



(51) International Patent Classification:
B65D 75/58 (2006.01)

(21) International Application Number:
PCT/IB2013/002591

(22) International Filing Date:
20 November 2013 (20.11.2013)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
MO2012A000284 20 November 2012 (20.11.2012) IT

(71) Applicant: **CARDONE S.R.L.** [IT/IT]; Via don Minzoni,
96/E, 42043 Gattatico RE (IT).

(72) Inventor: **REGGIO, Bruno**; c/o Cardone S.r.l., Via Don
Minzoni, 96/E, 4204 G att i o (IT).

(74) Agent: **ZOLI, Filippo**; Brunacci & Partners S.r.l., Via
Scaglia Est, 19-31, I-41126 Modena (IT).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to the applicant's entitlement to claim the priority of the
earlier application (Rule 4.17(iii))

Published:

— without international search report and to be republished
upon receipt of that report (Rule 48.2(g))

(54) Title: SINGLE-DOSE SEALED PACK WITH BREAK OPENING

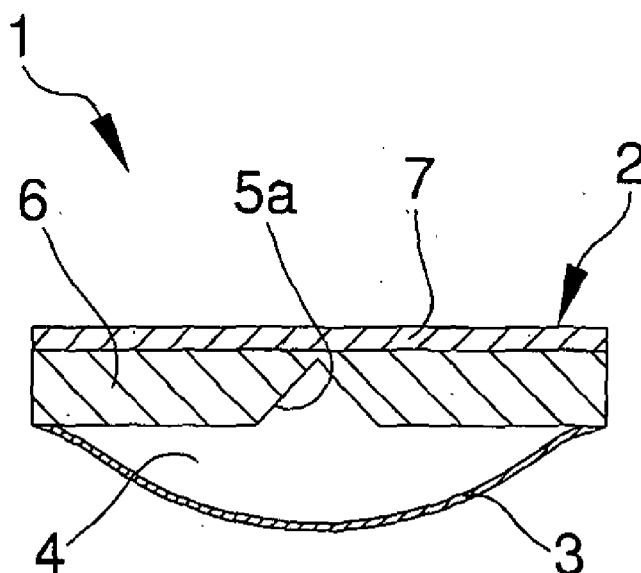


Fig. 1

(57) Abstract: The single-dose sealed pack (1) with
break opening comprising a first sheet (2) of semi-ri-
gid, plastic material, a second sheet (3) of flexible
plastic material associated with the first sheet (2), to
define a sealed containment chamber (4) for containing
at least a dose of a product, the first sheet (2) compr-
ising at least a bearing layer (6) and at least a barrier lay-
er (7), each of them having its own thickness, wherein
the barrier layer (7) is arranged towards the outside of
the chamber (4) with respect to the bearing layer (6);
the single-dose pack (1) comprising at least a first cut
(5a) defined at least on the inner face of the first sheet
(2) to guide the breakage of the first sheet itself so as to
determine the formation of an opening to allow the
product to come out, the first cut (5a) comprising an in-
dividual rectilinear section defining the bending axis of
the pack, the barrier layer (7) being of the isotropic and
not perforated type and having a lower elongation at
break than the maximum elongation applicable to it by
the only thickness of the bearing layer (6) following the
bending of the pack itself.

SINGLE-DOSE SEALED PACK WITH BREAK OPENING

Technical Field

The present invention relates to a single-dose sealed pack with break opening.

Background Art

5 As is known, single-dose packs with break opening are made up of a sheet of semi-rigid plastic material superimposed and sealed on a sheet of flexible plastic material so as to define a sealed containment chamber containing a dose of a liquid product. Generally, the sheet of semi-rigid material has a central pre-cut which facilitates and guides the subsequent breakage.

10 Some single-dose packs of known type are described by US 2005/0178086, WO 2009/040629 and WO 2007/145535.

In particular, US 2005/0178086 describes a single-dose pack, the semi-rigid sheet of which consists, proceeding from the inside towards the outside, of a sealing layer of flexible type, a barrier layer, which is also flexible, a semi-rigid
15 bearing layer and an outer covering layer. The pack described by US 2005/0178086 then comprises two cuts defined in correspondence to its opposite faces and suitable for guiding its breakage. In particular, the cut defined on the inner face involves the innermost sealing layer, the barrier layer and the bearing layer.

20 This type of pack does have some drawbacks.

In particular, the thickness of the various layers, as explicitly described, is very high, thus involving high manufacturing costs. The extra thickness of the layers is in particular to be put down to the need to maintain a big enough quantity of material between the cuts defined on the opposite faces of the semi-rigid sheet
25 in order to prevent any undesired escape of the product occurring.

Furthermore, despite the extra thicknesses, the packs made this way do not ensure the correct seal of the product inside them. In fact, the barrier layer must necessarily be affected by the cut defined on the inner face of the semi-rigid sheet so as to ensure its breakage following the bending of the pack itself. This
30 does however involve the risk of the contained product coming into contact with the barrier layer, undermining it and reacting with it, until it causes the deterioration of its properties in the case of particularly aggressive products.

The document WO 2009/040629, including in order to overcome these drawbacks, describes a single-dose pack where the various layers making up the semi-rigid sheet, which in this case as well comprise an inner sealing layer, an intermediate barrier layer and an outer bearing layer, are locally deformed but
5 without such deformation causing its breakage.

This solution also has drawbacks however, inasmuch as it is not possible to determine in a precise way the depth of the local deformation which ensures pack opening.

In fact, because the sealing layer has a high elongation at break, it frequently
10 occurs that such layer, once deformed, fails to break following the bending of the pack.

Even in the case of managing to identify the amount of deformation such as to ensure pack breakage, such deformation would be hard to achieve in a repetitive and reliable way due to the normal variations in thickness and levelness of the
15 materials used from time to time.

This means that, in this case as well, the only way of ensuring pack opening is to make a cut such as to perforate the sealing layer and the barrier layer.

Because the barrier properties of the layers also depend on their thickness, the deformation of same could affect their permeability to the gases in both
20 directions.

The document WO 2007/145535 in turn describes a pack wherein the semi-rigid sheet, comprising the barrier layer, is associated with a further flexible sheet turned outwards. According to WO 2007/145535, the semi-rigid sheet has a series of V or U-shaped cuts, which can be either through cuts or not, while the
25 outer flexible sheet can be completely integral or also have a cut arranged in such a way as not to superimpose itself on that of the semi-rigid sheet. The breakage of the outer flexible sheet occurs by effect of the sole mechanical action applied on same by the semi-rigid sheet following the breakage of the latter. More in particular, the cuts defined on the semi-rigid sheet open
30 following the bending of the pack, defining two distinct portions that contact the upper flexible sheet and reciprocally move away as the pack is gradually bent. Such two portions thus apply a "lever effect" on the upper flexible sheet, which

increases along with the increase in distance between their fulcrum and the area of contact with the upper sheet itself. The capacity of the semi-rigid support to apply the force necessary to tear the above film depends on its flexural strength.

The pack referred to in WO 2007/145535 also has drawbacks. It does in fact
5 necessarily require a much thicker semi-rigid sheet in order to permit applying enough mechanical force to cause the outer flexible sheet to break as well as the use of materials having well-defined rigidity specifications. Such thicknesses and such materials are expensive and this inevitably affects the end product.

Furthermore, the extreme fragility of the semi-rigid sheet can give rise to the
10 accidental breakage of same during the pack manufacture and distribution phase.

Not least, the conformation of the cut can be hazardous for the end user due to the sharp and in certain cases pointed tips that form as a result of pack breakage.

The document US 4,236,652 describes a sealed pack wherein the outer layer of
15 the pack has relative fibers arranged in a uni-axial direction and on which is defined a cut that extends parallel to the fibers themselves.

The document US 2010/155284 describes a sealed pack wherein the sheet of semi-rigid material has a pre-cut with at least one component transversal to the bending axis, in such a way that, following breakage, a lever effect is produced
20 on the outermost layer so as to make its breakage easier.

Description of the Invention

The main aim of the present invention is to provide a single-dose pack which permits ensuring the breakage of all the layers that make up the semi-rigid sheet and, at the same time, ensures a seal such as to prevent any of the contained
25 product from occasionally escaping.

Within this aim, an object of the present invention is to prevent damaging the barrier layer/s so as to maintain the integrity of the product contained in the pack.

One object of the present invention is to provide a single-dose pack which has
30 smaller thickness than those of the packs of known type.

Yet another object is to provide a single-dose pack which has lower manufacturing costs and, therefore, a lower end-product cost, than the packs of

known type, and which ensures, at the same time, the protection of the contained product from external contamination as well as being easy and ready to open.

Another object of the present invention is to provide a single-dose sealed pack
5 with break opening that allows to overcome the mentioned drawbacks of the background art in the ambit of a simple, rational, easy, effective to use and low cost solution.

The objects mentioned above are achieved by the present single-dose sealed pack with break opening according to claim 1.

10 Brief Description of the Drawings

Other characteristics and advantages of the present invention will become more evident from the description of a preferred, but not sole, embodiment of a single-dose sealed pack with break opening, illustrated purely as an example but not limited to the annexed drawings in which:

15 Figure 1 is a section view of a pack according to the invention, in a first embodiment;

Figure 2 is a section view of a pack according to the invention, in a second embodiment;

Figure 3 is a section view of a pack according to the invention, in a third
20 embodiment;

Figure 4 is a section view of a pack according to the invention, in a fourth embodiment;

Figure 5 is a plan view of the inner face of the semi-rigid sheet of a pack according to the invention, which represents the first cut made on it;

25 Figure 6 is a plan view of the inner face of the semi-rigid sheet of a pack according to the invention, which represents an alternative embodiment of the first cut;

Figure 7 is a plan view of the outer face of the semi-rigid sheet of a pack according to the invention, which represents the second cut made on it;

30 Figure 8 is a plan view of the outer face of the semi-rigid sheet of a pack according to the invention, which represents an alternative embodiment of the second cut;

Figure 9 is a plan view of the outer face of the semi-rigid sheet of a pack according to the invention, which represents an alternative embodiment of the second cut;

Figure 10 is a plan view of the outer face of the semi-rigid sheet of a pack according to the invention, which represents the punches made on it.

Embodiments of the Invention

With particular reference to such figures, globally indicated by 1 is a single-dose sealed pack with break opening.

The pack 1 comprises a first sheet 2 of semi-rigid plastic material and a second sheet 3 of flexible plastic material associated with the first sheet 2, generally (but not exclusively) by means of hot sealing, to define a sealed containment chamber 4 for containing a dose of a liquid product.

In the embodiments shown in the illustrations, the pack 1 has an elongated shape and a substantially rectangular conformation, thus having two median planes substantially perpendicular to each other, of which one longitudinal median plane and one transversal median plane. The pack 1 can however be made in a variety of geometric shapes, the conformation in the illustrations being shown by way of example only.

According to the invention, the first sheet 2 comprises at least a bearing layer 6 and at least a barrier layer 7 associated with the bearing layer 6 and arranged towards the outside with respect to the chamber 4. Both the bearing layer 6 and the barrier layer 7 have a relative thickness.

In other words, the bearing layer 6 is arranged on the side of the chamber 4 with respect to the barrier layer 7 which instead is arranged opposite the chamber itself with respect to the bearing layer 6.

More particularly, the bearing layer 6 is of the fragile type. In other words, the bearing layer 6 must be such as to break when undergoing bending.

The bearing layer 6 is e.g. made up of a material selected from the group comprising: polystyrene (PS), polyvinyl chloride (PVC), acrylonitrile-butadiene-styrene (ABS), acrylonitrile-butadiene-styrene and glass fibers, amorphous polyethylene-terephthalate (APET), polythene (PE) or polypropylene (PP).

The bearing layer 6 generally has a thickness between 50 μ m and 1000 μ m, even though its having smaller or greater thicknesses at the extremes of such range cannot be ruled out.

More in general, it is pointed out that the best bearing layer thickness must be
5 from time to time calculated according to the specifications of the material of which it is made up and also according to the mechanical specifications of the barrier layer 7, as will be described below in greater detail.

According to the invention, the barrier layer 7 is of the isotropic type, i.e., it has the same physical characteristics in all directions. In other words, the barrier
10 layer 7 does not have a preferential orientation of the relative fibers.

The barrier layer 7 is e.g. made of Aluminum (Al) or Evoh, or of silicon oxide (SiOx) or aluminum oxide (Al₂O₃).

Advantageously, the barrier layer 7 has a thickness between 5 μ m and 15 μ m, preferably between 6 μ m and 13 μ m. The use cannot however be ruled out of
15 smaller or greater thicknesses at the extremes of such ranges.

More in general, as already said above, it has been found that the type and thickness of the barrier layer 7 also considerably affect the thickness of the bearing layer 6, inasmuch as the greater the elongation at break of the barrier layer 7 the greater the elongation must be which the bearing layer 6 must be
20 able to apply on the barrier layer itself.

According to the invention, the bearing layer 6 and the barrier layer 7 must therefore be such that the elongation applicable by the thickness of the bearing layer 6 only on the barrier layer 7, following the bending of the pack 1, is greater than the elongation at break of the barrier layer itself.

25 The elongation at break is a property of the materials and is generally calculated by means of laboratory tests using methods known to the expert in the sector.

The maximum elongation applicable by the bearing layer 6 on the barrier layer 7 corresponds to the configuration wherein the opposite portions of the first sheet 2 onto which a force is applied by the operator to flex the first sheet itself
30 are brought into reciprocal contact. Very likely, in this condition, the breakage force relating to the bearing layer 6 has, given its fragility, already been exceeded. It follows therefore that the bearing layer 6 is broken into two parts

and its outer flaps are at maximum distance from one another, i.e., at double the thickness of the bearing layer itself.

The elongation at break of the barrier layer 7 must not therefore be more than double the thickness of the bearing layer 6.

- 5 It is pointed out, though it may seem banal for a technician in the sector, that because the barrier layer 7 is at extrados of the first sheet 2, its outermost fibers are prompted to traction.

The barrier layer 7, in fact, being turned towards the extrados of the first sheet 2 is that which, according to the following formula, suffers the greatest elongation

$$10 \quad \varepsilon = (y/R) l$$

where R is the curvature radius of the neutral axis (expressed in radiants) and y is the distance of the fibers considered from the neutral axis itself and l is the length of the neutral axis. This formula therefore defines the elongation (or shortening) deformation of the various fibers.

- 15 Expressing the formula in percentage (%) the elongation percentage will be:

$$\Delta l\% = (y/R) 100$$

In the case of the barrier layer 7 consisting of a sheet of aluminum with thickness of around 9 μm (micron), and therefore with an elongation at break of around 5-10%, the bearing layer 6 of a semi-rigid sheet of polystyrene with
20 thickness of around 400 μm and imagining, for simplicity, that the neutral axis lies substantially at half the thickness of the layer 6, we shall have:

$$y = 200 \mu\text{m}$$

$$\Delta l\% = 5-10\%$$

The breakage of the barrier layer 7 will occur for bending radius values of 2mm
25 or less, in the event of the percentage elongation $\Delta l\%$ being 10%, and for values of 4 mm or less, in case of the percentage elongation $\Delta l\%$ being 5%.

It follows therefore that the greater the elongation at break of the barrier layer 7, the greater the thickness of the bearing layer 6 must be, materials being equal, in such a way as to increase the distance of the outer fibers from the neutral
30 axis.

Preferably, the bearing layer 6 and the barrier layer 7 must be such that the maximum tension that can be applied by the thickness of the bearing layer 6 on

the barrier layer 7 must also be greater than the tensile strength σ_R of the barrier layer itself.

The tensile strength σ_R and the tension that can be applied by the bearing layer 6 must refer to a predefined direction and relate to the bending moment applied on the first sheet 2. More precisely, depending on the axis around which the bending moment is applied, the direction of the traction force applied on the extrados of the first sheet 2 changes.

By “*tensile strength*” (or breakage load) σ_R is meant the amount of tension beyond which the layer breaks. Such value, expressed in N/mm^2 , is generally calculated by means of laboratory tests using methods known to the expert in the sector. The breakage load can e.g. be calculated by means of the method of analysis suggested by UNI-EN-ISO standards.

By “*maximum tension*” applicable by the bearing layer 6 is meant the maximum traction stress which the bearing layer 6, when deformed by bending, is able to apply on the barrier layer 7.

In this case too, the tensile strength (or breakage load) σ_f undergone by the fibers increases along with the distance from the neutral axis according to the following formula:

$$\sigma_f = E (y/R)$$

where E is the elastic modulus of the material, R is the curvature radius of the neutral axis and y is the distance of the fibers considered from the neutral axis itself. It is therefore easy to appreciate how the fibers at the extrados are those which undergo the greatest stress.

The tension which can be applied by the bearing layer 6 increases in intensity as the first sheet 2 is gradually bent, inasmuch as the curvature of the first sheet itself increases and, therefore, the curvature radius R is reduced.

The maximum tension which can be applied by the bearing layer 6 corresponds therefore to the configuration wherein the opposite portions of the first sheet 2 on which a force is applied by the operator to bend the first sheet itself are brought into reciprocal contact. In this configuration in fact, the curvature radius R is equal to about half the thickness of the bearing layer 6, inasmuch as the centre of rotation in practice corresponds to the meeting point of the bent inner

faces of the bearing layer itself.

Very likely, in this condition, the breakage force relating to the bearing layer 6 has, given its fragility, already been exceeded. It follows therefore that the bearing layer 6 is broken into two parts and its outer flaps are at maximum distance from one another, thus applying the maximum possible stress on the above barrier layer 7.

By increasing the thickness of the bearing layer 6 therefore, both the elongation and the effort applied at the extrados are also increased. This means that, by increasing the thickness of the bearing layer 6, materials can be used for the barrier layer 7 with greater elongation at break and greater breakage load.

It can also occur that the barrier layer 7 has a tensile strength or an elongation at break below those applicable by the bearing layer 6. In this condition, the barrier layer 7 breaks before the bearing layer 6, applying to the latter, at the moment of its fracture, an additional and sudden stress that makes the breakage of the bearing layer itself easier.

This also occurs in the previously mentioned example, wherein the barrier layer 7 is made up of a sheet of aluminum about 9 μm (micron) thick and the bearing layer 6 of a sheet of semi-rigid polystyrene with a thickness of around 400 μm . It can also be imagined that the neutral axis lies substantially at half the thickness of the layer 6, and the elongation at break is 10% (worsening condition). We shall therefore have:

$$y = 200 \mu\text{m}$$

$$R = 2 \text{ mm (previously calculated)}$$

$$E_a = 110 \text{ N/m}^2 \text{ (aluminum elastic modulus)}$$

Using the above-mentioned tension formula ($\sigma = E y/R$), the tensile strength σ_{fa} undergone by the barrier layer 7 is equal to:

$$\sigma_{fa} = 110 \text{ N/m}^2 * (200/2000) = 11 \text{ N/m}^2$$

a value, this, which corresponds to about 27% of the breakage load of polystyrene (which therefore breaks after the barrier layer 7).

It should be noted that the thicknesses of the various layers shown in the illustrations are given by way of example only (and are not therefore in scale) and are unable to provide any indication as to the dimensional relations between

them.

According to the invention, the pack 1 then comprises at least a first cut 5a defined on the first sheet 2 to guide the breakage of the first sheet itself so as to determine the formation of an opening to allow the product to come out.

- 5 The first cut 5a has a substantially rectilinear individual section defining the bending line of the pack 1.

In the embodiment shown in the illustrations, the first cut 5a is defined in correspondence to the median area of the first sheet 2, and in particular in correspondence to its transversal median plane.

- 10 More in detail, the first cut 5a extends transversally to the longitudinal axis of the pack 1 and, therefore, also of the first sheet 2.

The first cut 5a has a depth such as to involve the bearing layer 6 but not the barrier layer 7, which is integral and not perforated.

- More in particular, it should be noted that the first cut 5a made on the bearing
15 layer 6 causes the reduction of the curvature radius R, thus ensuring the easier breakage of the first sheet 2.

In fact, again taking the formula used above for the tension σ we have

$$R = E (y/\sigma) l$$

- where E is the modulus of elasticity of the bearing layer 6, y the distance from
20 the neutral axis and l the length of the first sheet 2.

Because σ is a function of the applied bending moment, it follows that by making a cut on the bearing layer 6, in correspondence to the cut itself, the distance of the fibers from the neutral axis is reduced and the curvature radius R is also consequently reduced.

- 25 Preferably, the first cut 5a only involves the inner face of the bearing layer 6, meaning that turned towards the chamber 4.

- The first cut 5a can however involve both the inner face and the outer face of the bearing layer 6, meaning that turned towards the barrier layer 7. In this case, the first cut 5a thus defined is made before coupling the bearing layer 6 to the
30 barrier layer 7, in such a way as to maintain the integrity of the latter.

Suitably, the first cut 5a has a constant depth, though alternative embodiments cannot be ruled out wherein its depth is variable.

In a particular embodiment shown in figure 6, the pack 1 also comprises at least two further cuts 5b, defined on the same face of the first sheet 2 on which is obtained the first cut 5a, where such further cuts 5b are arranged transversal with respect to the first cut 5a and on opposite sides to this.

- 5 The further cuts 5b can be of the open line type, which can be rectilinear, curvilinear or the like or, alternatively, shaped so as to define a closed profile, even though this last embodiment is more difficult to make.

The further cuts 5b can be distanced from the extremities of the first cut 5a or else be tangential to these.

- 10 The presence of further cuts 5b, as mentioned above, is particularly important every time you wish to make sure that the breakage of the bearing layer 6 and/or of the barrier layer 7 does not extend along their entire width, the further cuts 5b being suitable for interrupting the extension of the crack and restricting breakage to the sole extension of the first cut 5a. This makes it possible to
- 15 ensure that the section through which the product comes out remains within the desired dimensions which are defined by the first cut 5a.

- In the case of the first cut 5a being defined on the first sheet 2, the first sheet itself will be bent around the first cut so defined, and so the above-mentioned parameters (elongation and tension) must be referred to the bending moment
- 20 applied around such bending line.

The first cut 5a involves at least the bearing layer 6.

In the first embodiment shown in figure 1, the first sheet 2 only comprises the bearing layer 6 and the barrier layer 7.

- In such case, the bearing layer 6 and the barrier layer 7 define the inner face and
- 25 the outer face respectively of the first sheet 2.

- In this embodiment, the first cut 5a only involves the bearing layer 6. In this first embodiment, the fact that on the bearing layer 6 both the first cut 5a and the further cuts 5b are defined, according to what has been described above, is particularly useful because, considering the bearing layer 6 and the barrier layer
- 30 7 are of the fragile type, the crack that develops following the bending of the pack 1 would tend to extend along their entire width.

The further cuts 5b are therefore suitable for preventing that the extension of the

opening that occurs following the bending of the pack 1 remains restricted to the first cut 5a and, therefore, that the breakage does not extend along the entire width of the layers 6 and 7.

In the second embodiment, shown in figure 2, the first sheet 2 also comprises a sealing layer 8 associated with the bearing layer 6 and turned towards the chamber 4. In other words, in this embodiment, the bearing layer 6 is placed between the barrier layer 7 and the sealing layer 8.

In this case, the sealing layer 8 and the barrier layer 7 define the inner face and the outer face respectively of the first sheet 2.

10 The sealing layer 8 is made e.g. of a material selected from the group comprising: polyethylene (PE) and polypropylene (PP).

Preferably, the sealing layer 8 has a thickness between 10 μm and 70 μm .

Generally, the sealing layer 8 is more ductile than the bearing layer 6.

Suitably, the second sheet 3 coupled to the sealing layer 8 also comprises a plurality of layers. For example, the second sheet 3 can comprise a layer of polyethylene (PE) or polypropylene (PP) coupled to a layer of metalized polyethylene terephthalate (PET) or can comprise a layer of polyethylene (PE) or polypropylene (PP) coupled to a layer of Aluminum (Al) and to a layer of polyethylene terephthalate (PET).

20 In this second embodiment, the first cut 5a involves both the bearing layer 6 and the sealing layer 8. Thanks to its greater ductility, during the bending of the pack 1, the sealing layer 8 tends to only break in correspondence to the first cut 5a, thus acting as a support for the bearing layer 6 and the barrier layer 7 and performing the function of control of the product exit section. For this reason, 25 the presence of further cuts 5b does not appear strictly necessary, even though the fact that these be also made in the presence of the sealing layer 8 cannot in any case be ruled out.

Even though the thickness of the various layers, and in particular of the sealing layer 8, is affected by various parameters such as the type of product contained 30 in the pack 1, the characteristics of the flexible second sheet 3, the filling conditions (such as temperature) and the technology used to seal the sheets 2 and 3 together, one example of this second embodiment of the pack 1 is the

following (proceeding from the inside towards the outside):

sealing layer in polythene (PE) or polypropylene (PP) with a thickness of 50 μ m;

bearing layer in polystyrene (PS) or acrylonitrile-butadiene-styrene (ABS) (with or without glass fibers) having a thickness between 200-400 μ m;

- 5 barrier layer in aluminum having a thickness between 7-15 μ m.

Advantageously, the first sheet 2 also comprises a protective layer 9 associated with the barrier layer 7 and turned outwards. In this case, therefore, the barrier layer 7 is placed between the bearing layer 6 and the protective layer 9.

- The protective layer 9 is e.g. made from a material selected from the group
10 comprising: polyethylene terephthalate (PET), lacquers and protective paints.

The protective layer 9 has a thickness between 0.1-20 μ m (indicate possible protective layer thickness), preferably between 10-12 μ m.

The third and the fourth embodiments, shown in the figures 3 and 4 respectively, both envisage the presence of the protective layer 9.

- 15 More in detail, in the third embodiment, the first sheet 2 comprises, proceeding from the inside towards the outside of the pack 1, the bearing layer 6, the barrier layer 7 and the protective layer 9.

In this case, the bearing layer 6 and the protective layer 9 define the inner face and the outer face respectively of the first sheet 2.

- 20 An example of this third embodiment of the pack 1 is the following (proceeding from the inside towards the outside):

bearing layer in polystyrene (PS) or acrylonitrile-butadiene-styrene (ABS) (with or without glass fiber) having a thickness between 200-400 μ m;

barrier layer in aluminum having a thickness between 7-15 μ m;

- 25 protective layer in polyethylene terephthalate (PET) having a thickness between 10-12 μ m.

- The fourth embodiment instead is a combination of the second and third embodiment described above. The first sheet 2 therefore comprises, proceeding from the inside towards the outside of the pack 1, the sealing layer 8, the
30 bearing layer 6, the barrier layer 7 and the protective layer 9.

In this case, the first sheet 2 therefore comprises both the sealing layer 8 and the protective layer 9 arranged on opposite sides the one to the other and defining

the inner face and the outer face respectively of the first sheet 2.

An example of this fourth embodiment of the pack 1 is the following (proceeding from the inside towards the outside):

sealing layer in polythene (PE) or polypropylene (PP) having a thickness of
5 50 μ m;

bearing layer in polystyrene (PS) or acrylonitrile-butadiene-styrene (ABS) (with or without glass fibers) having a thickness between 200-400 μ m;

barrier layer in aluminum having a thickness between 7-15 μ m;

protective layer in polyethylene terephthalate (PET) having a thickness between
10 10-12 μ m.

The protective layer 9 can be integral, i.e., not show any cut, or else a second cut can be defined on it.

In the first case it is suitable that the protective layer 9 has a lower elongation at break than the elongation which can be applied on it by the thickness of the
15 layers underneath, i.e. by the unit composed of the barrier layer 7, by the bearing layer 6 and, if any, by the sealing layer 8.

Such condition permits guaranteeing that the protective layer 9 breaks at least in the limit condition wherein the opposite portions of the first sheet 2 are brought into contact following the bending of the first sheet itself.

20 Preferably, the protective layer 9 also has a tensile strength σ_R below the maximum tension applicable to it by the thickness of the layers underneath.

To define the parameters mentioned above and the method for measuring them, reference should be made to what has been said above regarding the relation between the barrier layer 7 and the bearing layer 6.

25 Alternatively, as has been said above, on the protective layer 9, at least a second cut 10a can be defined.

Such second cut 10a can, e.g., be made by means of a laser beam suitably calibrated so that, once the protective layer 9 has been cut, it is reflected by the barrier layer in aluminum .

30 The second cut 10a defined on the protective layer 9 is preferably arranged in correspondence to the first cut 5a obtained on the inner face of the first sheet 2.

The second cut 10a can e.g. be superimposed on the first cut 5a.

In such case, the protective layer 9 reduces the value of the elongation and of the breakage load at the extrados of the first sheet 2 except in correspondence to the second cut 10a so defined. A discontinuity is therefore defined along the outer surface of the first sheet 2, which results in the energy being concentrated
5 along the second cut 10a and in the sooner breakage of the barrier layer 7 with respect to the bending angle of the first sheet itself. The presence of the protective layer 9, in this case, increases the overall fragility of the first sheet 2, irrespective of the fragility/ductility of the individually-considered protective layer.

- 10 In an alternative embodiment, the second cut 10a can be defined in such a way as to interrupt itself in correspondence to the first cut 5a.

The second cut 10a can take on various configurations, e.g., it can be of the continuous type or, alternatively, it can comprise a plurality of separate sections 10 arranged in succession the one to the other along the bending axis of the pack

- 15 1. In particular, the sections 10 can be open, e.g., of the rectilinear, curvilinear type or the like or, alternatively, they can be shaped so as to define a closed profile, such as e.g. small substantially circular holes (as shown in figure 9).

- In a further alternative embodiment, shown in the figure 8, the pack 1 can also have at least two further cuts 10b, defined on the same layer on which is defined
20 the second cut 10a, which are transversal with respect to the second cut 10a and are arranged on opposite sides of the second cut itself. The second cut 10a is preferably rectilinear, though alternative embodiments cannot be ruled out wherein it is of the curvilinear type or of the broken line type, while the further cuts 10b can be of the rectilinear type or, alternatively, shaped so as to define a
25 closed perimeter, even though this latter configuration is more difficult to make.

The further cuts 10b can be distanced from the extremities of the first cut 5a or else tangential with them.

- The presence of the second cut 10a and of the further cuts 10b also permits making the protective layer 9 with materials having mechanical characteristics
30 close to that of the barrier layer 7, while at the same time ensuring a limited extension of the product flow section.

In both the third and the fourth embodiments, the pack 1 comprises the first cut

5a and if necessary, depending on the type of material making up the layers 8 and 9, also the further cuts 5b. More in particular, the further cuts 5b are not strictly necessary in all those cases wherein the layers 8 and/or 9 are made from a material with greater elongation at break than the layers 6 and 7 and which therefore tend to only break in correspondence to the first cut 5a, thereby acting as support for the bearing layer 6 and the barrier layer 7 and performing the function of control of the product exit section.

Preferably, furthermore, the protective layer 9 has a pair of punches, identified in figure 10 by the reference number 11, defined on opposite sides with respect to a median plane of the protective layer itself and in correspondence to another median plane transversal to the previous one. More in detail, the punches 11 are arranged on opposite sides of the longitudinal median plane of the first sheet 2 and in correspondence to the transversal median plane of the first sheet itself.

Suitably, the punches 11 are defined in the proximity of the second cut 10a, on opposite sides of same.

The function of the punches 11 is to avoid the product contained in the chamber 4 from concentrating in the central area of same, thus making it easier to bend the pack 1 along the first cut 5a.

The method for choosing the thicknesses and the materials of each layer is of the empirical type, i.e., it envisages the execution of a series of tests aimed at checking the correct operation of the pack 1.

More in particular, once the number of layers has been defined to be used for the first sheet 2 and also the materials relating to each of such layers, the obtained pack 1 is bent and the correct opening of same is checked.

If the first sheet 2 does not open correctly, and in particular, if the barrier layer 7 does not fracture, it is possible to intervene in the following ways.

A first option consists in varying the thickness of the bearing layer 6, increasing it so as to apply a greater elongation (and also a greater tension) on the barrier layer 7, without changing the chosen materials and the chosen number of layers.

A second option is to introduce, if not already present, the sealing layer 8 (suitably cut), so as to increase the thickness of the layers arranged below the barrier layer 7.

A third option is to introduce, if not already present, the protective layer 9 (and the relative second cut 10a as well as, if necessary, the corresponding further cuts 10b), so as to create discontinuity on the outer surface of the first sheet 2 to make it easier to break the barrier layer 7 along the first cut 5a.

- 5 A fourth option is to modify the materials used, e.g., by choosing, for the barrier layer 7, a material having a lower elongation at break.

If, instead, the first sheet 2 opens correctly, other laboratory tests can be performed in order to optimize the thicknesses of the various layers used.

- In such case, e.g., the thickness of the bearing layer 6 can be reduced and a
10 check made to determine whether, this way, the barrier layer 7 continues to break following the bending of the first sheet 2.

In the same way, the thicknesses of the other layers can also be reduced, starting with those which are more expensive to make and always keeping within safety conditions such as to prevent the contamination of the product contained in pack

- 15 1.

The operation of the present invention is the following.

- Following the bending of the pack 1, which is done by bringing closer together its longitudinal extremities from the inner part of the pack itself (i.e., in such a way that the first sheet 2 represents the extrados of the pack bent this way), the
20 inner face of the first sheet 2 bends in correspondence to the first cut 5a. By effect of such bend, the mechanical stress acting on the first sheet 2 reaches maximum intensity in correspondence to its outer face, which can consist of the barrier layer 7 or of the protective layer 9 depending on the embodiment.

- As described above, the barrier layer 7 fractures in correspondence to the first
25 cut 5a inasmuch as it is in correspondence to this that the greatest elongation and the greatest intensity of strength occur (the curvature radius of the neutral axis being less in this area). Following the fracture of the barrier layer 7 a transit section is therefore defined of the liquid crossing the bearing layer 6, the barrier layer 7 and, in the case of the second and fourth described embodiments, also
30 the sealing layer 8.

As has already been said above, depending on the composition of the first sheet 2, besides the first cut 5a, transversal with respect to the longitudinal axis of the

pack 1, the further cuts 5b can also be defined. The conformation of the first cut 5a generally varies according to whether or not the need exists to make sure that the breakage of the barrier layer 7 and of the bearing layer 6, these being the most fragile layers, does not spread along their entire width.

- 5 In the event of the outer face of the first sheet 2 consisting of the protective layer 9 (as in the third and fourth described embodiments) this too breaks in correspondence to the first cut 5a thereby placing the chamber 4 in communication with the outside.

It has in practice been ascertained how the described invention achieves the
10 proposed objects and in particular the fact is underlined that the pack forming the subject of the present invention at the same time ensures the easy and safe opening of same and its seal against any accidental escape of the product contained in it.

More in particular, *the innovative layout of the barrier layer permits avoiding*
15 *the pre-cutting of same, thus ensuring pack seal and, at the same time, ensuring breakage inasmuch as such layer undergoes greater elongation and greater mechanical stresses because it represents or is arranged in the proximity of the extrados of the first sheet.*

Again, the particular claimed arrangement of the layers making up the first sheet
20 permits considerably reducing the thickness of the layers themselves compared to packs of known type, thus obtaining a big reduction in manufacturing costs and, therefore, a lower end-product cost.

CLAIMS

- 1) Single-dose sealed pack (1) with break opening comprising:
a first sheet (2) of semi-rigid plastic material;
a second sheet (3) of flexible plastic material associated with said first sheet (2),
5 to define a sealed containment chamber (4) for containing at least a dose of a product;
said first sheet (2) comprising at least a bearing layer (6) and at least a barrier layer (7), each of them having its own thickness, wherein said barrier layer (7) is arranged towards the outside of said chamber (4) with respect to said bearing
10 layer (6),
characterized by the fact that it comprises at least a first cut (5a) defined at least on the inner face of said first sheet (2) to guide the breakage of the first sheet itself so as to determine the formation of an opening to allow the product to come out, said first cut (5a) comprising an individual rectilinear section
15 defining the bending axis of the pack, and by the fact that said barrier layer (7) is of the isotropic and not perforated type and has a lower elongation at break than the maximum elongation applicable to it by the only thickness of said bearing layer (6) following the bending of the pack itself.
- 2) Pack (1) according to claim 1, characterized by the fact that the elongation at
20 break of said barrier layer (7) is less than double the thickness of said bearing layer (6).
- 3) Pack (1) according to claim 1 or 2, characterized by the fact that said bearing layer (6) is of the fragile type.
- 4) Pack (1) according to one or more of the preceding claims, characterized by
25 the fact that said bearing layer (6) has a thickness between 150 μ m and 500 μ m.
- 5) Pack (1) according to one or more of the preceding claims, characterized by the fact that said barrier layer (7) has a thickness between 5 μ m and 15 μ m.
- 6) Pack (1) according to one or more of the preceding claims, characterized by the fact that the tensile strength (σ_R) of said barrier layer (7) is below the
30 maximum tension applicable to it by the thickness of said bearing layer (6).
- 7) Pack (1) according to one or more of the preceding claims, characterized by the fact that said first sheet (2) comprises at least a sealing layer (8) associated

with said bearing layer (6) and turned towards the inside of said chamber (4) with respect to the bearing layer itself.

8) Pack (1) according to claim 7, characterized by the fact that said sealing layer (8) is made of a material having greater elongation at break than said bearing layer (6).

9) Pack (1) according to claim 7 or 8, characterized by the fact that said sealing layer (8) has a thickness between 10 μ m and 70 μ m.

10) Pack (1) according to one or more of the preceding claims, characterized by the fact that said first cut (5a) involves said bearing layer (6) and does not intercepts said barrier layer (7).

11) Pack (1) according to claim 10, characterized by the fact that said first cut (5a) also involves said sealing layer (8).

12) Pack (1) according to one or more of the preceding claims, characterized by the fact that said first sheet (2) comprises at least a protective layer (9) associated with said barrier layer (7) and turned outwards.

13) Pack (1) according to claim 12, characterized by the fact that said protective layer (9) has a lower elongation at break than the maximum elongation applicable to it at least by the thickness of said bearing layer (6) and of said barrier layer (7).

14) Pack (1) according to one or more of the preceding claims, characterized by the fact that said first sheet (2) comprises said protective layer (9) and said sealing layer (8) which define the outer face and the inner face respectively, of the first sheet itself.

15) Pack (1) according to one or more of the claims from 12 to 14, characterized by the fact that it comprises at least a second cut (10a) defined on said protective layer (9).

16) Pack (1) according to one or more of the preceding claims, characterized by the fact that at least one between said first and said second cuts (5a, 10a) extends transversally to the longitudinal axis of said first sheet (2).

17) Pack (1) according to claim 16, characterized by the fact that it comprises at least a pair of further cuts (5b, 10b) defined in correspondence to the extremities of at least one between said first and said second cuts (5a, 10a), said further cuts

being arranged transversal to the extension of the first and/or second cut itself.

- 18) Pack (1) according to one or more of the preceding claims, characterized by the fact that said second cut (10a) is substantially superimposed on said first cut (5a).
- 5 19) Pack (1) according to one or more of the preceding claims, characterized by the fact that said first sheet (2) comprises at least a pair of punches (11) defined on said protective layer (9) on opposite sides of its longitudinal median plane.

1/2

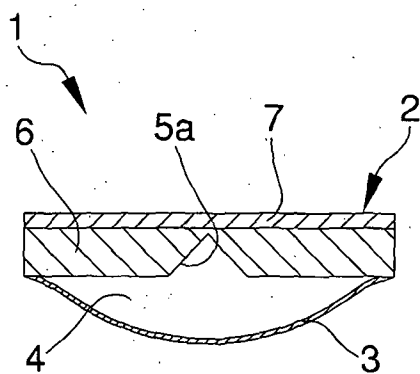


Fig. 1

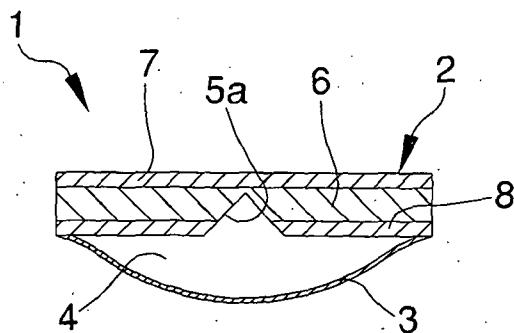


Fig. 2

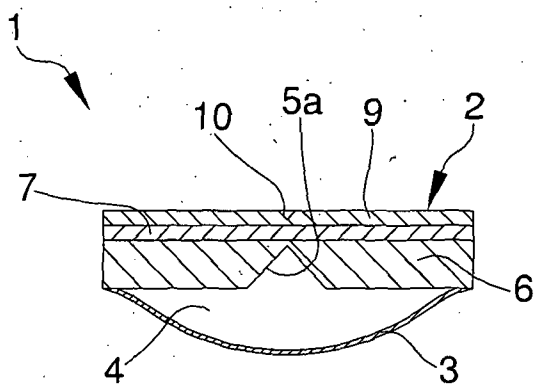


Fig. 3

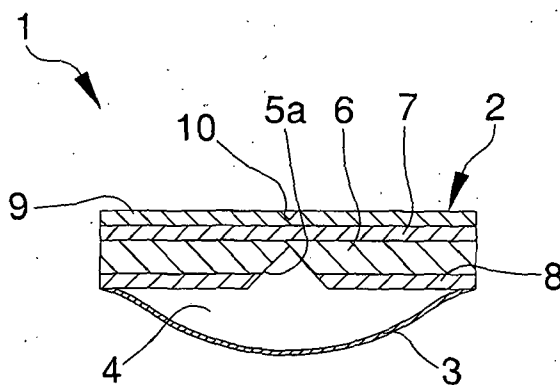


Fig. 4

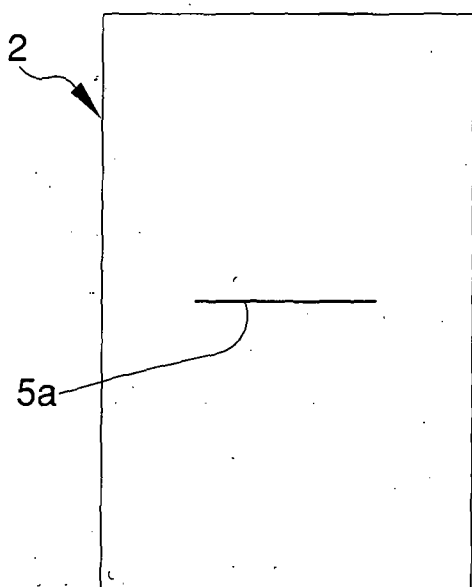


Fig. 5

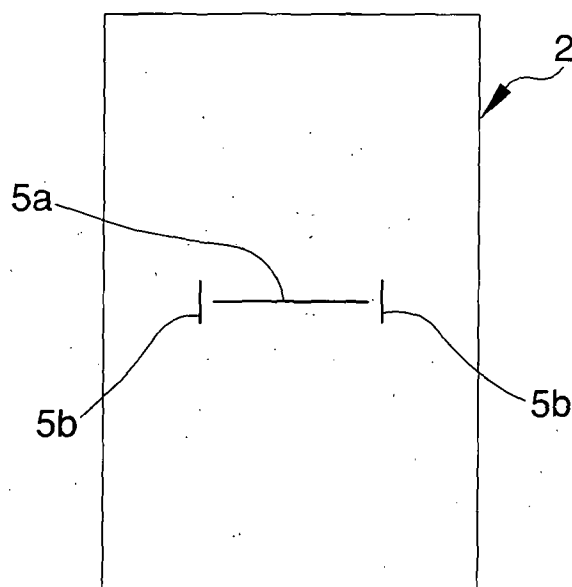


Fig. 6

2/2

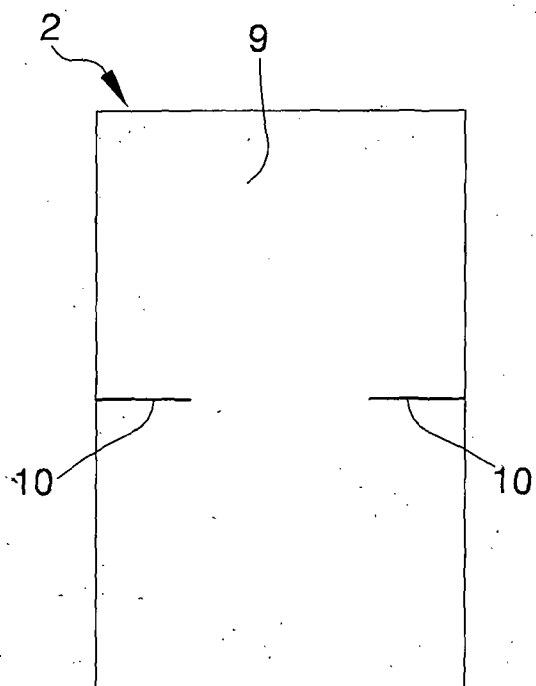


Fig. 7

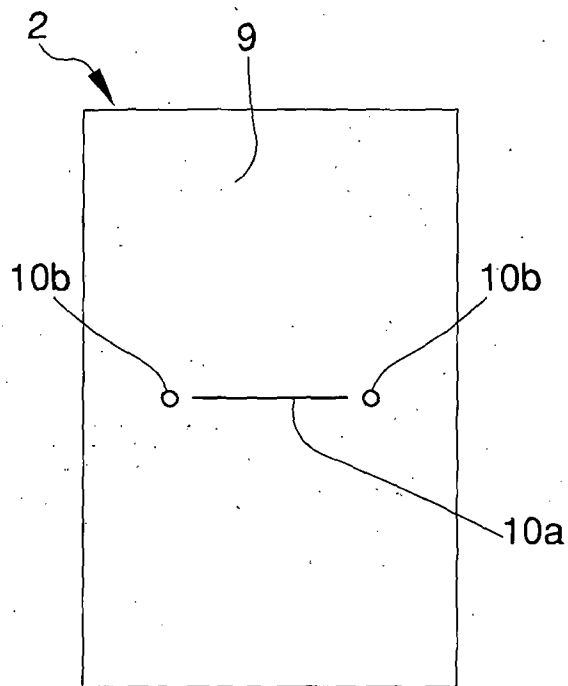


Fig. 8

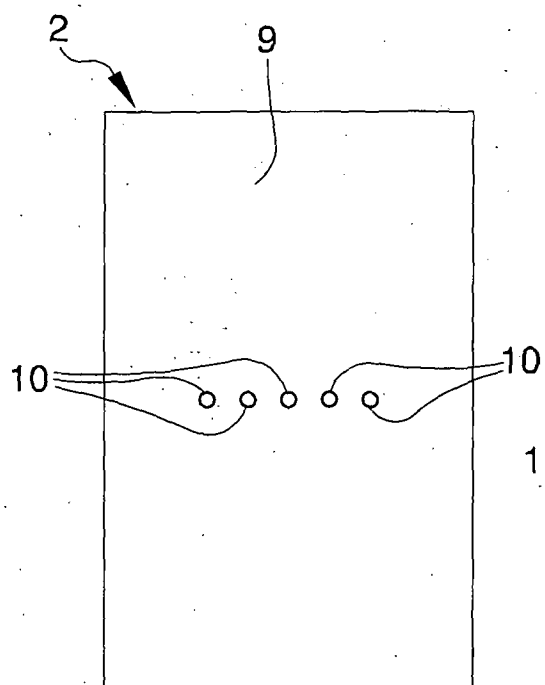


Fig. 9

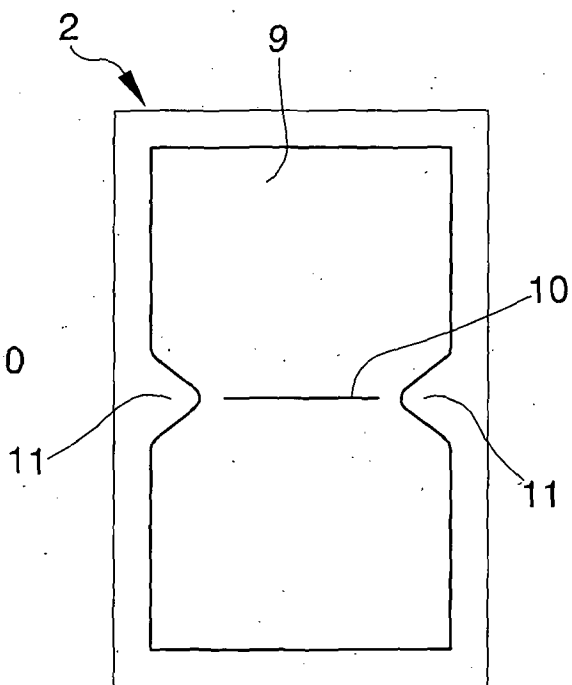


Fig. 10