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(54) Title: SEALED CONTAINER, METHOD AND APPARATUS FOR SEALING A CONTAINER

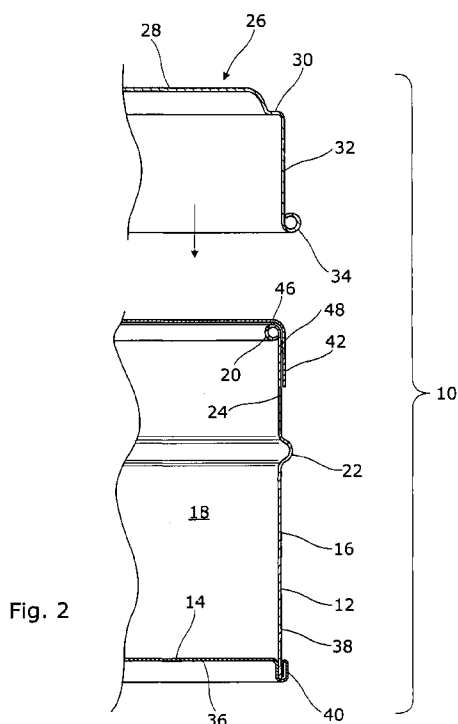


Fig. 2

(57) Abstract: A container body (12) has a base (14) and a side wall (16), an upper rim portion (20) of the side wall defining an opening to the interior volume of the container. The opening is closed by a membrane (42) extending across and heat sealed to the rim portion (20) to define a primary seal (46). The membrane has a peripheral skirt region extending about and heat sealed to an outer surface of the side wall adjacent the rim portion to define a secondary seal (48). The container may be a large diameter container with an opening having a maximum diameter of 150 mm or more. The container is sealed in an apparatus having a sealing head (130) with a heated metallic head portion (132) with a soft, resilient layer (144), and a recessed crimping head (146).



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Sealed Container, Method and Apparatus For Sealing A Container

Technical Field of the Invention

The present invention relates to sealed containers and to methods and apparatus for sealing containers. The present invention is particularly, but not
5 exclusively, related to large sealed containers and to methods and apparatus suitable for sealing large containers.

Background to the Invention

Containers comprising a main body having a base and a side wall which extends upwardly about the perimeter of the base to define an interior volume in
10 which product can be held are known. Containers of this type, which will be referred to herein as “containers of the type defined”, can be made from a variety of materials including metal (e.g. tinned or coated steel and aluminium), plastics, glass and paper. Containers of the type defined can be produced in a range of shapes and when viewed in plan may be round, oval, polygonal (including, for example, square, rectangular
15 and hexagonal), as well as irregular shapes. Containers of the type defined can also be provided in a range of sizes having openings with a maximum dimension ranging typically from around 30mm to 250mm or more. The term “maximum dimension” as used in relation to the opening refers to the largest dimension of the opening measured across the container at the upper edge or rim of the side wall. In a round container the
20 maximum dimension will be its diameter, whilst in a square or rectangular container it will be a diagonal measured from corner to opposed corner. The opening can be measured internally or externally but for convenience the dimensions stated herein will assume the opening is measured internally.

It is known to form the main body from a single component shaped to define the base and the side wall or to form it from two separate components joined together, one forming the base and the other the side wall. When made from polymeric materials or glass, the main body will typically be moulded or otherwise formed as a single component. It is known to make the main body from a single metal component, say by deep drawing, or from two components. In a two-piece construction, the side wall is typically formed from a generally rectangular flat metal sheet which is curved or folded to form the side wall. The opposed ends of the sheet are connected together to form a seam which extends vertically up the side wall. A separate sheet of metal forms the base and is joined to the lower edge of the side wall in the completed main body.

Containers of the type defined can be provided with a separate push-fit lid to close the opening of the main body. The lid typically has a downwardly extending flange about its periphery which is a push-fit over an upper end region of the side wall of the main body. A ridge may be formed in the side wall parallel to and spaced downwardly from the rim against which a lower edge of the lid flange sits when the lid is fitted. When provided with a push-fit lid, a container of the type defined is commonly referred to as a "tin" regardless of the material from which it is actually made, which may or may not contain tin.

Containers of the type defined are often used to package confectionery and other snack foods such as biscuits and wafers that are intended for sharing and/or otherwise consumed over a period of time. The provision of a push-fit lid means the container can be easily opened to allow some of the product to be removed and

reclosed to protect the remaining product until it is consumed. Containers used for this purpose can often be quite large.

Whilst push-fit lids are a close fit, they do not provide a hermetic seal. In order to protect perishable product prior to first opening, it is known to close the opening of a container of the type defined by means of a membrane which is hermetically sealed to the rim of the main body. However, the known membrane sealing arrangements are typically only suitable for use with smaller containers and have not been used for large containers. In this regards, a container is regarded as "large" if it has a main body with an opening having a maximum dimension of 150 mm or more, and more particularly a maximum dimension of 175 mm or more, and even more particularly a maximum dimension of 190 mm or more. Generally, with large containers it is known to hermetically seal the product within an inner packaging, which may comprise a sealed plastic bag or other flexible sealed wrapper in which the product is contained, inside the container. In order to first gain access to the product case, it is necessary to remove the lid and to open the inner packaging, which is often removed. This may require that the whole of the contents are completely removed from the container. Once the inner packaging as been removed, any remaining product is replaced in the container and the lid reclosed.

Whilst inner packaging has been found to be effective, it has disadvantages and is not always popular with consumers.

It is desirable to provide an alternative container of the type defined which overcomes or at least mitigates some or all of the disadvantages of the known containers.

It is desirable to provide an alternative membrane sealing arrangement for a container of the type defined which is also suitable for large containers.

It is desirable to provide a method of sealing the opening of a container of the type defined which can be used to seal a large container.

- 5 It is also desirable to provide alternative apparatus for sealing a container of the type defined which can be used to seal a large container.

Summary of the Invention

In accordance with a first aspect of the invention, there is provided a container comprising a main body having a base and a side wall defining an interior volume, an
10 opening to the interior volume being defined by an upper rim portion of the side wall, the opening being closed by means of a membrane extending across and heat sealed to the rim portion to define a primary seal, the membrane having a peripheral skirt region extending about and heat sealed to an outer surface of the side wall adjacent the rim portion to define a secondary seal.

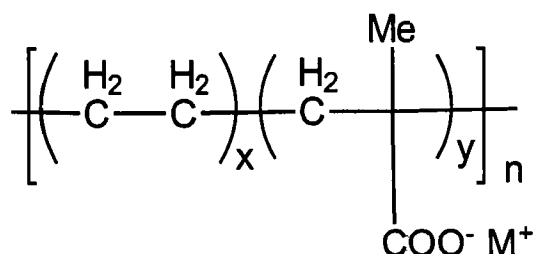
- 15 The primary seal may be a hermetic seal.

The container may further comprise a push-fit lid which engages about an outside surface of the side wall.

- The container may be large container, that is to say the opening of the main body may have a maximum dimension of 150 mm or more, or more preferably a
20 maximum dimension of 175 mm or more, or even more preferably a maximum dimension of 190 mm or more.

The membrane may have a heat sealant composition comprising a mixture of 70 wt% to 80 wt% polyethylene; 5 wt% to 10 wt% low density polyethylene (LDPE); and 10 wt% to 15 wt% of an ionomer comprising a metal salt of an ethylene-methacrylic acid co-polymer.

- 5 The metal salt of the ethylene-methacrylic acid co-polymer may have the structure:



wherein

Me is methyl; and

- 10 M is selected from zinc, lithium, sodium or potassium.

The sealant composition may comprise 75 wt% to 80 wt% of polyethylene.

The sealant composition may comprise 11 wt% to 13 wt % of ionomer.

The sealant composition may comprise 7 wt% to 10 wt% of LDPE.

- 15 The sealant composition may comprise substantially 78 wt% polyethylene; substantially 10 wt% low density polyethylene (LDPE); and substantially 12 wt% of ionomer.

The sealant composition may comprise 70% to 85% hot melt polyethylene (PE), 10% to 15% Surlyn (RTM), and 5%-10% low density polyethylene (LDPE).

The sealant composition may comprise 78% hot melt PE, 12% Surlyn (RTM), and 10% LDPE.

The membrane may be a laminate comprising an outer aluminium foil layer and an inner layer of polyethylene terephthalate (PET) layer, the inner layer being
5 coated with the heat sealing compound. The aluminium foil layer may be printed on and covered with a high temperature resistant varnish.

The membrane may comprise a paper substrate coated with the heat sealing compound.

The rim portion may have a convex upper surface. The rim may be narrow in
10 comparison to the opening having a width in the range of 2 mm to 6 mm or a width in the range of 1% to 4% of the internal diameter of the container.

The primary seal may have a width of 0.9 to 1.3 mm, or more preferably a width of 1.0 to 1.25 mm

In an embodiment the main body is a two-piece construction in which the side
15 wall is produced from by a substantially rectangular plate having opposed longitudinal ends and upper and lower edges, the plate being bent into the shape of the side wall and the opposed ends joined together in a vertical seam, wherein in at least one of the upper corners where an opposed end meets the upper edge, the apex of the corner is removed. The apex may be removed in both of the upper corners of the
20 plate. The apex may be removed in all corners of the plate.

The main body may be coated with any one or more of the following: varnish, acrylic varnish, PET, alkyd varnish, at least in the regions where the seals are formed.

In accordance with a second aspect of the invention, there is provided a method of sealing a container, wherein the container comprises a main body having a base and a side wall defining an interior volume, an opening to the interior volume being defined by an upper rim portion of the side wall, the method comprising

5 positioning a membrane extending across the upper rim so as to close the opening, the membrane having a peripheral skirt region extending beyond the rim, heat sealing the membrane to the rim to form a primary seal between the membrane and the rim and subsequently crimping the peripheral skirt region of the membrane down about an outer surface of the side wall and heat sealing the skirt region to the outer surface of

10 the side wall to form a secondary seal between the membrane and the side wall.

The container may also comprise a push-fit lid, and the method may also comprise fitting the lid over the sealed main body so that the lid engages about an outside surface of the side wall over the crimped edge of the membrane.

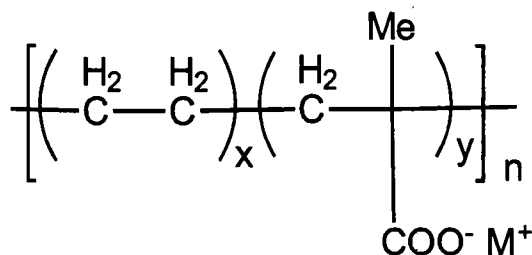
The container may be large container, that is to say the opening of the main

15 body may have a maximum dimension of 150 mm or more, or more preferably a maximum dimension of 175 mm or more, or even more preferably a maximum dimension of 190 mm or more.

The heat seal may be formed using a heat sealant composition comprising a mixture of 70 wt% to 80 wt% polyethylene; 5 wt% to 10 wt% low density

20 polyethylene (LDPE); and 10 wt% to 15 wt% of an ionomer comprising a metal salt of an ethylene-methacrylic acid co-polymer.

The metal salt of the ethylene-methacrylic acid co-polymer may have the structure:



wherein

Me is methyl; and

M is selected from zinc, lithium, sodium or potassium

5 The sealant composition may comprise 75 wt% to 80 wt% of polyethylene.

The sealant composition may comprise 11 wt% to 13 wt % of ionomer.

The sealant composition may comprise 7 wt% to 10 wt% of LDPE.

The sealant composition may comprise substantially 78 wt% polyethylene;
substantially 10 wt% low density polyethylene (LDPE); and substantially 12 wt% of
10 ionomer

The membrane may be a laminate comprising an outer aluminium foil layer and an inner layer of polyethylene terephthalate (PET) layer, the inner layer being coated with the heat sealing compound. The aluminium foil layer may be printed on and covered with a high temperature resistant varnish.

15 The membrane may comprise a paper substrate coated with the heat sealing compound.

The method may comprise forming the primary seal with a width of 0.9 to 1.3 mm, more preferable a width of 1.0 to 1.25 mm.

In an embodiment, the step of heat sealing the membrane to the rim to form the primary seal is carried out using a heated sealing head having a soft, resilient surface which is brought in to contact with the membrane to press the membrane on to the rim and apply heat to melt a heat sealing compound.

5 In an embodiment, the step of crimping the peripheral skirt region of the membrane down about an outer surface of the side wall and heat sealing the skirt region to the outer surface of the side wall to form a secondary seal is carried out using a heated sealing head which is brought into contact with the membrane to press the membrane on to the rim and the outside surface of the side wall and to apply heat
10 to melt a heat sealing compound.

In an embodiment, the method comprises forming the main body as a two-piece construction in which the side wall is produced from a substantially rectangular plate having opposed longitudinal ends and upper and lower edges, the plate being formed into a desired shape for the side wall and the opposed longitudinal ends joined
15 together to form a seam, wherein the method comprises forming the side wall from a sheet shaped such that the apex of the corner is removed in at least one of the upper corner regions where an opposed longitudinal end meets the upper edge. The apex of the corner may be removed in both of the upper corner regions. The apex of the corner may be removed in all of its corner regions.

20 In accordance with a third aspect of the invention, there is provided apparatus for heat sealing a membrane to the rim portion of a container main body, the apparatus comprising sealing unit including a sealing head having a heated metallic head portion with a soft, resilient layer for contact with the membrane.

The soft, resilient surface layer may have shore hardness A of 80 or less.

The soft, resilient surface layer may be made of silicon.

The soft, resilient surface layer may be capable of conforming to irregularities in the rim of up to 3 mm or more.

5 In an embodiment, the sealing head is configured for use in sealing a membrane to the rim portion of a container main body in which the rim portion defines an opening with a maximum dimension of 150 mm or more, or more preferably a maximum dimension of 175 mm or more, or even more preferably a maximum dimension of 190 mm or more.

10 In accordance with a fourth aspect of the invention, there is provided apparatus for heat crimping a skirt region of a membrane to an outer side wall region of a container main body, the heat crimping unit comprising a crimping head having a heated metallic head portion, wherein the crimping head is recessed, having peripheral flange for location about an outer surface of a side wall of a container main
15 body.

The apparatus may comprise a heat sealing unit in accordance with the third aspect of the invention and a crimping unit in accordance with the fourth aspect of the invention.

A Detailed Description of the Invention

20 In order that the invention may be more clearly understood, embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a plan view from above of the main body of a container of the type defined in accordance with the invention;

Figure 2 is an exploded, partial cross sectional view taken on line A-A of Figure 1 but also showing the main body sealed by means of a membrane in accordance with
5 the invention and a push-fit lid for mounting to the main body;

Figure 3 is a perspective view of the main body of the container of Figure 2;

Figure 4 is a plan view from above of a membrane for sealing the main body of a container of the type defined in accordance with the invention;

Figure 5 is a schematic cross sectional view on an enlarged scale through the
10 membrane of Figure 4 illustrating a laminated construction in accordance with one embodiment of the membrane;

Figure 6 is a partial sectional view of the sealed main body of Figure 4 showing a primary seal and a secondary side seal between the membrane and the main body;

Figure 7 is a view similar to that of Figure 6 but showing the assembly after formation
15 of the primary seal and prior to formation of the secondary side seal;

Figures 8a to 8d are a series of plan views of different embodiments of a sheet of material suitable for forming the side wall of the main body of the container of Figures 1 and 2;

Figure 9 is a perspective view of apparatus for sealing a container of the type defined
20 in accordance with an aspect of the invention;

Figure 10 is a perspective view of a sealing unit forming part of the apparatus of Figure 9;

Figure 11 is a perspective view of a crimping unit also forming part of the apparatus of Figure 9; and

Figure 12 is a partial cross sectional view of a crimping head forming part of the crimping unit of Figure 11.

5 Figures 1 and 2 show a container 10 of the type defined in accordance with the invention. The container has a main body 12 comprising a base 14 and a side wall 16 which extends upwardly about the periphery of the base 14. An internal volume 18 in which product can be received is defined between the side wall 16 and the base 14. In the embodiment shown, the container is round when viewed in plan having a
10 cylindrical side wall. However, the invention is not limited to containers that are round but can be applied to containers of any suitable shape including oval, polygonal or irregularly shape containers.

 The upper edge of the side wall 16 is curled to form a rim 20 with a convex curved upper surface. In the present embodiment, the side wall is curled inwardly but
15 in an alternative embodiment it can be curled outwardly. The side wall is shaped to define an external ridge 22 which extends about the side wall parallel to but spaced below the rim 20. The upper edge region of the side wall between the ridge 22 and the rim defines a lip 24 for receiving a push-fit lid 26. The lid 26 has a substantially planar upper surface 28, although this could be embossed or otherwise profiled, which
20 curves downwardly about its periphery to a radially outwardly extending flange 30. A further flange 32 extends downwardly from the outer periphery of the radial flange 30 for engagement about the lip 24 on the main body. The lower end of the downward flange 30 is curled outwardly to form a rolled end 34. When the lid 26 is fully fitted,

the curled end 34 abuts the ridge 22 whilst the rim 20 abuts the radial flange 30 to provide a firm fit. The rolled end 34 on the lid 26 provides a surface which can be gripped by the fingers to help remove the lid.

In the present embodiment, the main body 12 is made from metal and is a two-
5 piece construction including a first component or end 36 which forms the base 14 and a second component 38 which forms the side wall 16 in a known manner. The first component 36 is a circular sheet of metal having a substantially planar central region which defines the majority of the base. The edge of the sheet 36 and the lower end of the side wall 16 are folded about each other to form a joint 40 in a known manner. It
10 will be appreciated that the central region of the base need not be wholly planar but it could be shaped to provide additional rigidity. Also, the precise manner by which the base 14 and the side wall 16 are joined is not essential to the invention and any of the known arrangements used in the manufacture of tins and cans can be adopted.

The second component 38 is conventionally formed from a substantially
15 rectangular sheet of metal which is folded around to form the desired shape, which in this embodiment is a cylinder, and the ends joined by means of a vertical seam 41 shown in Figure 3. The vertical seam may be a folded seam and/or may be soldered or welded, in a known manner.

The container 10 is a large container in which the opening of the main body
20 has an internal diameter θ of 150 mm or more and a rim with a width X of 2 to 6 mm. In a non-limiting example, the opening of the main body has an internal diameter θ 199 mm and the rim has a width X 2.5 mm. The rim 20 is then relatively narrow in

comparison to the diameter of the container, the width of the rim being in the range of about 1% to 4% of the internal diameter of the container.

In accordance with the invention, the opening of the main body 12 is sealed by means of a membrane 42 as illustrated in Figures 2, 3, 6 and 7. The membrane 42 as
5 illustrated in Figure 4 is circular in shape for use with the circular main body 12 and has a diameter larger than that of the rim 20 of the main body so that when positioned centrally across the opening, a peripheral portion 44 of the membrane (the inner extent of which is schematically indicated by the solid line 45 in Figure 4) extends beyond the rim 20 to form a skirt 44 that is folded down about the outside of the lip
10 24. In the non-limiting embodiment, the membrane has a diameter of 210 mm providing a skirt of 3-8 mm. The membrane 42 is heat sealed to the upper surface of the rim 20 to form a primary seal 46 and the skirt 44 is hot crimped to the outside surface of the lip 24 of the side wall 16 to form a secondary seal 48. The membrane 42 has a pair of tabs 50 on opposite sides which are not sealed to the sidewall and
15 which can be used to remove the membrane 42 on first opening. The membrane 42 when attached to the main body 12 hermetically closes the main body 12 to protect the contents and when removed will leave marks on the main body 12 to provide tamper evidence.

The membrane 42 in this embodiment is circular for use with the circular main
20 body 12. However, it will be appreciated that the shape and size of the membrane 42 can be adapted for use with a container main body having a different shape and/or size. Furthermore, whilst a hermetic seal is preferable for many applications, in some situations the seal need not need to be hermetic, for example where only a simple seal or tamper evidence is required.

As illustrated in Figure 5, in one embodiment the membrane is a laminate comprising an outer aluminium foil layer 52 and an inner layer of polyethylene terephthalate (PET) layer 54. The inner layer 54 is coated with a heat sealing compound layer 56 on its exposed lower/inner surface. In the non-limiting
5 embodiment, the aluminium foil layer may be 9 to 25 micron in thickness and the PET layer may be 8 to 18 micron in thickness. The exposed upper surface of the aluminium foil layer 52, which is outer most when the membrane is affixed to the main body, may be printed on and/or covered with a high temperature resistant varnish 58. Any suitable varnish can be used such as an acrylic varnish, an alkyd
10 varnish or PET.

In an alternative embodiment, the aluminium foil and the PET layers are replaced by a paper substrate to provide different print effects. In this case, in the non-limiting embodiment the paper substrate may be 9 gsm to 120 gsm paper.

The heat sealing compound 56, is a blend of polymers comprising 70% to 85%
15 hot melt polyethylene (PE), 10% to 15% Surlyn (RTM) which is an ionomer comprising a metal salt of an ethylene-methacrylic acid co-polymer, and 5%-10% low density polyethylene (LDPE). In a particularly preferred embodiment the heat sealing compound is a blend of 78% hot melt PE, 12% Surlyn (RTM), and 10% LDPE. SURLYN (RTM) is sold by E.I. DuPont Nemours and Co, USA.

20 This heat sealing compound 56 has been found to be particularly effective in hermetically sealing large containers and has a low temperature seal initiation with an easy peel for removal of the sheet. The seal initiation may start from about 90 Deg. C. The highest temperature the heat sealing compound can be subjected to is about

315 Deg. C at 40gsm of coating. However, the temperature range may vary depending on the weight of the coating. Use of this heat sealing compound 56 does not require any treatment to be applied to the rim of the container and can be used to seal containers made of a range of materials including metal, glass and plastics and will
5 seal on a range of finishes including tin, PET varnish, acrylic varnish, mixed varnish and alkyd varnish.

The primary seal 46 is a thin, line or point seal having a width Y of about 0.9-1.3 mm and more preferably 1-1.25 mm. The secondary seal 48 has a depth Z of about 2 to 4 mm depending on the size of the skirt 44. The secondary seal 48 helps to
10 ensure that the container main body 12 is fully sealed and makes it more difficult for the membrane 42 to be removed without leaving marks providing tamper evidence.

Effective sealing of a membrane 42 to the rim 20 of a large container is difficult as any imperfections in the rim can affect the seal quality more significantly than would be the case with a smaller container. Also, the side wall 16 tends not to be
15 as rigid as with smaller containers. Furthermore, the width of the rim 20 on large containers is very small relative to the size of the opening which makes an effective seal difficult to form. This is a particular issue where the rim 20 is convex as the area in which the primary seal can be formed is further reduced. In contrast, for example, glass jars tend to have relatively thick side walls and wide rims relative to the
20 dimension of the opening.

In order to be able to seal the membrane 42 to a main body 12 of a large container, very precise tooling and manufacturing processes are required to produce the main body 12 so as to minimise irregularities in the rim 20. For example, where

the main body 12 is a two-piece construction, the formation of the vertical seam 41 where the ends of a conventional rectangular sheet forming the side walls are joined will usually create a ridge on the rim 20 which can prevent effective sealing. Particular care then needs to be taken in forming the vertical seam to keep any ridging
5 to a minimum.

Figures 8a to 8d illustrate different embodiments of a modified plate 38a – 38d that can be used to form the side wall of a two-piece main body and which are adapted to reduce or eliminate ridging on the rim 20 resulting from the longitudinal ends 60, 62 of the plates being joined to form the vertical seam 41. As can be seen, in
10 each of these plates at least one of the corners 64, 66 where a vertical end 60, 62 meets the upper edge 68 of the plate, this being the edge which forms the rim 20, has its apex 70 removed. In other words, at the at least one corner 64, 66, the material does not extend to fill the right angle subtended by extrapolation of the vertical end and the upper edge, as illustrated by dashed lines in Figure 8a. The reduction of
15 material at one or both of the upper corners 64, 66 reduces the amount of ridging in the rim when the vertical seam is produced. As illustrated in Figure 8c, both of the upper corners 64, 66 could have their apices removed. Indeed, as illustrated in Figure 8d, all the corners could have their apices removed so that the plate 38b can be used either way up for ease of manufacture. As illustrated, the apex could be removed by
20 means of a chamfer or angled cut at the corner or corners, however the corner or corners could be curved or otherwise shaped so that the apex is removed. The size of the chamfer or other profiling should be sufficient to reduce the formation of a ridge on the rim 20 to a minimum but without adversely affecting the vertical seam. It will be appreciated that the apex can be removed from one or more corners either by

starting with a rectangular plate and physically removing the apex or by producing the plate with the apex already removed. Reference to the apex being removed is intended to cover both possibilities.

Apparatus 100 for applying the membrane 42 to the main body 12 is shown in
5 Figures 9 to 11. The apparatus 100 comprises a carousel unit 110 having a central turntable 112 with a plurality of arcuate indentations 114 in its outer diameter, in each of which a main body 12 can be inserted and retained for incremental movement between a number of discrete work stations 116-120 located about the unit as the turntable 112 is rotated. The carousel unit 110 has a loading area 111 at which an
10 unsealed main body can be loaded into one of the indentations 114. The main body 12 is loaded in an upright position with the rim 20 uppermost and is pre-filled with product. The turntable 112 rotates in a clockwise direction as shown and a first work station 116 is located adjacent the loading area and comprises a pick and place unit 122 which is configured to pick a membrane 42 from a stock of membranes (not
15 shown) and to position the membrane centrally on the rim 20 of a main body 12 at that work station. The pick and place unit 122 will not be described in detail but those skilled in the art will have no difficulty in selecting an appropriate unit for this task. Also located at the first work station 116 is a tacking unit 124 which tacks the picked and placed membrane 42 in position on the rim 20. The membrane 42 can be tacked at
20 a number of discreet locations about the rim 20, say three or four. The tacking unit may apply heat and pressure to the membrane 42 at the discreet locations in order to melt the sealing compound 56 to form a bond between the membrane 42 and the rim 20. Each tack may have a length in the region of 8-12 mm. The degree of tacking should be sufficient to hold the membrane 42 in position while main body 12 is

moved in the turntable to a second work station 118 where the primary seal 46 is produced.

The second work station 118 comprises a heat sealing unit 126 which forms the primary seal 46 as will be described in more detail below. From the second work station 118, the main body 12 is moved to a third work station 120 which comprises a hot crimping unit 128 which crimps the skirt 44 of the membrane 42 to the side wall to form the secondary seal 48. The crimping unit 128 also applies further heat and pressure to the rim 20 to ensure the primary seal is fully formed. From the third work station 120, the sealed main body is moved to an unloading area 130 where it is removed from the carousel unit 110 for further processing and packaging. This will typically include placing a lid on the sealed main body 12 with the lid 26 being a close push-fit over the sealed and crimped skirt 44 of the membrane 42 and the lip 24 on the main body. However, lid placement could also be effected on the carousel unit 110 by the addition of a further work station.

The heat sealing unit 126 is illustrated in more detail in Figure 10 and includes a sealing head 130 having an electronically heated metal head portion 132, which may be made of brass or any other suitable material. The sealing head 130 is mounted to a plate 134 which is attached to the piston 136 of a hydraulic actuator 138. The body 140 of the actuator is fixedly mounted to the carousel unit 110 by means of a mounting plate 142. The arrangement is such that the actuator 138 can be actuated to bring the heated sealing head 130 into contact with the membrane 42 on the upper rim 20 of a main body when positioned below the heat sealing unit 126 at the second work station 118. The heat and pressure applied by the sealing head causes the sealing compound 56 to melt so as to bond the membrane 42 to the rim 20 and form the

primary seal 46. The lower face of the sealing head which contacts the membrane 42 has a soft resilient layer 144 which conforms to non-uniformities of the rim 20 so that an effective primary seal 46 is produced all about the rim 20. The soft resilient layer 144 can be made from any suitable material, such as silicon, and has a shore A
5 hardness of 80 or less and preferable between 60 to 20. Preferably, the soft, resilient layer 144 should be configured so as to be capable of conforming to irregularities of up to 3 mm or more. A soft resilient layer with a thickness of 3mm to 10mm has been found to be effect with a thickness of 6mm being particularly advantageous.

The heat crimping unit 128 is illustrated in more detail in Figures 11 and 12. It
10 is very similar to the heat sealing unit 126 as described above except that the lower end face of the crimping/sealing head 146 is profiled and shaped to press the skirt 44 in to contact with the outer surface of the side wall 16. The head 146 has a coated, metallic main body 147 with a circular plate portion 147A and a downwardly depending cylindrical rim portion 147B which engages about the outer surface of the
15 lip 24 of the main body 12. The inner surface of the rim portion 147B is flared outwardly relative to the plate portion 147A at an angle α of about 4 to 6 degrees, preferably 5 degrees. This helps to press the skirt 44 of membrane 42 against the outer surface of the lip 24 on the main body without damaging the membrane 42. The plate portion 147A is mounted to an electronically heated metal head portion 148, which
20 may be made of brass or any other suitable material.

The crimping head 146 is mounted to a plate 150 which is attached to the piston 152 of a hydraulic actuator 154. The body 156 of the actuator is fixedly mounted to the carousel unit 110 by means of a mounting plate 158. The arrangement is such that the actuator 154 can be actuated to bring the heated crimping head 146

into contact with the membrane 42 on the upper rim 20 of a main body when positioned below the heat crimping unit 128 at the third work station 118. The heat and pressure applied by the crimping head 146 causes the sealing compound 56 to melt so as to form the secondary seal 48. The crimping head 146 of the heat crimping unit 128 will also press the membrane 42 into contact with the upper surface of the rim 20 so as to ensure that the primary seal 46 is fully formed. The heat crimping head 146 does not have a resilient layer but it could be provided with one.

In each of the heat sealing and heat crimping units 126, 128, the metallic head portion 132, 148 is heated by means of electric heating elements and applies heat directly to the membrane 42. The use of a heated metallic die head to directly heat the membrane is particularly advantageous for use in sealing a container containing product, such as food products, which are sensitive to the heat as the heat is focused directly in the rim and heating of the product is minimised. However, other arrangements for heating the sealing compound can be used, particularly where the products are not heat sensitive. This could include the use of hot air and pressure or induction heating. However, induction heating for a large container would present difficulties and may lead to slower production times.

It will be appreciated that whilst heat sealing unit 126 and the heat crimping unit 128 as described above each use a hydraulic actuator 138, 154 for controlling movement of the sealing and crimping heads 130, 146, any suitable arrangement for moving the heads can be adopted.

The primary and secondary seals 46, 48 produced by the heat sealing unit 126 and the heat crimping unit 128 may be separate seals but work together to ensure the

main body 12 is hermetically sealed and to provide a tamper evidence function. Whilst the membrane is heat sealed to the container, it need not be a heat shrink material.

The method of manufacture and the manufacturing apparatus described herein
5 are particularly suitable for sealing large containers but can be used in conjunction with smaller containers having an opening of say 30 mm or more. Accordingly, the method and apparatus are very versatile.

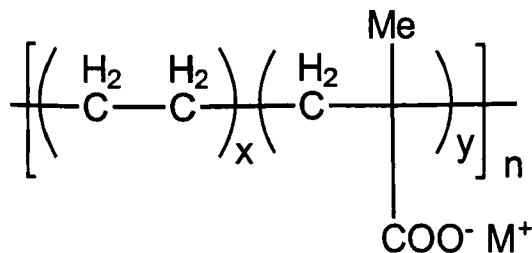
The above embodiments are described by way of example only. Many variations are possible without departing from the scope of the invention as defined in
10 the appended claims.

Terms such as “upper”, “lower”, “vertical” and the like as used herein refer to the container and its parts when positioned in a generally upright position for normal use as illustrated in the accompanying Figures. It will be appreciated however that the container can be used in other orientations and the terms should be construed
15 accordingly.

CLAIMS

1. A container comprising a main body having a base and a side wall defining an interior volume, an opening to the interior volume being defined by an upper rim portion of the side wall, the opening being closed by means of a
5 membrane extending across and heat sealed to the rim portion to define a primary seal, the membrane having a peripheral skirt region extending about and heat sealed to an outer surface of the side wall adjacent the rim portion to define a secondary seal.
2. A container as claimed in claim 1, wherein the primary seal is a hermetic seal.
- 10 3. A container as claimed in claim 1 or claim 2, wherein the container further comprises a push-fit lid which engages about an outside surface of the side wall.
4. A container as claimed in any one of the preceding claims, wherein the container is large container, that is to say the opening of the main body has a
15 maximum dimension of 150 mm or more, or more preferably a maximum dimension of 175 mm or more, or even more preferably a maximum dimension of 190 mm or more.
5. A container as claimed in any one of the preceding claims, wherein the membrane has a heat sealant composition comprising a mixture of 70 wt% to
20 80 wt% polyethylene; 5 wt% to 10 wt% low density polyethylene (LDPE); and 10 wt% to 15 wt% of an ionomer comprising a metal salt of an ethylene-methacrylic acid co-polymer.

6. A container as claimed in claim 5, wherein the metal salt of the ethylene-methacrylic acid co-polymer has the structure:



wherein

- 5 Me is methyl; and

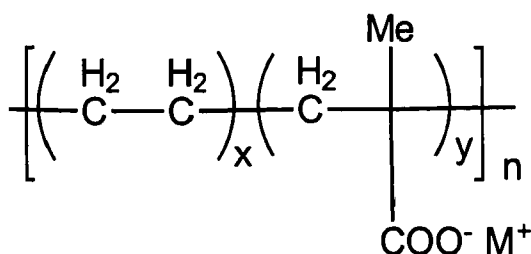
M is selected from zinc, lithium, sodium or potassium

7. A container as claimed in claim 5 or claim 6, wherein the sealant composition comprises one or more of the following: 75 wt% to 80 wt% of polyethylene; 11 wt% to 13 wt % of ionomer; 7 wt% to 10 wt% of LDPE.
- 10 8. A container as claimed in any one of claims 5 to 7, wherein the sealant composition comprises substantially 78 wt% polyethylene; substantially 10 wt% low density polyethylene (LDPE); and substantially 12 wt% of ionomer.
9. A container as claimed in any one of claims 5 to 8, wherein the membrane is a laminate comprising an outer aluminium foil layer and an inner layer of
- 15 polyethylene terephthalate (PET) layer, the inner layer being coated with the heat sealing compound or wherein the membrane comprises a paper substrate coated with the heat sealing compound.
10. A container as claimed in any one of the preceding claims, wherein the rim portion has a convex upper surface.

11. A container as claimed in any one of the preceding claims, wherein the primary seal has a width of 0.9 to 1.3 mm, more preferably the primary seal has a width of 1.0 to 1.25 mm
12. A container as claimed in any one of the preceding claims, wherein the main
5 body is a two-piece construction in which the side wall is produced from by a substantially rectangular plate having opposed longitudinal ends and upper and lower edges, the plate being bent into the shape of the side wall and the opposed ends joined together in a vertical seam, wherein in at least one of the upper corners where an opposed end meets the upper edge, the apex of the
10 corner is removed.
13. A method of sealing a container, wherein the container comprises a main body having a base and a side wall defining an interior volume, an opening to the interior volume being defined by an upper rim portion of the side wall, the method comprising positioning a membrane extending across the upper rim so
15 as to close the opening, the membrane having a peripheral skirt region extending beyond the rim, heat sealing the membrane to the rim to form a primary seal between the membrane and the rim and subsequently crimping the peripheral skirt region of the membrane down about an outer surface of the side wall and heat sealing the skirt region to the outer surface of the side wall
20 to form a secondary seal between the membrane and the side wall.
14. A method as claimed in claim 13, wherein the container further comprises a push-fit lid, and the method comprises fitting the lid over the sealed main body

so that the lid engages about an outside surface of the side wall over the crimped edge of the membrane.

15. A method as claimed in claim 13 or claim 14, wherein the container is large container, that is to say the opening of the main body has a maximum dimension of 150 mm or more, or more preferably a maximum dimension of 175 mm or more, or even more preferably a maximum dimension of 190 mm or more.
16. A method as claimed in any one of claims 13 to 15, wherein the heat seal is formed using a heat sealant composition comprising a mixture of 70 wt% to 80 wt% polyethylene; 5 wt% to 10 wt% low density polyethylene (LDPE); and 10 wt% to 15 wt% of an ionomer comprising a metal salt of an ethylene-methacrylic acid co-polymer.
17. A method as claimed in claim 16, wherein the metal salt of the ethylene-methacrylic acid co-polymer has the structure:



wherein

Me is methyl; and

M is selected from zinc, lithium, sodium or potassium

18. A method as claimed in claim 16 or claim 17, wherein the sealant composition comprises one or more of the following: 75 wt% to 80 wt% of polyethylene; 11 wt% to 13 wt % of ionomer; 7 wt% to 10 wt% of LDPE.
19. A method as claimed in any one of claims 16 to 18, wherein the sealant
5 composition comprises substantially 78 wt% polyethylene; substantially 10 wt% low density polyethylene (LDPE); and substantially 12 wt% of ionomer
20. A method as claimed in any one of claims 16 to 19, wherein the membrane is a laminate comprising an outer aluminium foil layer and an inner layer of polyethylene terephthalate (PET) layer, the inner layer being coated with the
10 heat sealing compound or wherein the membrane comprises a paper substrate coated with the heat sealing compound.
21. A method as claimed in any one of claims 13 to 20, wherein the method comprises forming the primary seal with a width of 0.9 to 1.3 mm, more preferable a width of 1.0 to 1.25 mm.
- 15 22. A method as claimed in any one of claims 13 to 21, wherein the step of heat sealing the membrane to the rim to form the primary seal is carried out using a heated sealing head having a soft, resilient surface which is brought in to contact with the membrane to press the membrane on to the rim and apply heat to melt a heat sealing compound.
- 20 23. A method as claimed in any one of claims 13 to 22, wherein the step of crimping the peripheral skirt region of the membrane down about an outer surface of the side wall and heat sealing the skirt region to the outer surface of the side wall to form a secondary seal is carried out using a heated sealing

head which is brought into contact with the membrane to press the membrane on to the rim and the outside surface of the side wall and to apply heat to melt a heat sealing compound.

24. A method as claimed in any one of claims 13 to 23, the method comprising forming the main body as a two-piece construction in which the side wall is produced from a substantially rectangular plate having opposed longitudinal ends and upper and lower edges, the plate being formed into a desired shape for the side wall and the opposed longitudinal ends joined together to form a seam, wherein the method comprises forming the side wall from a sheet shaped such that the apex of the corner is removed in at least one of the upper corner regions where an opposed longitudinal end meets the upper edge.
25. Apparatus for heat sealing a membrane to the rim portion of a container main body, the apparatus comprising sealing unit including a sealing head having a heated metallic head portion with a soft, resilient layer for contact with the membrane.
26. Apparatus for heat crimping a skirt region of a membrane to an outer side wall region of a container main body, the heat crimping unit comprising a crimping head having a heated metallic head portion, wherein the crimping head is recessed, having peripheral flange for location about an outer surface of a side wall of a container main body.

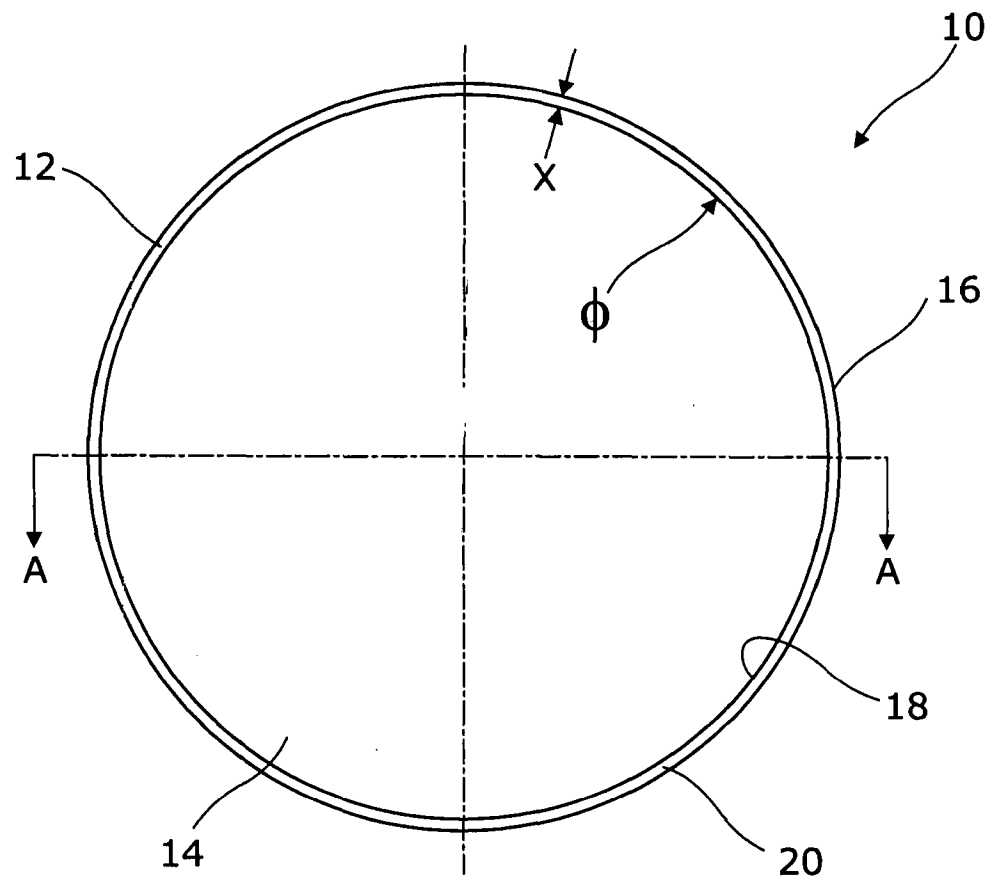


Fig. 1

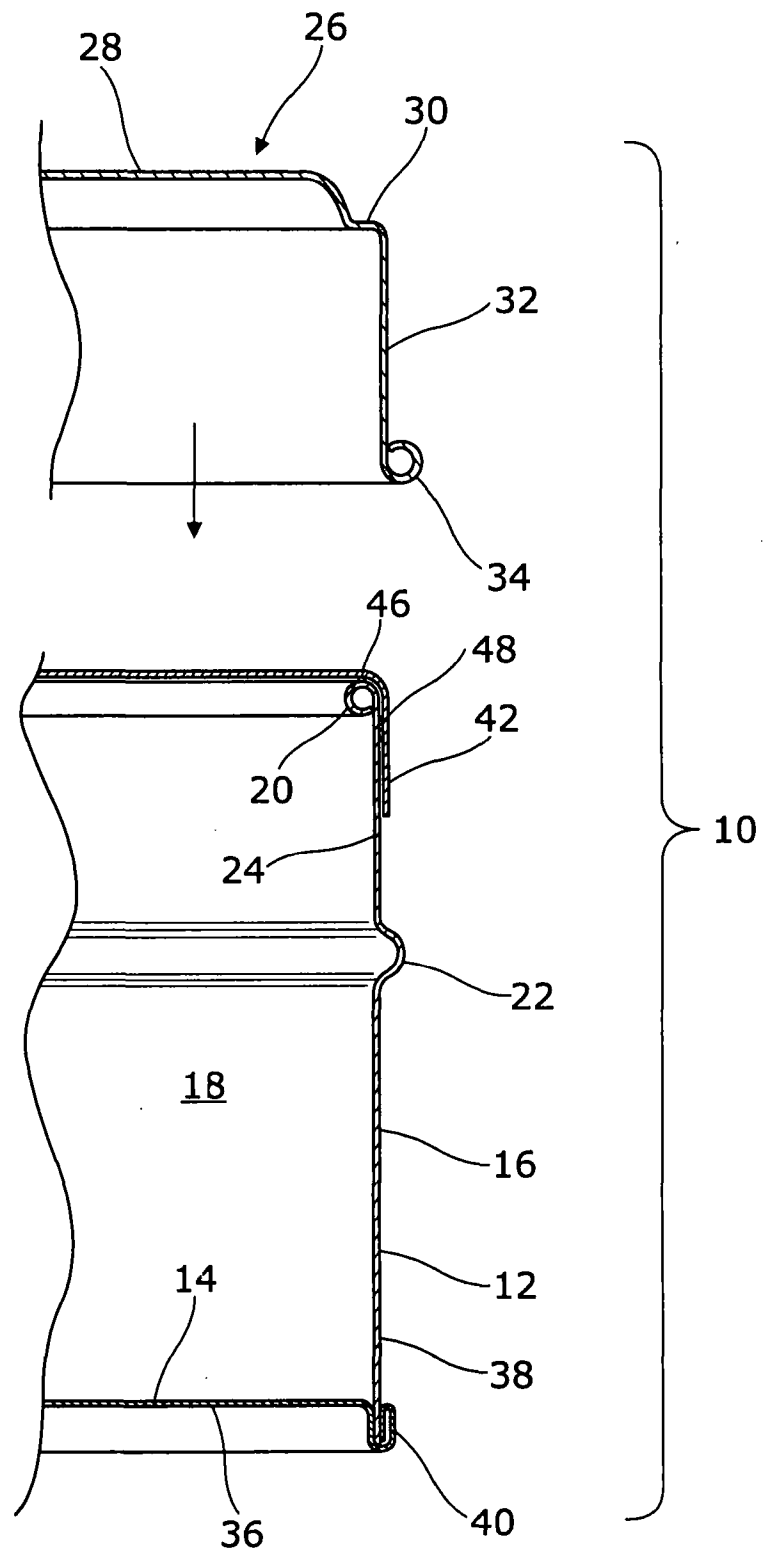
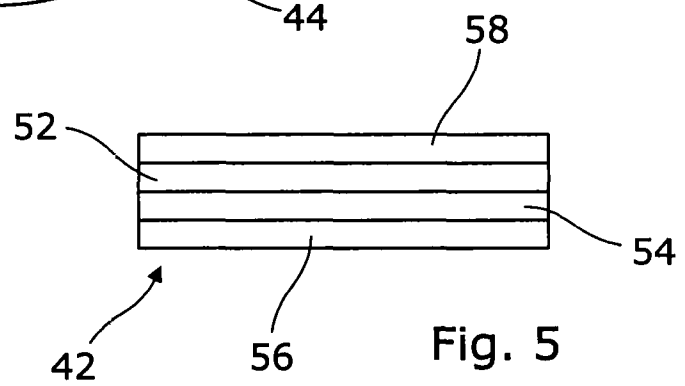
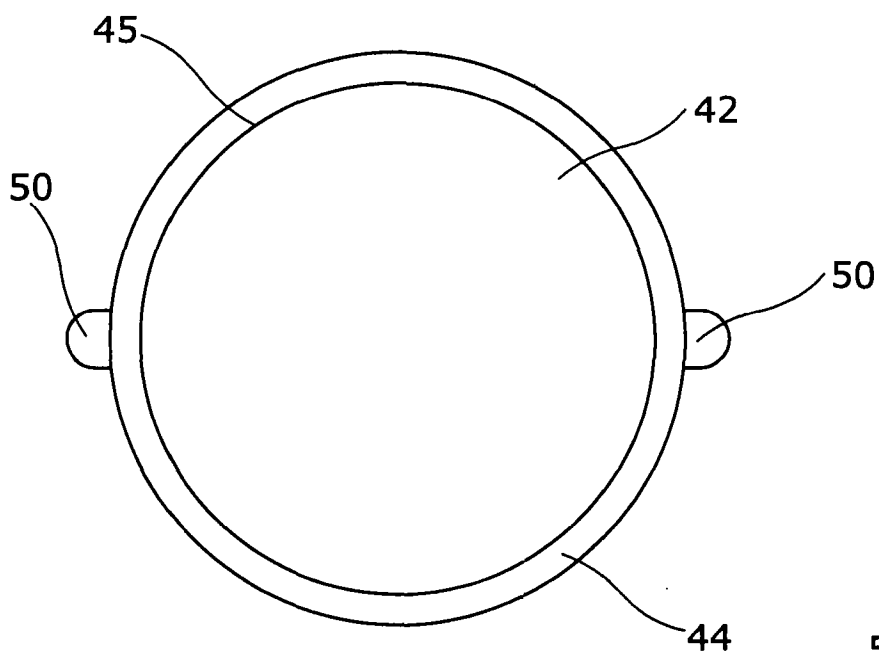
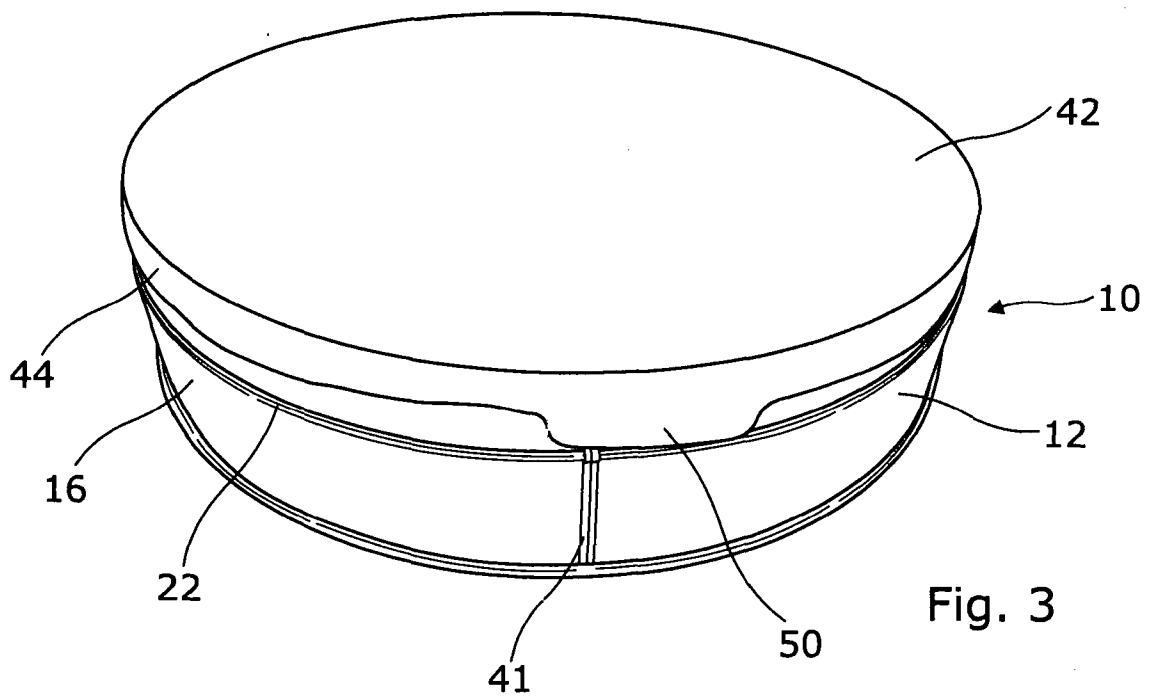
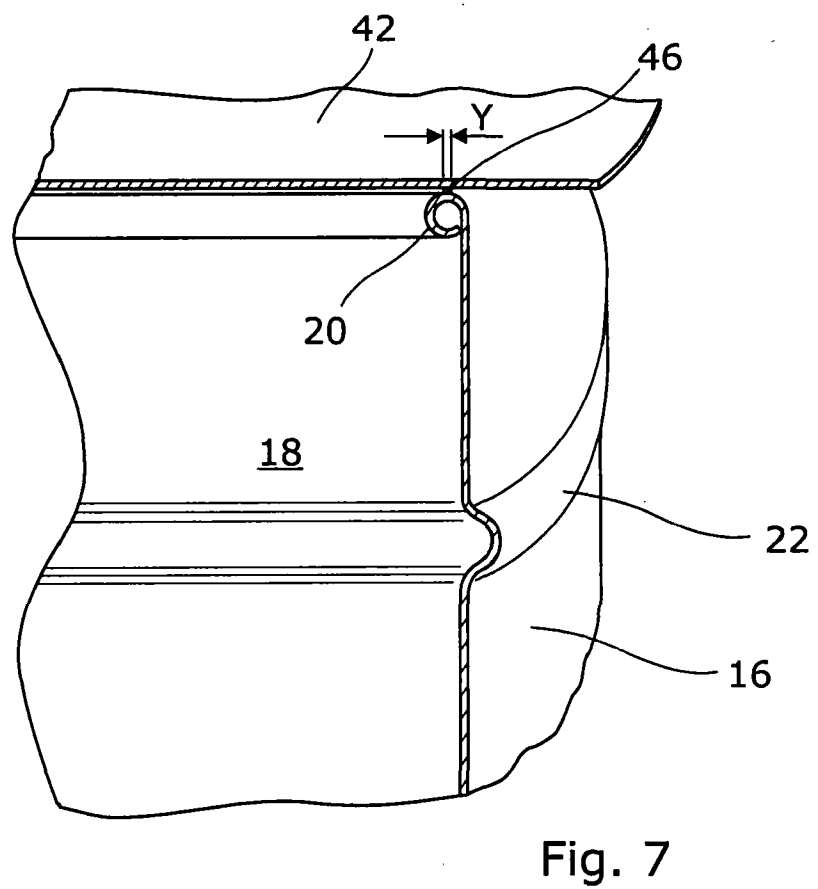
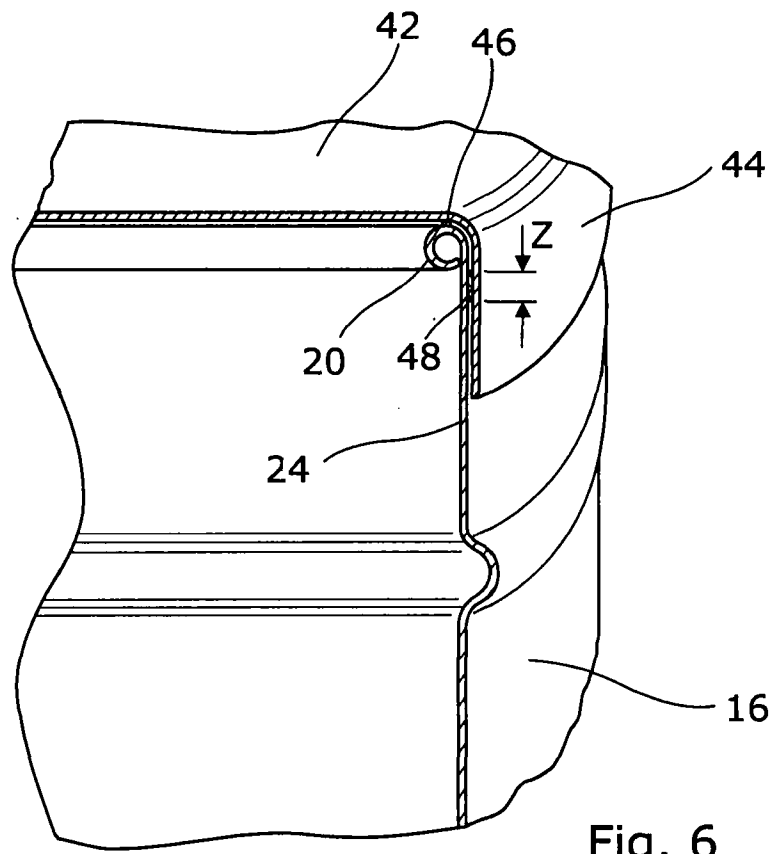
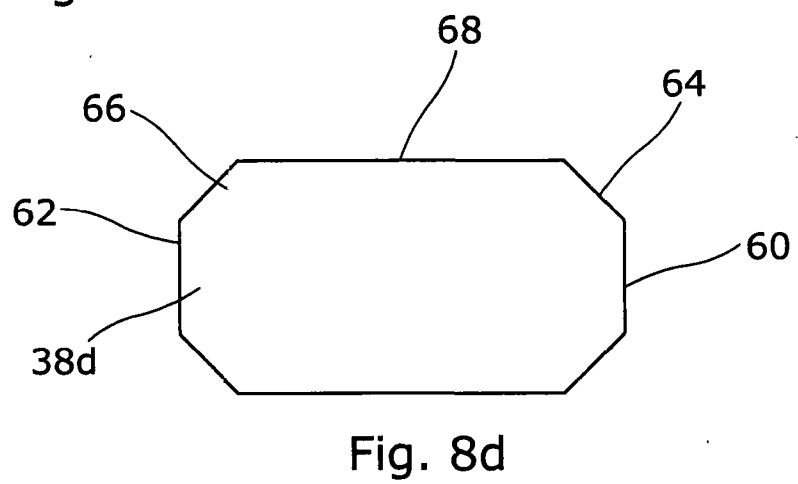
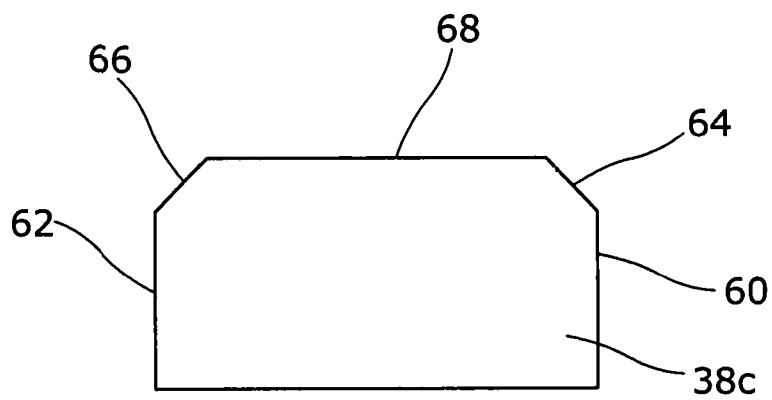
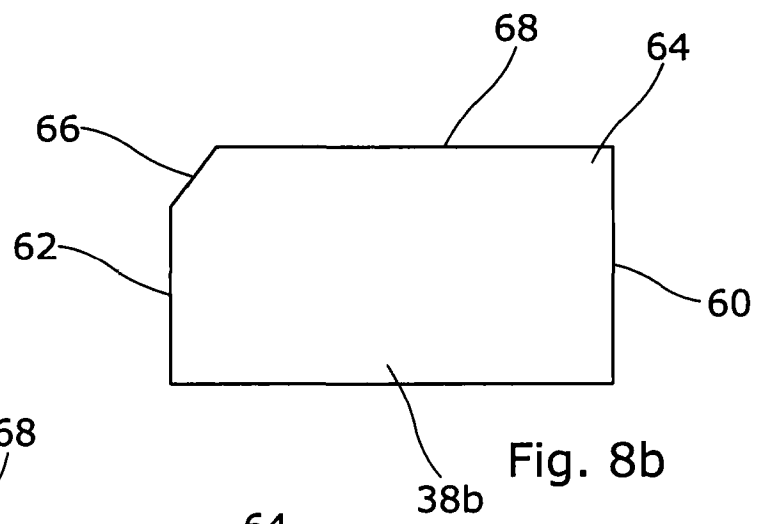
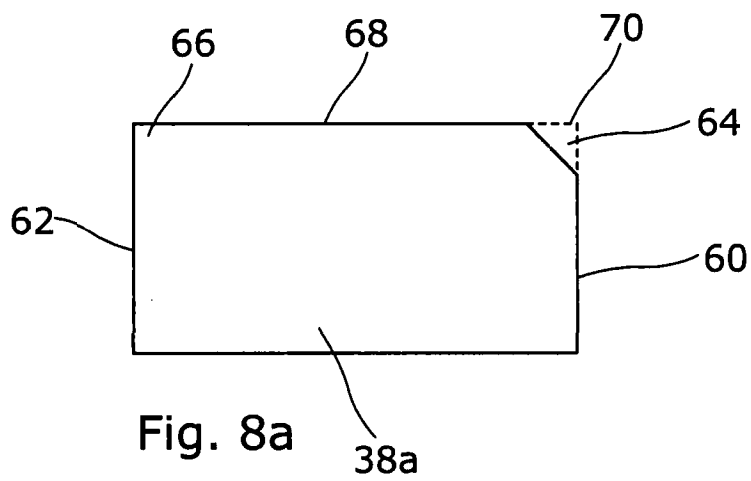


Fig. 2







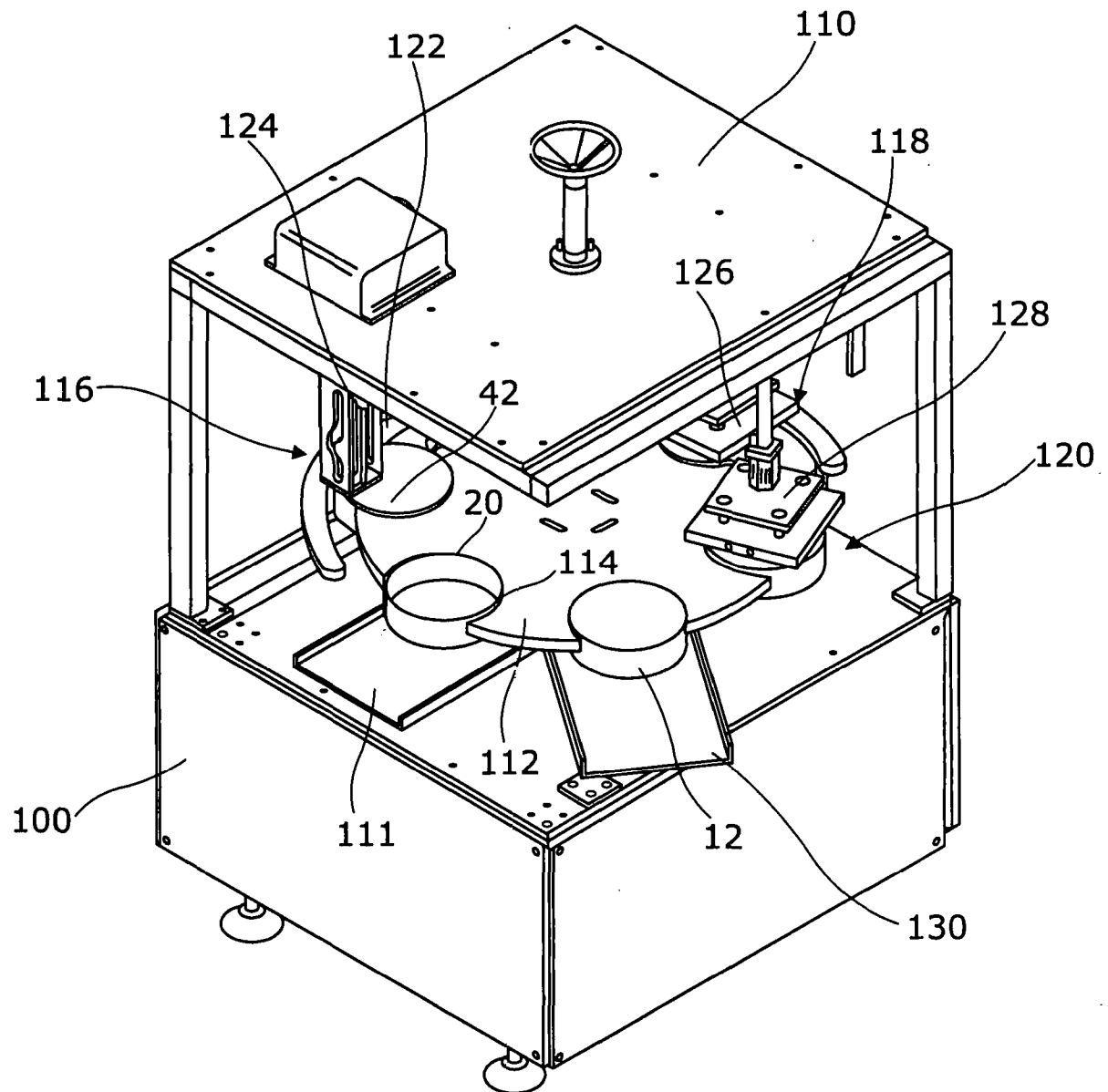
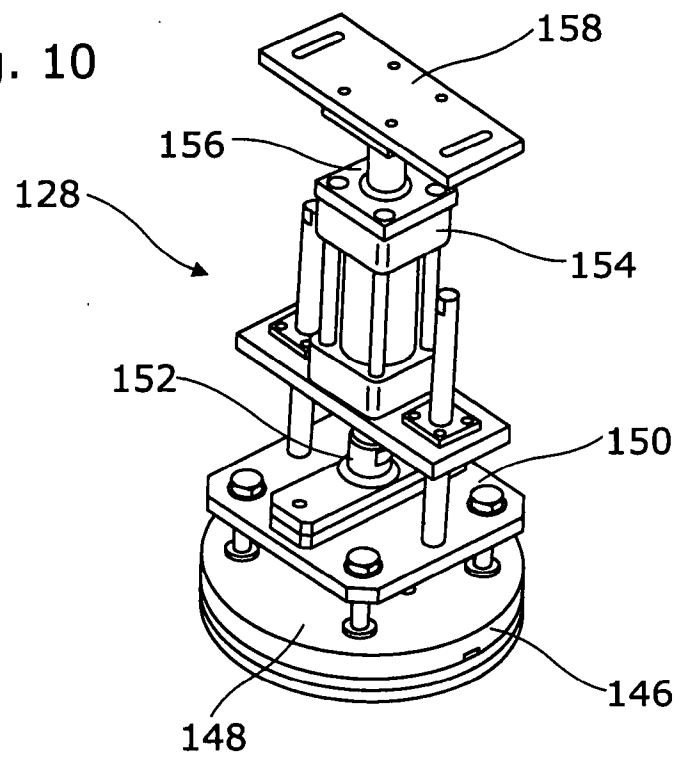
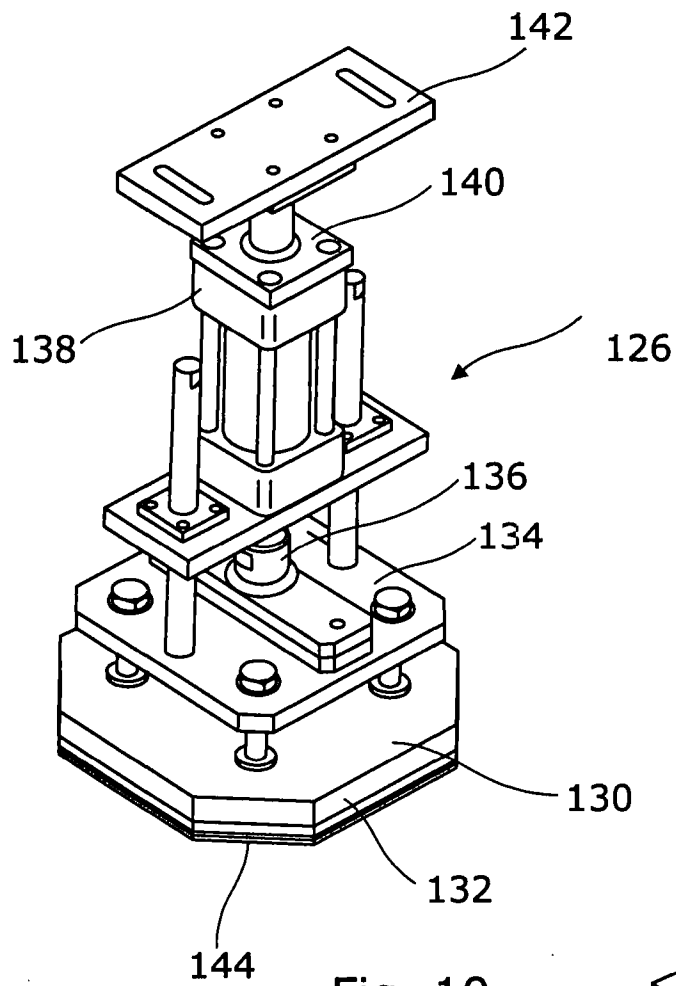


Fig. 9



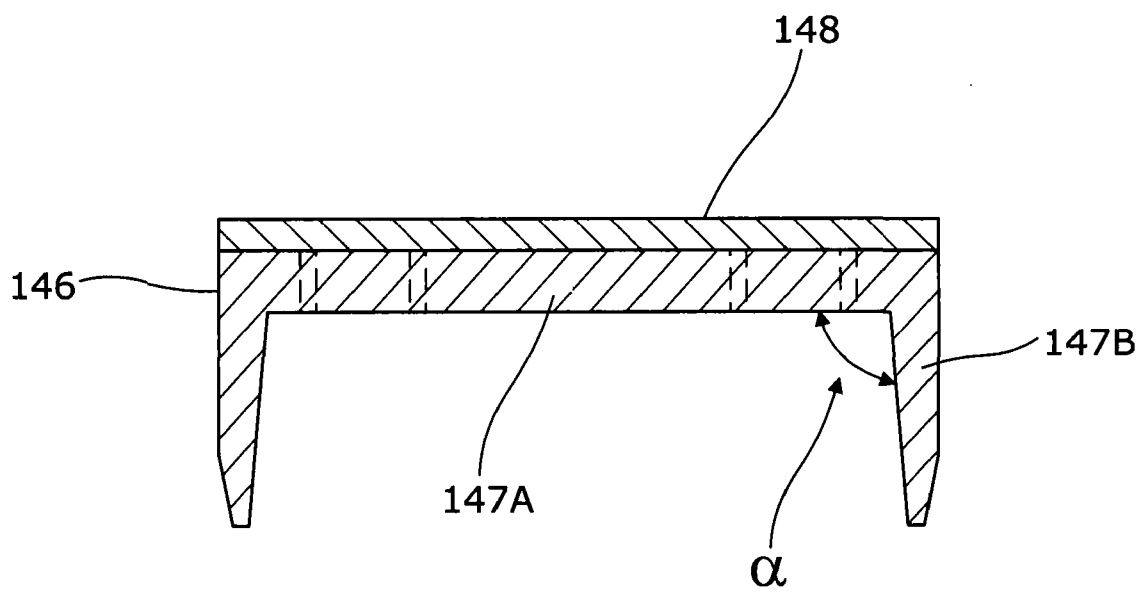


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/000969

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D51/18 B65B7/28
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65D B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/002247 A1 (ABARKA PACKAGING SOLUTIONS B V [NL]; VAN CUIJK WILHELMUS HENRICUS M [N] 7 January 2010 (2010-01-07)	1-4, 13-15
Y	page 1, line 24 - line 31 page 3, line 16 - line 21 page 3, line 29 - line 30 page 6, line 13 - line 18 figures 6-8	9-11,20, 21
Y	EP 2 277 793 A1 (TOPPAN PRINTING CO LTD [JP]) 26 January 2011 (2011-01-26) paragraph [0020]; figures 3, 5	9-11,20, 21



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 August 2015

Date of mailing of the international search report

02/11/2015

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Bridault, Alain

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2015/000969

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-4, 9-11, 13-15, 20, 21

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 9-11, 13-15, 20, 21

A container closed by a membrane extending to the container side wall; corresponding method.

2. claims: 5-8, 16-19

A heat sealant composition; a sealing method using it.

3. claims: 12, 24

A container made from a plate a corner of which has been removed; a method using it.

4. claims: 22, 25

A sealing head for the rim of a container, with a soft, resilient layer; method using it.

5. claims: 23, 26

A recessed sealing head for the side wall of a container; method using it.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2015/000969

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010002247	A1	07-01-2010	CA 2739720 A1 07-01-2010
			EP 2307286 A1 13-04-2011
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