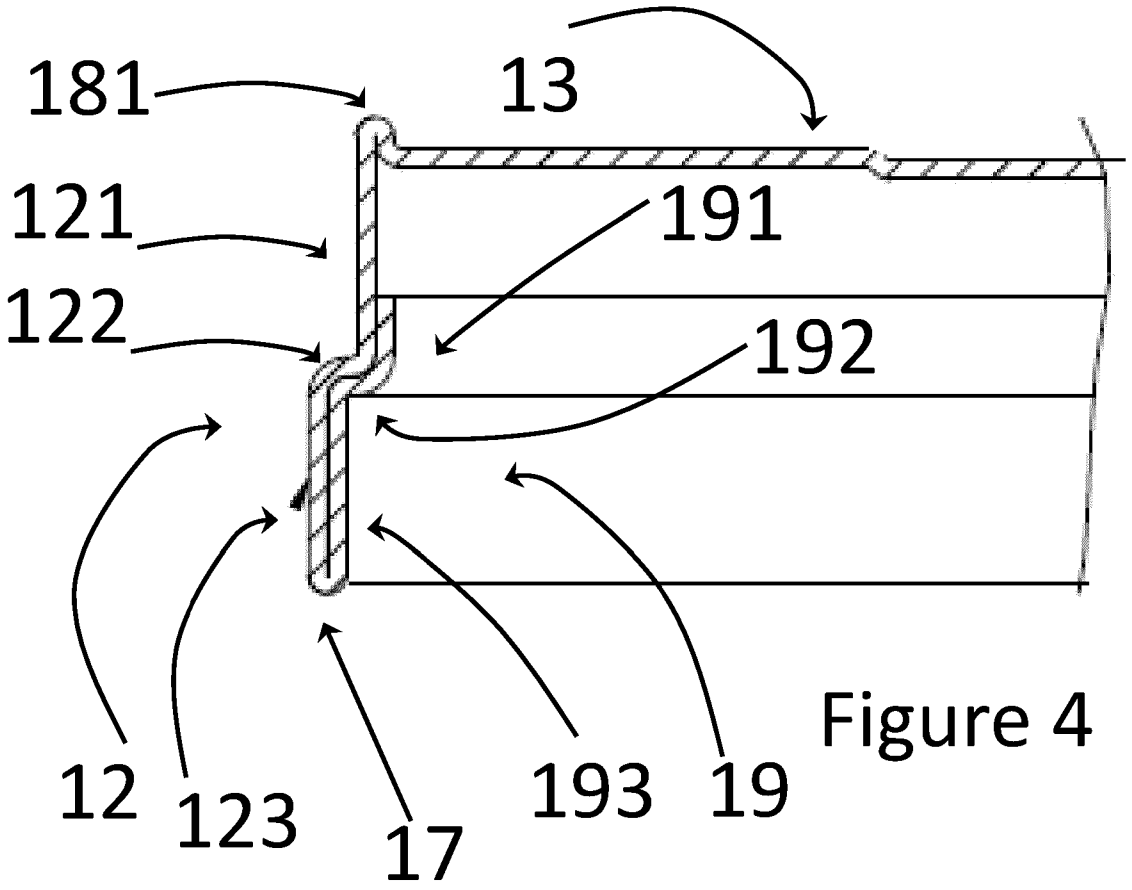

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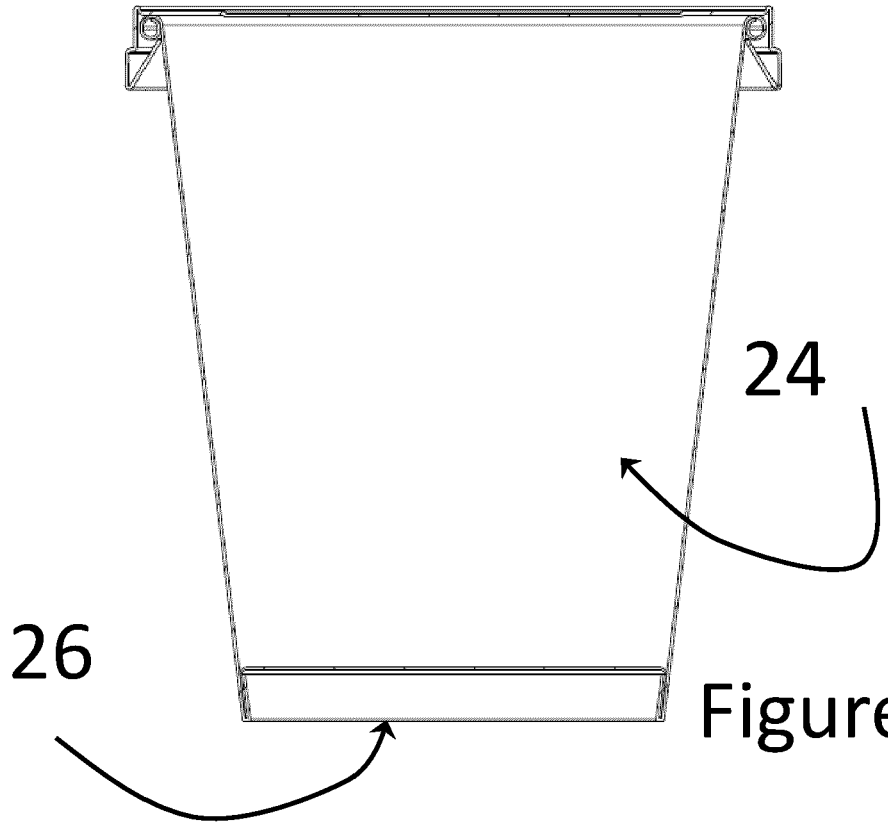

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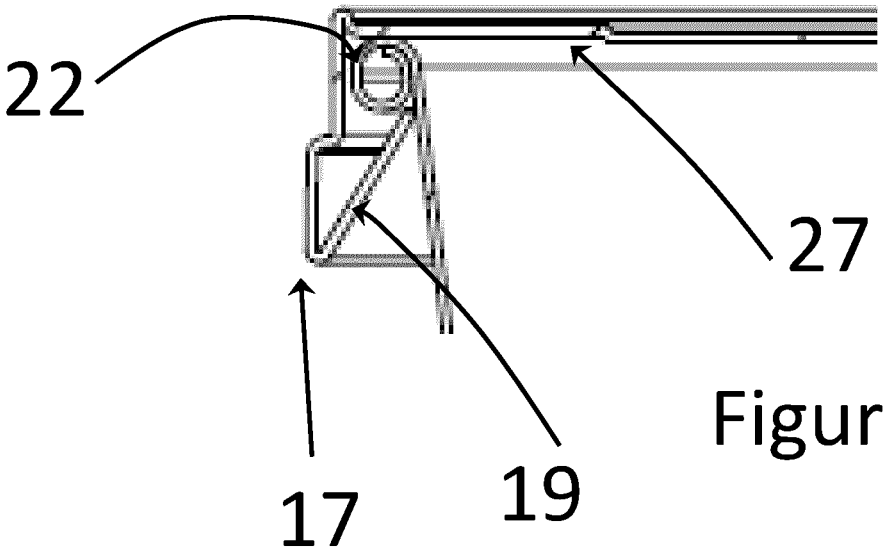

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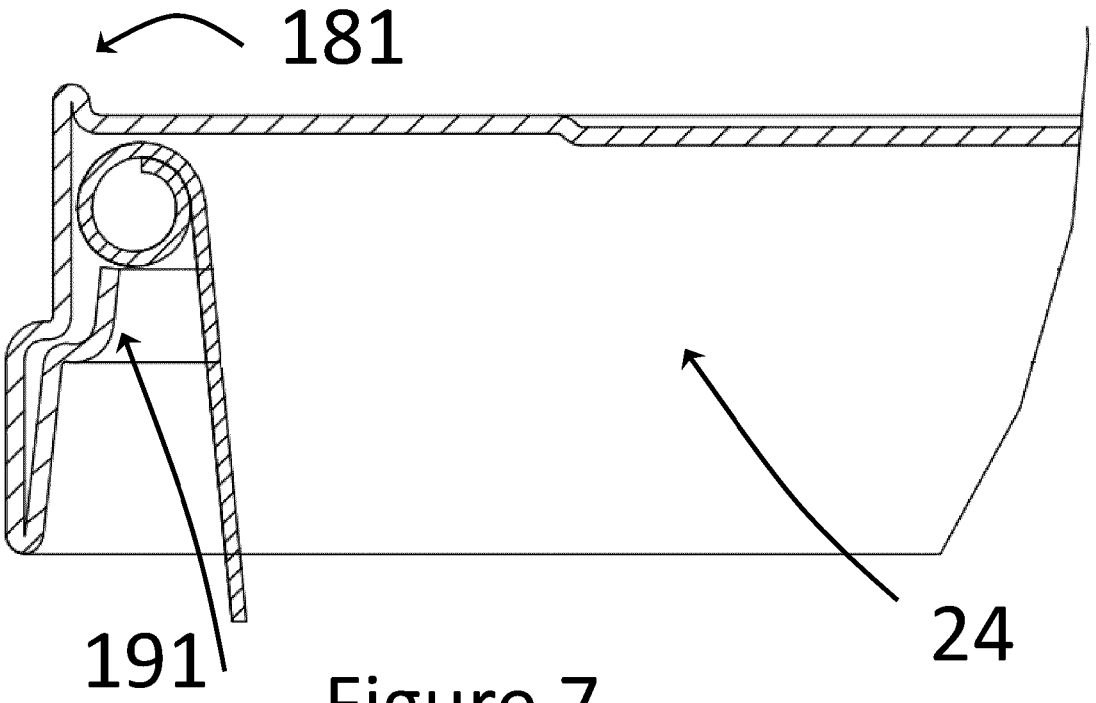

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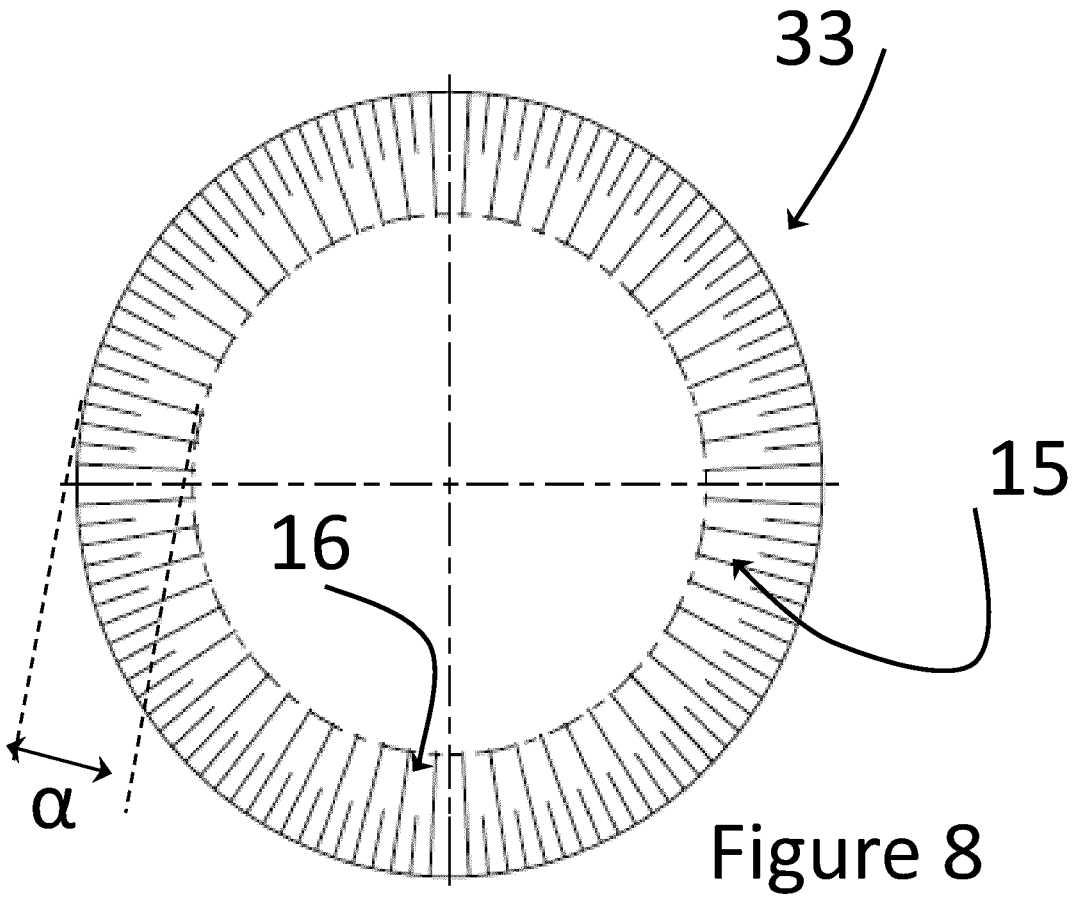

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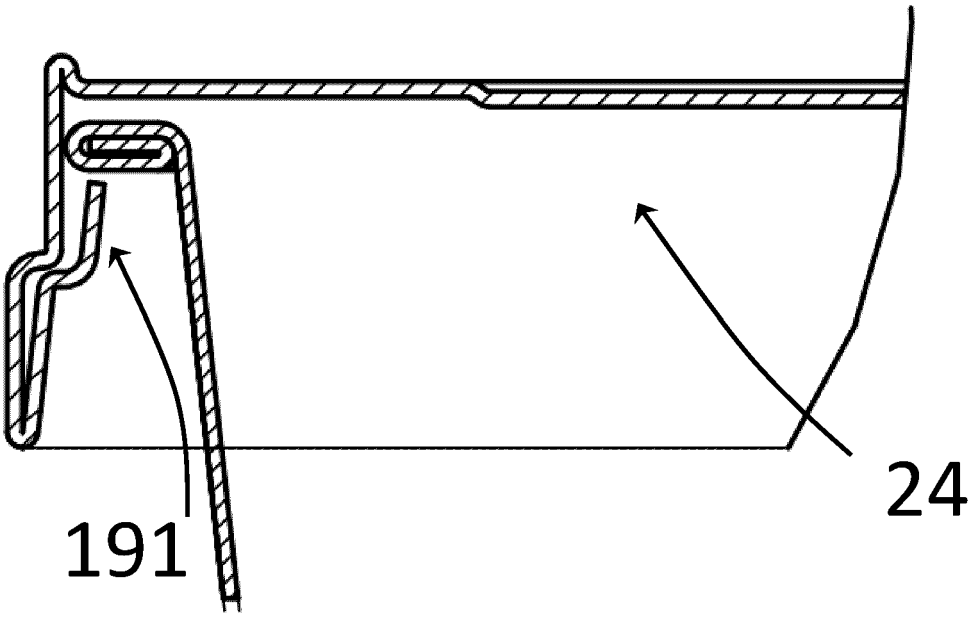

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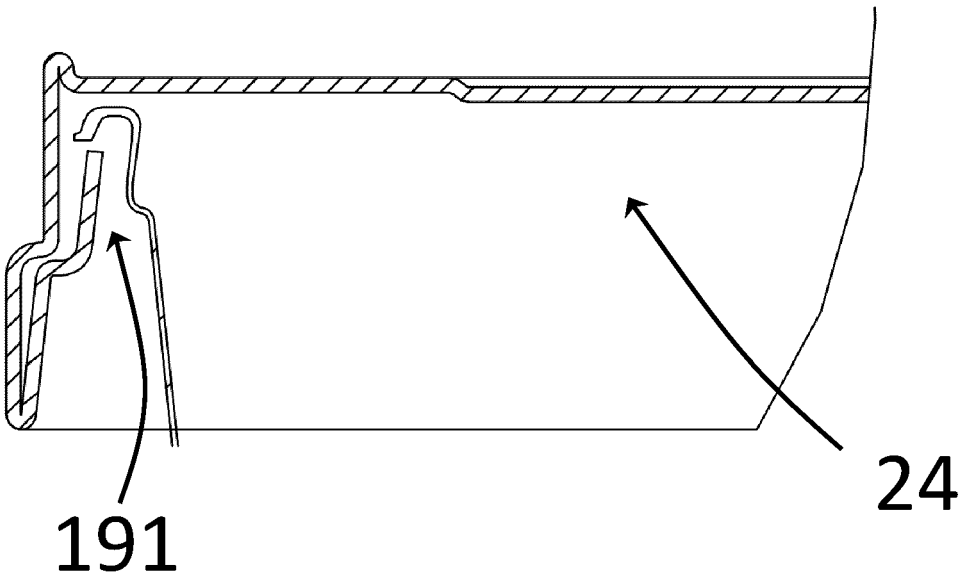

Figure 10

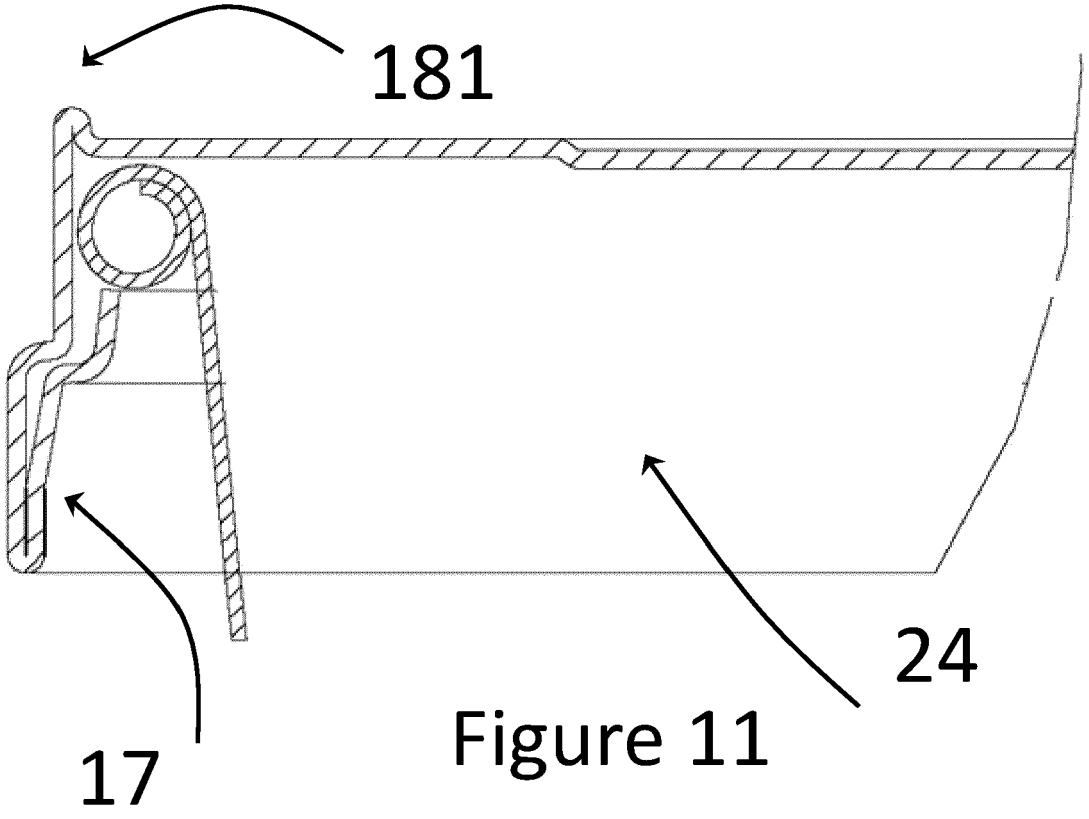

Figure 11

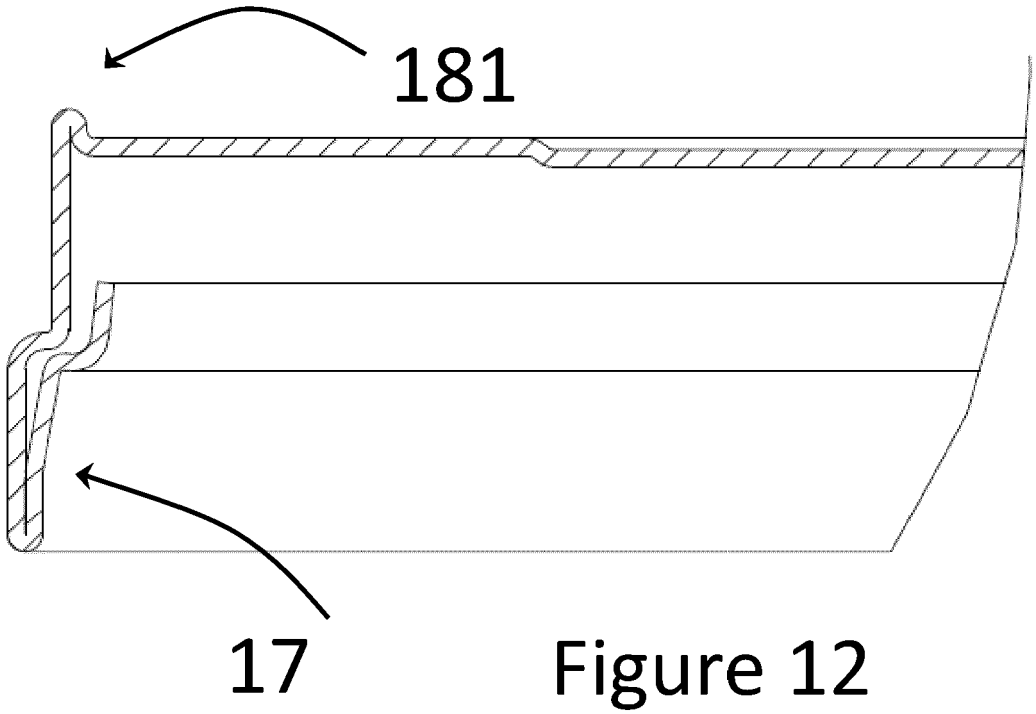

Figure 12

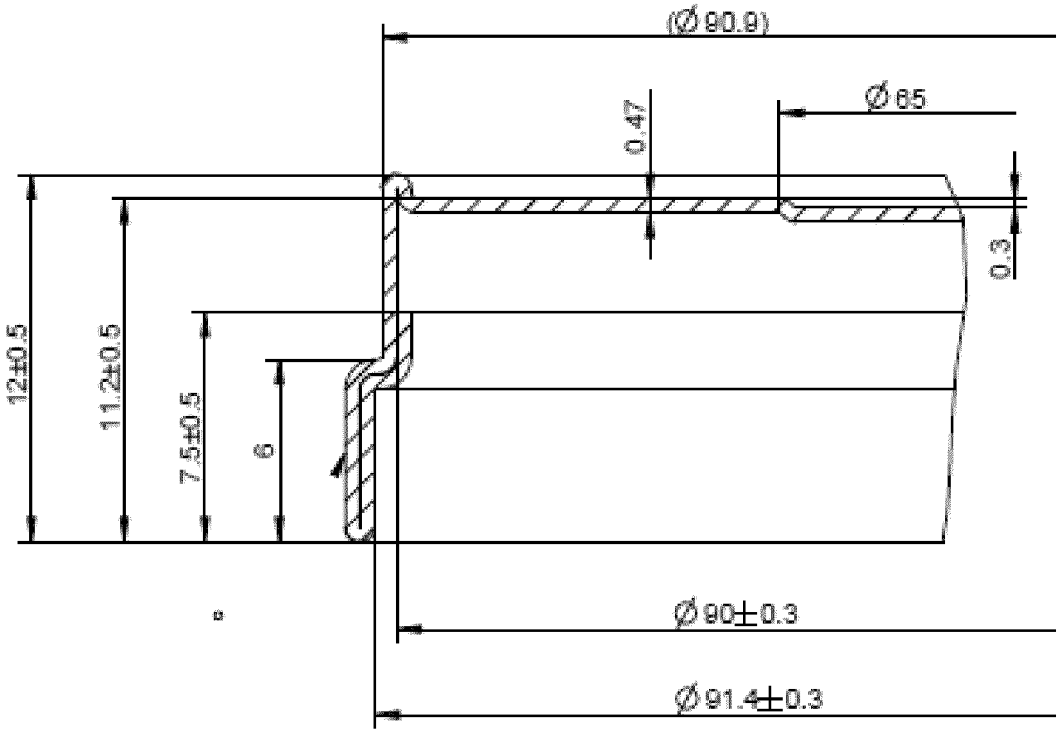

Figure 13

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Application Number
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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	12 December 2024	Cardoso, Victor

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