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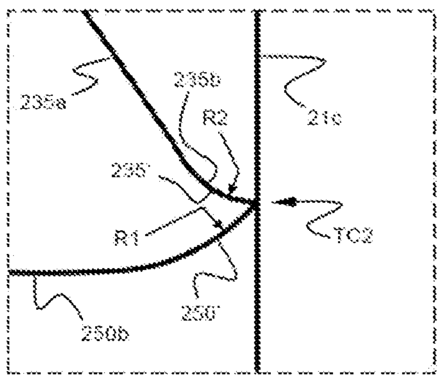
(54) Title **CARTON BLANK AND GABLE TOP CARTON PRODUCED FROM THE SAME**

(57) Abstract

The present invention relates to a carton blank comprising a plurality of panels configured to form a gable top carton by folding, each of the plurality of panels comprising a wall section sub-panel and a top-closure sub-panel. The carton blank comprises a longitudinal crease line section defining a border between two neighbouring top-closure sub-panels, on which longitudinal crease line section is located a top corner position configured to form a top corner of the carton when the carton blank is folded. The carton blank also comprises a transverse crease line forming a border between one of said neighbouring top-closure subpanels and a neighbouring wall section sub-panel of the carton blank, wherein said border terminates at the top corner position. The carton blank further comprises a diagonal crease line arranged in said one of said neighbouring top-closure sub-panels, which diagonal crease line defines a folding line terminating at the top corner position. When terminating at the top corner position, the folding line forms an angle of at least 70° with the longitudinal crease line section.



CARTON BLANK AND GABLE TOP CARTON PRODUCED FROM THE SAME

The present invention relates to a carton blank for producing a paper or paperboard-based packaging of a type commonly referred to as a gable top carton. The present invention also relates to a gable top carton produced from such a blank.

Gable top cartons are commonly used to distribute pourable products, such as pourable bulk products and liquid consumable products, e.g. dairy products, such as milk, or fruit juices. Gable top cartons are produced from a laminate packaging material, which typically comprises a multi-ply paper or paperboard sheet on which is laminated one or a plurality of barrier layers for holding the liquid and/or prevent migration of air and flavour degrading substances through the paperboard. A barrier layer may typically comprise a polyethylene or an aluminium layer.

In production of the carton, the laminate packaging material is cut to form a substantially rectangular blank, which is folded, filled and sealed to form the carton.

To facilitate folding of the carton blank, the blank comprises crease lines. As is known in the art, a crease line is an embossed or impressed depression on one side of the paperboard with a corresponding raised ridge or welt on the other side forming a line along which the paperboard is structurally weakened and along which the paperboard will bend or fold in a controlled manner when pressure is applied.

When laying out the crease lines on the carton board, attention must be given to the corner positions, i.e. the positions on the blank that form the corners of the carton when the blank is folded. In particular, in order to obtain well-defied corners, special attention must be given to how the crease lines approach and connect to the corner positions. This is especially the case for cartons having a geometry that is more complex than the strict rectangular, block-shape geometry.

The present invention relates to this problem and provides a carton blank having crease lines that has been found to provide well-defined top corners, especially the top corners of the front side of the carton.

In the following description, “longitudinal” will be used to designate a direction that is substantially parallel to side edges of the carton blank, and “transverse” will be used to designate a direction that is substantially parallel to top and bottom edges of the carton blank. “Diagonal” will be used to designate a direction that forms an angel of substantially 45° to the bottom, side and top edges.

According to a first example aspect, the present invention relates to a carton blank comprising a plurality of panels configured to form a gable top carton by folding, wherein each of the plurality of panels comprises a wall section sub-panel and a top-closure sub-panel, wherein the carton blank comprises a longitudinal crease line section defining a border between two neighbouring top-closure sub-panels, on which longitudinal crease line section is located a top corner position configured to form a top corner of the carton when the carton blank is folded, wherein the carton blank also comprises a transverse crease line forming a border between one of said neighbouring top-closure sub-panels and a neighbouring wall section sub-panel of the carton blank, wherein said border terminates at the top corner position, and wherein the carton blank further comprises a diagonal crease line arranged in said one of said neighbouring top-closure sub-panels, which diagonal crease line defines a folding line terminating at the top corner position.

In such carton blanks, it may be difficult to convert the top corner position to a well-defined top corner in the folded carton. This may especially be the case when the border defined by the transverse crease line, when terminating at the top corner position, forms an obtuse angle with the longitudinal crease line section.

However, it has been found that a well-defined top corner position can be obtained by arranging the folding line defined by the diagonal crease line such that the folding line, when terminating at the top corner position, forms an angle of at 70°, more preferably at least 80°, and even more preferably at least 90°, e.g. 90°, with the longitudinal crease line section.

Therefore, according to a first example aspect, the present invention provides a carton blank comprising a plurality of panels configured to form a gable top carton by folding, each of the plurality of panels comprising a wall section sub-panel and a top-closure sub-panel.

The carton blank comprises a longitudinal crease line section defining a border between two neighbouring top-closure sub-panels, on which longitudinal crease line section is located a top corner position configured to form a top corner of the carton when the carton blank is folded.

The carton blank also comprises a transverse crease line forming a border between one of said neighbouring top-closure sub-panels and a neighbouring wall section sub-panel of the carton blank, wherein said border terminates at the top corner position.

The carton blank further comprises a diagonal crease line arranged in said one of said neighbouring top-closure sub-panels, which diagonal crease line defines a folding line terminating at the top corner position.

When terminating at the top corner position, the folding line forms an angle of at least 70° with the longitudinal crease line section.

In alternative embodiments, the angle formed between the longitudinal crease line section and the folding line defined by diagonal crease line at the top corner position may be any one of: at least 80°, at least 90°, e.g. 90°.

According to a second example aspect, the present invention provides a carton blank configured to form a gable top carton by folding, the carton blank comprising a first, a second, a third, a fourth and a fifth panel, each comprising:

- a first sub-panel configured to form part of a bottom closure of the carton;
- a second sub-panel neighbouring the first sub-panel and configured to form a wall section of the carton; and
- a third sub-panel neighbouring the second sub-panel and configured to form part of a top closure of the carton,

wherein the carton blank comprises:

- a first longitudinal crease line section defining a border between the third sub-panel of the first panel and the third sub-panel of the second panel;
- a second longitudinal crease line section defining a border between the third sub-panel of the second panel and the third sub-panel of the third panel;
- a third longitudinal crease line section defining a border between the third sub-panel of the third panel and the third sub-panel of the fourth panel; and
- a fourth longitudinal crease line section defining a border between the third sub-panel of the fourth panel and the third sub-panel of the fifth panel,

wherein the second panel comprises:

- a transverse crease line defining a border between the second sub-panel and the third sub-panel of the second panel, the border extending across the second panel between a first top corner position located on the first longitudinal crease line section and a second top corner position located on the second longitudinal crease line section, which first top corner position is configured to form a first top corner of the carton, and which second top corner position is configured to form a second top corner of the carton; and
- a first diagonal crease line of the second panel defining a folding line in the third sub-panel of the second panel terminating at the second top corner position;

and wherein the fourth panel comprises:

- a transverse crease line defining a border between the second sub-panel and the third sub-panel of the fourth panel, the border extending across the fourth panel between a third top corner position located on the third longitudinal crease line section and a fourth top corner position located on the fourth longitudinal crease line section, which third top corner position is configured to form a third top corner of the carton, and which fourth top corner position is configured to form a fourth top corner of the carton; and
- a first diagonal crease line of the fourth panel defining a folding line in the third sub-panel of the fourth panel terminating at the third top corner position;

wherein the folding line defined by the first diagonal crease line of the second panel, when terminating at the second top corner position, forms an angle of at least 70° with the second longitudinal crease line section, and wherein the folding line defined by the first diagonal crease line of the fourth panel, when terminating at the third top corner position, forms an angle of at least 70° with the third longitudinal crease line section.

Each of the angle formed between the first diagonal crease line of the second panel and the second longitudinal crease line section and the angle formed between the first diagonal crease line of the fourth panel and the third longitudinal crease line section, may be any one of: at least 80°, at least 90° and 90°.

The angle formed between the first diagonal crease line of the second panel and the second longitudinal crease line section may be equal to the angle formed between the first diagonal crease line of the fourth panel and the third longitudinal crease line section.

The first diagonal crease line of the second panel may comprise a diagonal crease line section having a convex side facing the transverse crease line of the second panel, and the first diagonal crease line of the fourth panel may comprise a diagonal crease line section having a convex side facing the transverse crease line of the fourth panel.

The second panel may comprise a transverse gable crease line defining a border between a top gusset sub-sub-panel and a gable seal sub-sub-panel of the third sub-panel of the second panel and the folding line defined by the first diagonal crease line of the second panel may extend between the transverse gable crease line of the second panel and the second top corner position. Also, the fourth panel may comprise a transverse gable crease line defining a border between a top gusset sub-sub-panel and a gable seal sub-sub-panel of the third sub-panel of the fourth panel, and the folding line defined by the first diagonal crease line of the fourth panel may extend between the transverse gable crease line of the fourth panel and the third top corner position.

The border defined by the transverse crease line of the second panel, when terminating at the second top corner position, may form an obtuse angle with the second longitudinal crease line section, and the border defined by the transverse crease line of the fourth panel, when terminating at the third top corner position, may form an obtuse angle with the third longitudinal crease line section.

The transvers crease line of the second panel may terminate at the second top corner position in an arc having a first radius of curvature, the transvers crease line of the fourth panel may terminate at the third top corner position in an arc having said first radius of curvature, the first diagonal crease line of the second panel may terminate at the second top corner position in an arc having a second radius of curvature, the first diagonal crease line of the fourth panel may terminate at the third top corner position in an arc having said second radius of curvature, and said second radius of curvature may be less than said first radius of curvature.

The second radius of curvature may be any one of: 20%-80% of the first radius of curvature; 40%-60% of the first radius of curvature; and 45%-55% of the first radius of curvature.

Said arc of the first diagonal crease line of the second panel may have a centre of curvature located on said second longitudinal crease line section, and said arc of the first diagonal crease line of the fourth panel may have a centre of curvature located on said third longitudinal crease line section.

Said arc of the transverse crease line of the second panel may have a centre of curvature located in the second panel at a lateral distance from said second longitudinal crease line section, and said arc of the transverse crease line of the fourth panel may have a centre of curvature located in the fourth panel at a lateral distance from said third longitudinal crease line section, wherein said lateral distance may be within the range of 40% to 90% of the first radius of curvature.

The second panel may comprise a second diagonal crease line defining a folding line in the third sub-panel terminating at the first top corner position and forming an angle of at least 70° with the first longitudinal crease line section, and the fourth panel may comprise a second diagonal crease line defining a folding line in the third sub-panel terminating at the fourth top corner position and forming an angle of at least 70 °with the fourth longitudinal crease line section.

The second diagonal crease line of the second panel may comprise a diagonal crease line section having a convex side facing the transverse crease line of the second panel, and the second diagonal crease line of the fourth panel may comprise a diagonal crease line section having a convex side facing the transverse crease line of the fourth panel.

The angle formed between the second diagonal crease line of the second panel and the first longitudinal crease line section may be equal to the angle formed between the second diagonal crease line of the fourth panel and the fourth longitudinal crease line section.

According to a third example aspect, the present invention provides a gable top carton comprising a carton blank as disclosed above.

Above-discussed preferred and/or optional features of each aspect may be used, alone or in appropriate combination, in the other aspects of the invention.

Following drawings are appended to facilitate the understanding of the invention:

Fig. 1 is a plane view of an embodiment of a carton blank according to the first aspect of the invention.

Figs. 2a, 2b, 2a’ and 2b’ are detail views of the carton blank according to Fig. 1.

Figs. 4 and 5 are detail views of a carton blank according to one embodiment of the invention.

Fig. 6 is a perspective view of a carton in accordance with a first embodiment of the present invention.

Figs. 7 and 8 are side views of the carton according to Fig. 6.

Figs. 9-11 are plane views of further embodiments of carton blanks according to the invention.

Figs. 12a and 12b are detailed plane views of a further embodiment of carton blank according to the invention.

Figs. 13a and 13b are detailed plane views of yet a further embodiment of carton blank according to the invention.

In the following, embodiments of the invention will be described in more detail with reference to the drawings. However, it is specifically intended that the invention is not limited to the embodiments and illustrations contained herein but includes modified forms of the embodiments including portions of the embodiments and combinations of elements of different embodiments as come within the scope of the following claims.

It is appreciated that certain features of the invention, which, for clarity, have been described above in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which, for brevity, have been described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination. In particular, it will be appreciated that features described in relation to one particular embodiment may be interchangeable with features described in relation to other embodiments.

In the drawings, like reference numerals have been used to indicate common parts, elements or features unless otherwise explicitly stated or implicitly understood from the context.

An embodiment of a carton blank 10 according to the invention is shown in Fig. 1. The blank 10 is shown with the surface configured to form the outside surface of the carton facing the viewer.

The blank 10 is made from a suitable package material, such as a multi-ply paper or paperboard sheet on which is laminated one or a plurality of barrier layers for holding content, e.g. a liquid, and/or prevent migration of air and flavour degrading substances through the sheet. At least portions of the blank may be coated with a layer of thermoplastic material allowing a carton formed from the blank to be sealed by plastic welding.

The blank 10 is substantially rectangular and comprises a first, bottom edge 11, a second, top edge 12 and parallel, third and fourth, side edges 13, 14. The side edges 13 and 14 are rectilinear, whereas the top and bottom edges 11 and 12 have an irregular shape. The blank 10 also comprises a plurality of crease lines defining folding lines along which the blank 10 is configured to be folded when formed into the carton.

In this description, “longitudinal” will be used to designate a direction that is substantially parallel to the side edges 13 and 14, i.e. substantially vertical in Fig. 1, and “transverse” will be used to designate a direction that is substantially parallel to the top and bottom edges 11 and 12, i.e. substantially horizontal in Fig. 1. “Diagonal” will be used to designate a direction that is at an angel of substantially 45° to the bottom, side and top edges 11-14.

The blank 10 comprises five panels, P1-P5, separated by longitudinal crease lines 20, 21, 22 and 23 defining folding lines extending across the panel 10 from the bottom edge 11 to the top edge 12. Consequently, the longitudinal crease lines 20, 21, 22 and 23 divide the bottom and top edges 11, 12 into sub-sections 11a, 11b, 11c, 11d, 11e and 12a, 12b, 12c, 12d, 12e, respectively.

Each panel P1-P5 comprises a first sub-panel 110, 210, 310, 410, 510 forming a bottom-closure sub-panel, a second sub-panel 120, 220, 320, 420, 520 forming a wall section sub-panel, and a third sub-panel 130, 230, 330, 430, 530 forming a top-closure sub-panel. The bottom closure sub-panels 110, 210, 310, 410 and 510 are configured to form a bottom closure of the carton and the top-closure sub-panels 130, 230, 330, 430, 530 a top closure of the carton. The wall section sub-panel 120 of the first panel P1 is configured to form a back wall of the carton and the wall section sub-panel 320 of the third panel P3 a front wall. The wall sections 220 and 420 of the second and fourth panels P2, P4 are configured to form side walls of the carton. The fifth panel P5 is configured to be attached to an inside surface of the first panel P1 adjacent the side edge 13 when the carton is formed.

The blank 100 displays positions TC1, TC2, TC3, TC4, BC1, BC2, BC3 and BC4 defining top and bottom corners of the carton when formed (see Figs. 6-8).

Each longitudinal crease line 20, 21, 22 and 23 comprises a first longitudinal crease line section 20a, 21a, 22a, 23a extending between the bottom edge 11 and the bottom corner position BC1, BC2, BC3, and BC4, respectively. Each longitudinal crease line 20, 21, 22 and 23 also comprises a second longitudinal crease line section 20b, 21b, 22b, 23b extending between the bottom corner position BC1, BC2, BC3, BC4 and the top corner position TC1, TC2, TC3, and TC4, respectively, and a third longitudinal crease line section 20c, 21c, 22c, 23c extending between the top corner position TC1, TC2, TC3, TC4 and the top edge 12. In the present embodiment, the longitudinal crease lines 20, 21, 22 and 23 are continuous, i.e. uninterrupted, and extend vertically across the blank 10 between the bottom edge 11 and the top edge 12. In alternative embodiments, however, the longitudinal crease lines 20, 21, 22, 23 need not be continuous or rectilinear, and/or the longitudinal crease line sections 20b, 21b, 22b, 23b may be arranged to accommodate corner panel sections between the wall section sub-panel 120, 220, 320, 420 and 520.

The first panel P1 comprises a bottom crease line 140 extending from the position BC1 to a position on the side edge 13 level to BC1. In other words, the bottom crease line 140 extends transversely across the panel P1 in a direction which is orthogonal to the side edge 13 and to the longitudinal crease line 20. The bottom crease line 140 forms a border between the bottom-closure sub-panel 110 and the wall section sub-panel 120 of the panel. Further, the first panel P1 comprises a top crease line 150 extending from the position TC1 to a position on the side edge 13 that is level or substantially level to TC1. Consequently, in the present embodiment the top crease line 150 extends transversely across the panel P1 in a direction which is substantially orthogonal to the side edge 13 and to the longitudinal crease line 20, i.e. parallel to the bottom crease line 140. However, in alternative embodiments the top crease line 150 need not be parallel to the bottom crease line 140. The top crease line 150 forms a border between the wall section sub-panel 120 and the top-closure sub-panel 130.

The bottom-closure sub-panel 110 comprises a flap 111 which assists in securing a safe closure of the bottom of the carton. Within the art of carton production, the function of such flaps is known as such and the flap 111 will not be discussed further here.

The top-closure sub-panel 130 comprises a top-fin crease line 131 extending transversely across the panel P1 parallel to the top crease line 150, i.e. in a direction which is orthogonal to the side edge 13 and to the longitudinal crease line 20. The top-fin crease line 131 defines a folding line forming a border between a roof sub-sub-panel 132 and a top-fin sub-sub-panel 133 of the top-closure sub-panel 130. In the present embodiment, the top edge sub-section 12a is slightly convex, thus providing a curved, convex top fin in the carton folded from the blank 10. However, the top edge sub-section 12a may be rectilinear, concave or any other shape.

The panel P1 comprises disposal crease lines 160a, 160b extending transversally across the lower part of the wall section sub-panel 120. As is known in the art, disposal crease lines are not activated when the carton is folded from the blank 10 during filling but are activated by a user during disposal of the carton when empty. In particular, as is known in the art, disposal crease lines are configured to facilitate folding the empty carton to a flat shape, thus ensuring space efficient disposal.

The second panel P2 comprises a bottom crease line 240 extending transversely across the panel P2 between positions BC1 and BC2. BC1 and BC2 are level, i.e. arranged along a line which is orthogonal to the longitudinal crease lines 20 and 21. Consequently, the bottom crease line 240 extends transversely across the panel P2 in a direction which is orthogonal to the longitudinal crease lines 20 and 21. The bottom crease line 240 forms a border between the bottom-closure sub-panel 210 and the wall section sub-panel 220.

The second panel P2 further comprises a transverse top crease line 250 extending across the panel P2 between positions TC1 and TC2 and defining a folding line forming a border between the wall section sub-panel 220 and the top closure sub-panel 230. The top crease line 250 is not rectilinear as the corresponding crease line 150 of panel P1 but curved. Starting from the position TC1, the top crease line 250 initially extends generally orthogonally from the longitudinal crease line 20 and then curves towards the bottom edge 11 of the carton blank. Approximately midway between the longitudinal crease lines 20 and 21, the top crease line 250 transitions from bending downwards to bending upwards, terminating at the position TC2 in an arc 250’ having a radius of curvature R1 and a convex side facing the second sub-panel 220, which arc 250’ forms an obtuse angle α with the longitudinal crease line section 21c, i.e. an angle within the interval of 90° to 180° (see Figs. 2a and 2a’). Consequently, the transverse top crease line 250 comprises a first section 250a having a convex side facing the top edge 12, i.e. upwards, and a second section 250b having a convex side facing the bottom edge 11, i.e. downwards, which first section 250a connects to the longitudinal crease line 20 at a right angle, and which second section 250b connects to the longitudinal crease line 21 upwardly inclining.

The bottom-closure sub-panel 210 comprises a first diagonal crease line 211 extending between position BC1 and a position adjacent the bottom edge sub-section 11b midway between the longitudinal crease lines 20 and 21. The bottom-closure sub-panel 210 also comprises a second diagonal crease line 212 extending between position BC2 and said position adjacent the bottom edge sub-section 11b midway between longitudinal crease lines 20 and 21, thus intercepting the first diagonal crease line 211 in this position. The diagonal crease lines 211 and 212 form folding lines that assist folding of the bottom-closure sub-panel 210 when the bottom closure of the carton is formed.

The top-closure sub-panel 230 comprises a transverse gable crease line 231 extending transversely across the panel P2 defining a folding line forming a border between a top gusset sub-sub-panel 232 and a gable seal sub-sub-panel 233 of the top-closure sub-panel 230.

The top gusset sub-sub-panel 232 comprises a first diagonal crease line 234 extending between position TC1 and a position on the transverse gable crease line 231 midway between the longitudinal crease lines 20 and 21. The top gusset sub-sub-panel 232 also comprises a second diagonal crease line 235 extending between position TC2 and said position on the transverse gable crease line 231 midway between the longitudinal crease lines 20 and 21, thus intercepting the first diagonal crease line 234 in this position.

The first diagonal crease line 234 is rectilinear. However, the second diagonal crease line 235 is curved and comprises a first section 235a having a convex side facing the longitudinal crease line section 21c and a second section 235b having a concave side facing the longitudinal crease line section 21c. The second diagonal crease line 235 transitions from said first section 235a to said second section 235b adjacent the position TC2, terminating in the position TC2 in an arc 235' having a convex side facing the transverse crease line 250 and a radius of curvature R2 (see Figs. 2a and 2a').

The gable seal sub-sub-panel 233 comprises a longitudinal gable crease line 236 extending between the transverse gable crease line 231 and the top edge sub-section 12b parallel to and equidistant the longitudinal crease lines 20 and 21. In other words, the longitudinal gable crease line 236 extends vertically from the position on the transverse gable crease line 231 where the diagonal crease lines 234 and 235 intercept each other.

As the first panel P1, the second panel P2 comprises disposal crease lines 260a-260e which are configured to be activated by a user during disposal of the carton when empty.

The third panel P3 comprises a bottom crease line 340 extending transversely across the panel P3 between positions BC2 and BC3. BC2 and BC3 are level, i.e. arranged along a line which is orthogonal to the longitudinal crease lines 21 and 22. Consequently, the bottom crease line 340 extends transversely across the panel P3 in a direction which is orthogonal to the longitudinal crease lines 21 and 22. The bottom crease line 340 defines a folding line forming form a border between the bottom-closure sub-panel 310 and the wall section sub-panel 320 of the panel P3. The third panel P3 is free from a crease line defining a folding line forming a border between the wall section sub-panel 320 and the top-closure sub-panel 330. Therefore, in the carton resulting from folding the blank 10 there is no distinct border between the wall section sub-panel 320 and the top-closure sub-panel 330. Instead, the wall section sub-panel 320 and the top-closure sub-panel 330 will continuously transition into each other and merge in a border region.

The top-closure sub-panel 330 comprises a top-fin crease line 331 extending transversely across the panel P3 in a direction which is orthogonal to the longitudinal crease lines 21 and 22, i.e. parallel to the bottom crease line 340. The top-fin crease line 331 defines a folding line forming a border between a roof sub-sub-panel 332 and a top-fin sub-sub-panel 333 of the top-closure panel 330. The roof sub-sub-panel 332 is provided with a circular through-going opening 334 for receiving a pour spout fitment. As in panel P1, the top edge sub-section 12c is slightly convex, thus providing a curved, convex top fin in the carton folded from the blank 10.

The fourth panel P4 is essentially a mirror image of the second panel P2. Consequently, the fourth panel P4 comprises a bottom crease line 440 extending transversely across the panel P4 between positions BC3 and BC4. BC3 and BC4 are level, i.e. arranged along a line which is orthogonal to the longitudinal crease lines 22 and 23. Consequently, the bottom crease line 440 extends transversely across the panel P4 in a direction which is orthogonal to the longitudinal crease lines 22 and 23. The bottom crease line 440 forms a border between the bottom-closure sub-panel 410 and the wall section sub-panel 420.

The fourth panel P4 further comprises a transverse top crease line 450 extending across the panel P4 between positions TC3 and TC4 and defining a folding line forming a border between the wall section sub-panel 420 and the top closure sub-panel 430. The top crease line 450 is curved in the same manner as the top crease line 250 of panel P2. Consequently, starting from the position TC4, the top crease line 450 initially extends generally orthogonally from the longitudinal crease line 23 and then curves towards the bottom edge 11 of the carton blank. Approximately midway between the longitudinal crease lines 22 and 23, the top crease line 450 transitions from bending downwards to bending upwards, terminating at the position TC3 in an arc 450’ having a radius of curvature R1 and a convex side facing the second sub-panel 420, which arc 450’ forms an obtuse angle α with the longitudinal crease line section 22c (see Figs. 2b and 2b’). Consequently, the transverse top crease line 450 comprises a first section 450a having a convex side facing the top edge 12, i.e. upwards, and a second section 450b having a convex side facing the bottom edge 11, i.e. downwards, which first section 450a connects to the longitudinal crease line 23 at a right angle, and which second section 450b connects to the longitudinal crease line 22 upwardly inclining.

The bottom-closure sub-panel 410 comprises a first diagonal crease line 411 extending between position BC3 and a position adjacent the bottom edge sub-section 11d midway between the longitudinal crease lines 22 and 23. The bottom-closure sub-panel 410 also comprises a second diagonal crease line 412 extending between position BC4 and said position adjacent the bottom edge sub-section 11d midway between longitudinal crease lines 22 and 23, thus intercepting the first diagonal crease line 411 in this position. The diagonal crease lines 411 and 412 form folding lines that assist folding of the bottom-closure sub-panel 410 when the bottom closure of the carton is formed.

The top-closure sub-panel 430 comprises a transverse gable crease line 431 extending transversely across the panel P4 defining a folding line forming a border between a top gusset sub-sub-panel 432 and a gable seal sub-sub-panel 433 of the top-closure sub-panel 430.

The top gusset sub-sub-panel 432 comprises a first diagonal crease line 434 extending between position TC4 and a position on the transverse gable crease line 431 midway between the longitudinal crease lines 22 and 23. The top gusset sub-sub-panel 432 also comprises a second diagonal crease line 435 extending between position TC3 and said position on the transverse gable crease line 431 midway between the longitudinal crease lines 22 and 23, thus intercepting the first diagonal crease line 434 in this position.

The first diagonal crease line 434 is rectilinear. However, the second diagonal crease line 435 is curved and comprises a first section 435a having a convex side facing the longitudinal crease line section 22c and a second section 435b having a concave side facing the longitudinal crease line section 22c. The second diagonal crease line 435 transitions from said a first section 435a to said second section 435b adjacent the position TC3, terminating at the position TC3 in an arc 435' having a convex side facing the transverse crease line 450 and a radius of curvature R2 (see Figs. 2b and 2b').

The gable seal sub-sub-panel 433 comprises a longitudinal gable crease line 436 extending between the transverse gable crease line 431 and the top edge sub-section 12d parallel to and equidistant the longitudinal crease lines 22 and 23. In other words, the longitudinal gable crease line 436 extends vertically from the position on the transverse gable crease line 431 where the diagonal crease lines 434 and 435 intercept each other.

As the second panel P2, the fourth panel P4 comprises disposal crease lines 460a-460e which are configured to be activated by a user during disposal of the carton when empty.

In the fifth panel P5, two co-linear bottom crease lines 540a, 540b define a folding line extending across the panel P5, which folding line is co-linear to the bottom crease lines 140, 240, 340 and 440 in panels P1-P4 and forms a border between the bottom-closure sub-panel 510 and the wall section sub-panel 520 of panel P5. Also, two co-linear top crease lines 550a, 550b define a folding line which is generally co-linear to the top crease line 150 of the first panel P1, which folding line forms a border between the body sub-panel 520 and the top-closure sub-panel 530. Furthermore, two co-linear top-fin crease lines 531a, 531b define a folding line which is generally co-linear to the top-fin crease lines 131 and 331 of panels P1 and P3, which folding line forms a border between a roof sub-sub-panel 532 and a top-fin sub-sub-panel 533 of the top-closure sub-panel 530.

In the present embodiment, the border defined by the transverse crease line 250 of the second panel P2, when terminating at the second top corner position TC2, forms an obtuse angle α of approximately 140° with the second longitudinal crease line section 21c. Also, the border defined by the transverse crease line 450 of the fourth panel P4, when terminating at the third top corner position TC3, forms an obtuse angle α of approximately 140° with the third longitudinal crease line section 22c. The folding line defined by the first diagonal crease line 235 of the second panel P2, when terminating at the second top corner position TC2, forms an angle β of approximately 90° with the second longitudinal crease line section 21c. Likewise, the folding line defined by the first diagonal crease line 435 of the fourth panel P4, when terminating at the third top corner position TC3, forms an angle β of approximately 90° with the third longitudinal crease line section 22c. In alternative embodiments, the angle β formed between the first diagonal crease line 235 of the second panel P2 and the second longitudinal crease line section 21c and the angle β formed between the first diagonal crease line 435 of the fourth panel P4 and the third longitudinal crease line section 22c, may be any one of at least 80° and at least 90°, e.g. 90° as in the embodiment shown in Fig. 1.

It has been found that using this diagonal crease line configuration, predictable and precise folding of the carton blank in the area surrounding the top corners positions TC2 and TC3 can be achieved.

As discussed above, the arc 250’ of the transverse crease line 250 of the second panel P2 and the arc 450’ of the transverse crease line 450 of the fourth panel P4 both have a radius of curvature R1 (see Figs 2a, 2b, 2a’ and 2b’). Also, the arc 235’ of the diagonal crease line 235 of the second panel P2 and the arc 435’ of the diagonal crease line 435 of the fourth panel P4 both have a radius of curvature R2. The radius of curvature R2 of the arcs 235’ and 435’ is smaller than the radius of curvature R1 of the arcs 250’ and 450’.

The second radius of curvature R2 may be within the range of 20%-80% of the first radius of curvature R1, e.g. within the range of 40%-60% of the first radius of curvature R1, or 45%-55% of the first radius of curvature R1. In one embodiment, show in Figs. 4 and 5, R1 is 14 mm and R2 is 6 mm.

The arc 235’ may have a centre located on the longitudinal crease line section 21c, and the arc 435’ may have a centre located on the longitudinal crease line section 22c, as is shown if Figs. 4 and 5. This will make the diagonal crease lines 235 and 435 connect to the top corner position TC2 and TC3, respectively, at a right angle, which has been found to result in particularly precise folding of the carton blank.

The arc 250’ may have a centre located in the second panel P2 at a lateral distance D from the longitudinal crease line section 21c, and the arc 450’ may have a centre located in the fourth panel P4 at the same lateral distance D from the longitudinal crease line section 22c. The lateral distance D may be within the range of 40%-90% of the first radius of curvature R1. In the embodiment shown in Figs. 4 and 5, the centre of the arc 250' and 450' is located at a lateral distance D of approximately 11 mm from the longitudinal crease line section 21c and 22c respectively.

A method of forming a carton from the carton blank 10 discussed above is as follows. After the blank of Fig. 1 has been produced, the fifth panel P5 is sealed to the inside wall of panel P1 to form a sleeve open at both ends. This sleeve is subsequently bottom-sealed, by folding inwards of the first sub-panels 110, 210, 310, 410 and 510 and sealing of the same, to produce an open-topped, bottom-sealed carton. A pour spout fitment (see Figs. 6 and 7) is lowered into the open top of the carton and is introduced into the opening 334 from inside the carton until a flange thereof abuts the inside surface of the sub-panel 330 round the opening 334, whereupon the flange is sealed to the innermost layer of the sub-panel 330 around the opening. The still open-topped carton is then filled with the liquid to be packaged.

The sub-panels 130, 230, 330, 430 and 530 are then folded-in and sealed to each other to provide a sealed top closure of the carton.

Figs. 6-8 show a carton 600 formed from the blank 10 illustrated in Fig. 1. The carton 600 comprises top and bottom corners TC1', TC2', TC3', TC4', BC1', BC2', BC3' and BC4' defined by corresponding top and bottom corner positions TC1, TC2, TC3, TC4, BC1, BC2, BC3 and BC4 of the blank 10 (see Fig. 1). Between the top corners TC1', TC2', TC3', TC4' and the bottom corners BC1', BC2', BC3', BC4' the carton 600 has a generally rectangular or square cross-section.

The carton 600 comprises a bottom closure 602 formed from the sub-panels 110, 210, 310, 410 and 510. The carton 600 further comprises a back wall section 610 formed from the sub-panel 120 and a front wall section 606 formed from the sub-panel 320. The carton 600 also comprises a first side wall section 604 formed from the sub-panel 220 and a second side wall section 608 formed from the sub-panel 420.

The carton 600 also comprises a top closure 612 formed from the sub-panels 130, 230, 330, 430 and 530. The top closure 612 comprises a back roof section 614 formed from the sub-sub-panel 132 and a front roof section 616 formed from the sub-sub-panel 332. The top closure 612 also comprises a first gable section 618 formed from a section of sub-sub-panel 232 delimited by crease lines 234 and 235, and a second gable section 620 formed from a section of sub-sub-panel 432 delimited by crease lines 434 and 435. The top closure 612 further comprises a top fin 622 where the sub-panels 130, 230, 330, 430 and 530 are sealed to each other and a pour spout 624 arranged in the through-going opening 334 in sub-sub-panel 332.

As there is no crease line between the sub-panels 320 and 330 of the third panel P3 (see Fig. 1), the front wall 606 is continuous with the front roof section 616 via a curved transition area T. In such embodiments, it may be challenging to obtain distinct formation of the second and third top corners TC2' and TC3' as folding of the carton material along unwanted folding lines may occur. However, by designing each diagonal crease line 235 and 435 such that it terminates in the corner position TC2, TC3 in an arc 235', 435' having a convex side facing the transverse crease line 250, 450 and a radius of curvature R2 being larger than the radius of curvature R1 of the transverse crease line 250, 450 (see Figs. 2 and 3), precise folding of the carton material can be achieved. It is to be understood, however, that this design of the diagonal crease line 235 and 435 is equally suitable for cartons having a crease line separating the front wall section 606 and the front roof section 616. Consequently, in alternative embodiments, the front wall section and the front roof section may be separated by a transverse crease line, e.g. as is shown in Fig. 9.

A further embodiment of a carton blank 30 according to the invention is shown in Fig. 9. The carton blank 30 differs from the carton blank 10 of Fig. 1 only in that the third panel P3 of the blank 30 comprises a transverse crease line 350 extending across the panel P3 between positions TC2 and TC3 and defining a folding line forming a border between the wall section sub-panel 320 and the top closure sub-panel 330.

Yet a further embodiment of a carton blank 40 according to the invention is shown in Fig. 10. The carton blank 40 differs from the carton blank 10 of Fig. 1 in that the transverse crease lines 250 and 450 terminate at the corner positions TC1 and TC4, respectively, in the same manner as they terminate at the corner positions TC2 and TC3. Also, the carton blank 40 differs from the carton blank 10 of Fig. 1 in that the diagonal crease lines 234 and 434 terminate in the top corner position TC1 and TC4 in the same manner as the diagonal crease lines 235 and 435 terminate at the top corner positions TC2 and TC3, respectively. Consequently, the transverse crease line 250 terminates at TC1 in an arc 250'' having a radius of curvature R1 and a convex side facing the second sub-panel 220. Also, the diagonal crease line 234 terminates at the top corner position TC1 in an arc 234' having a convex side facing the transverse crease line 250 and a radius of curvature R2 being larger than the radius of curvature R1 of the arc 250'' (see also Fig. 2). Furthermore, the transverse crease line 450 terminates at the top corner positions TC4 in an arc 450'' having a radius of curvature R1 and a convex side facing the second sub-panel 420. Also, the diagonal crease line 434 terminates at the top corner position TC4 in an arc 434' having a convex side facing the transverse crease line 450 and a radius of curvature R2 being larger than the radius of curvature R1 of the arc 450'' (see also Fig. 3).

Yet another embodiment of a carton blank 50 according to the invention is shown in Fig. 11. The carton blank 50 differs from the carton blank 40 of Fig. 10 in that the first panel P1 has no transverse crease line separating the wall section sub-panel 120 and the top-closure sub-panel 130. Consequently, in the carton formed from the blank 50, the back wall will be continuous with the back roof section via a curved transition area in the same manner as is the case for the front wall 606 and the front roof section 616 of the carton 600 shown in Figs. 6-8.

It is understood that the above-discussed curved sections 235a, 435b, 250b and 450b of the diagonal crease lines 235, 435 and the transverse crease lines 250, 450 (see Figs. 2a and 2b) do not have to extend all the way to the respective top corner positions. Figs. 12a and 12b show such an embodiment of a carton blank where the diagonal crease lines 235, 435 and the transverse crease lines 250, 450 each comprises a rectilinear section 235c, 435c, 250c, 450c arranged between the curved section 235b, 435b, 250b, 450b and the respective top corner position TC2, TC3, which rectilinear section 235c, 435c, 250c, 450c connect to the top corner position TC2 and TC3, respectively.

It is also understood that the diagonal crease lines 235, 435 and the transverse crease lines 250, 450 do not have to extend all the way to the respective top corner positions. Figs. 13a and 13b show such an embodiment of a carton blank where the diagonal crease lines 235, 435 and the transverse crease lines 250, 450 terminate prior to reaching the respective top corner position TC2, TC3, but sufficiently close, i.e. within 0-5 mm, to define a folding line extending to the top corner position. For example, terminating the diagonal crease lines 235, 435 and the transverse crease lines 250, 450 e.g. 2 mm from the respective top corner position TC2, TC3 may still provide precise folding of the carton blank, although extending the crease lines 235, 435, 250 and 450 all the way to the top corner positions TC2, TC3 may be preferable.

Although the subject of the present invention, i.e. the design of the diagonal crease lines of the top-closure sub-panels of panels two and four, has been discussed based on specific carton blank and carton embodiments, it is understood that the present invention may be implemented in other types of carton blanks and cartons. For example, the design of the diagonal crease lines according to the invention may be implemented in blanks and cartons having bottom closure configurations other than shown in the illustrative embodiments, or in blanks and cartons having dispensing means other than the illustrated pour spout.

In the preceding specification, various aspects of the invention have been described and discussed with reference to the illustrative embodiments. For purposes of explanation, specific numbers, systems and configurations were set forth in order to provide a thorough understanding of the closure device and its workings. However, this specification is not intended to be construed in a limiting sense. Various modifications and variations of the illustrative embodiment, as well as other embodiments of the closure device, which are apparent to person skilled in the art to which the disclosed subject-matter pertains, may lie within the scope of the present invention as defined by the following claims.

Claims

1. A carton blank (10, 30, 40, 50) configured to form a gable top carton (600) by folding, the carton blank (10, 30, 40, 50) comprising a first (P1), a second (P2), a third (P3), a fourth (P4) and a fifth (P5) panel, each comprising:
   - a first sub-panel (110, 210, 310, 410, 510) configured to form part of a bottom closure (602) of the carton (600);
   - a second sub-panel (120, 220, 320, 420, 520) neighbouring the first sub-panel (110, 210, 310, 410, 510) and configured to form a wall section (604, 606, 608, 610) of the carton (600); and
   - a third sub-panel (130, 230, 330, 430, 530) neighbouring the second sub-panel (120, 220, 320, 420, 520) and configured to form part of a top closure (612) of the carton (600),

   wherein the carton blank (10, 30, 40, 50) comprises:
   - a first longitudinal crease line section (20c) defining a border between the third sub-panel (130) of the first panel (P1) and the third sub-panel (230) of the second panel (P2);
   - a second longitudinal crease line section (21c) defining a border between the third sub-panel (230) of the second panel (P2) and the third sub-panel (330) of the third panel (P3);
   - a third longitudinal crease line section (22c) defining a border between the third sub-panel (330) of the third panel (P3) and the third sub-panel (430) of the fourth panel (P4); and
   - a fourth longitudinal crease line section (23c) defining a border between the third sub-panel (430) of the fourth panel (P4) and the third sub-panel (530) of the fifth panel (P4),

   wherein the second panel (P2) comprises:
   - a transverse crease line (250) defining a border between the second sub-panel (220) and the third sub-panel (230) of the second panel (P2), the border extending across the second panel (P2) between a first top corner position (TC1) located on the first longitudinal crease line section (20c) and a second top corner position (TC2) located on the second longitudinal crease line section (21c), which first top corner position (TC1) is configured to form a first top corner (TC1’) of the carton, and which second top corner position (TC2) is configured to form a second top corner (TC2’) of the carton; and
   - a first diagonal crease line (235) of the second panel (P2) defining a folding line in the third sub-panel (230) of the second panel (P2) terminating at the second top corner position (TC2);

   and wherein the fourth panel (P4) comprises:
   - a transverse crease line (450) defining a border between the second sub-panel (420) and the third sub-panel (430) of the fourth panel (P4), the border extending across

the fourth panel (P4) between a third top corner position (TC3) located on the third longitudinal crease line section (22c) and a fourth top corner position (TC4) located on the fourth longitudinal crease line section (23c), which third top corner position (TC3) is configured to form a third top corner (TC3') of the carton, and which fourth top corner position (TC4) is configured to form a fourth top corner (TC4') of the carton; and

- a first diagonal crease line (435) of the fourth panel (P4) defining a folding line in the third sub-panel (430) of the fourth panel (P4) terminating at the third top corner position (TC3);

characterised by the folding line defined by the first diagonal crease line (235) of the second panel (P2), when terminating at the second top corner position (TC2), forming an angle (β) of at least 70° with the second longitudinal crease line section (21c), and by the folding line defined by the first diagonal crease line (435) of the fourth panel (P4), when terminating at the third top corner position (TC3), forming an angle (β) of at least 70° with the third longitudinal crease line section (22c).

2. The carton blank (10, 30, 40, 50) according to claim 1,

wherein each of the angle (β) formed between the first diagonal crease line (235) of the second panel (P2) and the second longitudinal crease line section (21c) and the angle (β) formed between the first diagonal crease line (435) of the fourth panel (P4) and the third longitudinal crease line section (22c), is any one of: at least 80°, at least 90° and 90°.

3. The carton blank (10, 30, 40, 50) according to any one of claims 1 and 2, wherein the angle (β) formed between the first diagonal crease line (235) of the second panel (P2) and the second longitudinal crease line section (21c) is equal to the angle (β) formed between the first diagonal crease line (435) of the fourth panel (P4) and the third longitudinal crease line section (22c).

4. The carton blank (10, 30, 40, 50) according to claim 1,

wherein the first diagonal crease line (235) of the second panel (P2) comprises a diagonal crease line section (235b) having a convex side facing the transverse crease line (250) of the second panel (P2);

and wherein the first diagonal crease line (435) of the fourth panel (P4) comprises a diagonal crease line section (435b) having a convex side facing the transverse crease line (450) of the fourth panel (P4).

5. The carton blank (10, 30, 40, 50) according to any one of the preceding claims,

wherein the second panel (P2) comprises a transverse gable crease line (231) defining a border between a top gusset sub-sub-panel (232) and a gable seal sub-sub-panel (233) of the third sub-panel (230) of the second panel (P2);

wherein the folding line defined by the first diagonal crease line (235) of the second panel (P2) extends between the transverse gable crease line (231) of the second panel (P2) and the second top corner position (TC2);

wherein the fourth panel (P4) comprises a transverse gable crease line (431) defining a border between a top gusset sub-sub-panel (432) and a gable seal sub-sub-panel (433) of the third sub-panel (430) of the fourth panel (P4); and

wherein the folding line defined by the first diagonal crease line (435) of the fourth panel (P4) extends between the transverse gable crease line (431) of the fourth panel (P4) and the third top corner position (TC3).

6. The carton blank (10, 30, 40, 50) according to any one of the preceding claims,

wherein the border defined by the transverse crease line (250) of the second panel (P2), when terminating at the second top corner position (TC2), forms an obtuse angle (α) with the second longitudinal crease line section (21c);

and wherein the border defined by the transverse crease line (450) of the fourth panel (P4), when terminating at the third top corner position (TC3), forms an obtuse angle (α) with the third longitudinal crease line section (22c).

7. The carton blank (10) according to any one of the preceding claims,

wherein the transvers crease line (250) of the second panel (P2) terminates at the second top corner position (TC2) in an arc (250’) having a first radius of curvature (R1);

wherein the transvers crease line (450) of the fourth panel (P4) terminates at the third top corner position (TC3) in an arc (450’) having said first radius of curvature (R1);

wherein the first diagonal crease line (235) of the second panel (P2) terminates at the second top corner position (TC2) in an arc (235’) having a second radius of curvature (R2);

wherein the first diagonal crease line (435) of the fourth panel (P4) terminates at the third top corner position (TC3) in an arc (435’) having said second radius of curvature (R2); and

wherein said second radius of curvature (R2) is less than said first radius of curvature (R1).

8. The carton blank (10) according to claim 7, wherein the second radius of curvature (R2) is any one of: 20%-80% of the first radius of curvature (R1); 40%-60% of the first radius of curvature (R1); and 45%-55% of the first radius of curvature (R1).

9. The carton blank (10) according to claim 8, wherein said arc (235’) of the first diagonal crease line (235) of the second panel (P2) has a centre of curvature located on said second longitudinal crease line section (21c), and said arc (435’) of the first diagonal

crease line (435) of the fourth panel (P4) has a centre of curvature located on said third longitudinal crease line section (22c).

10. The carton blank (10) according to any one of claims 7-9, wherein said arc (250') of the transverse crease line (250) of the second panel (P2) has a centre of curvature located in the second panel (P2) at a lateral distance (D) from said second longitudinal crease line section (21c), and wherein said arc (450') of the transverse crease line (450) of the fourth panel (P4) has a centre of curvature located in the fourth panel (P4) at a lateral distance (D) from said third longitudinal crease line section (22c), wherein said lateral distance (D) is within the range of 40% to 90% of the first radius of curvature (R1).

11. The carton blank (40, 50) according to any one of the preceding claims,

    wherein the second panel (P2) comprises a second diagonal crease line (234) defining a folding line in the third sub-panel (230) terminating at the first top corner position (TC1) and forming an angle (β) of at least 70° with the first longitudinal crease line section (20c); and

    wherein the fourth panel (P4) comprises a second diagonal crease line (434) defining a folding line in the third sub-panel (430) terminating at the fourth top corner position (TC4) and forming an angle (β) of at least 70 °with the fourth longitudinal crease line section (23c).

12. The carton blank (40, 50) according to claim 11,

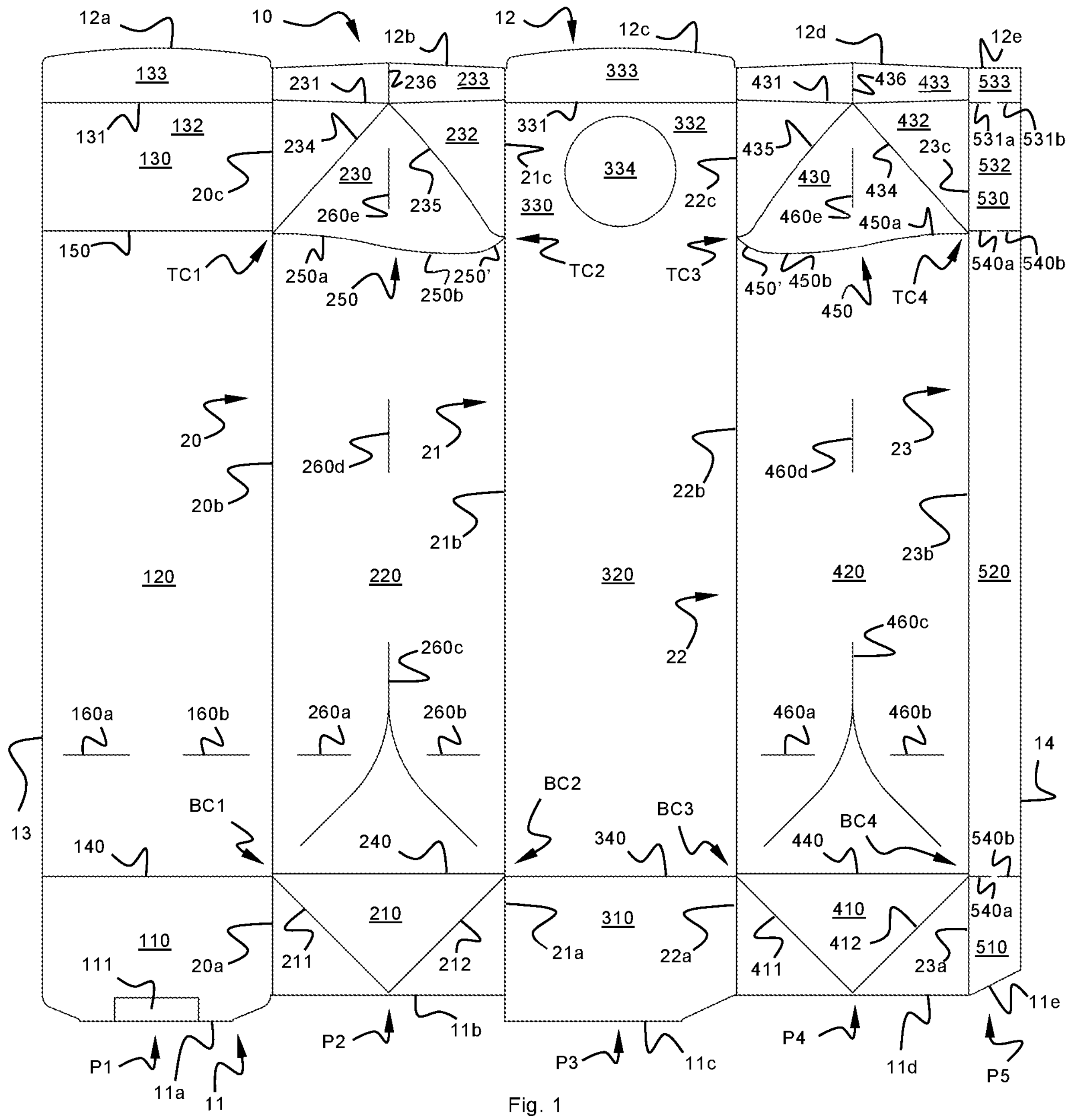
    wherein the second diagonal crease line (234) of the second panel (P2) comprises a diagonal crease line section (234b) having a convex side facing the transverse crease line (250) of the second panel (P2);

    and wherein the second diagonal crease line (434) of the fourth panel (P4) comprises a diagonal crease line section (434b) having a convex side facing the transverse crease line (450) of the fourth panel (P4).

13. The carton blank (40, 50) according to any one of claims 11 and 12,

    wherein the angle (β) formed between the second diagonal crease line (234) of the second panel (P2) and the first longitudinal crease line section (20c) is equal to the angle (β) formed between the second diagonal crease line (434) of the fourth panel (P4) and the fourth longitudinal crease line section (23c).

14. A gable top carton comprising a carton blank (10) according to any one of the preceding claims.


12a
10
12b
12
12c
12d
12e
133
231
236
233
333
431
436
433
533
131
132
130
234
232
331
332
334
435
432
531a
531b
230
235
21c
330
22c
430
434
23c
532
530
20c
260e
460e
450a
150
TC1
250a
250
250b
250'
TC2
TC3
450'
450b
450
TC4
540a
540b
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21
23
260d
460d
22b
20b
21b
23b
120
220
320
420
520
22
260c
460c
160a
160b
260a
260b
460a
460b
14
13
BC1
BC2
BC3
BC4
140
240
340
440
540b
110
210
310
410
540a
20a
211
212
21a
22a
411
412
23a
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P1
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11
P2
11b
P3
11c
P4
11d
11e
P5

Fig. 1

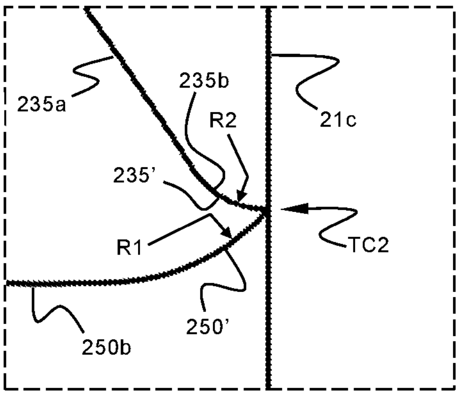

Fig. 2a

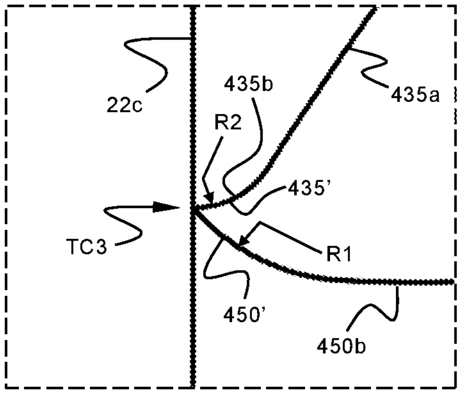

Fig. 2b

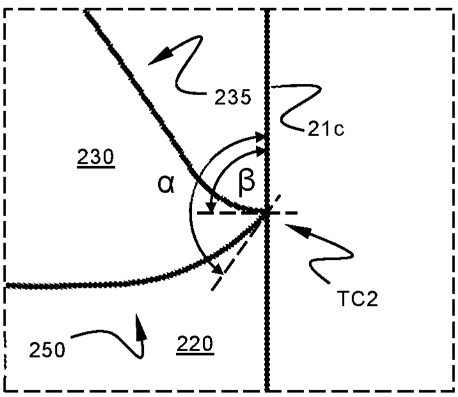

Fig. 2a'

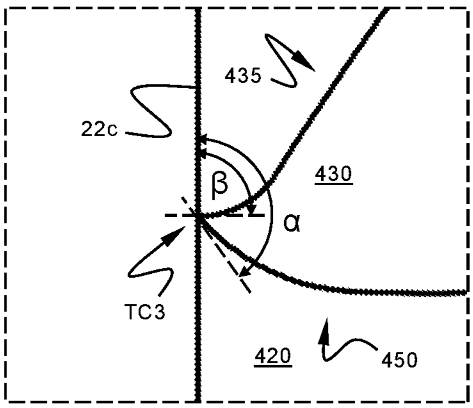

Fig. 2b'

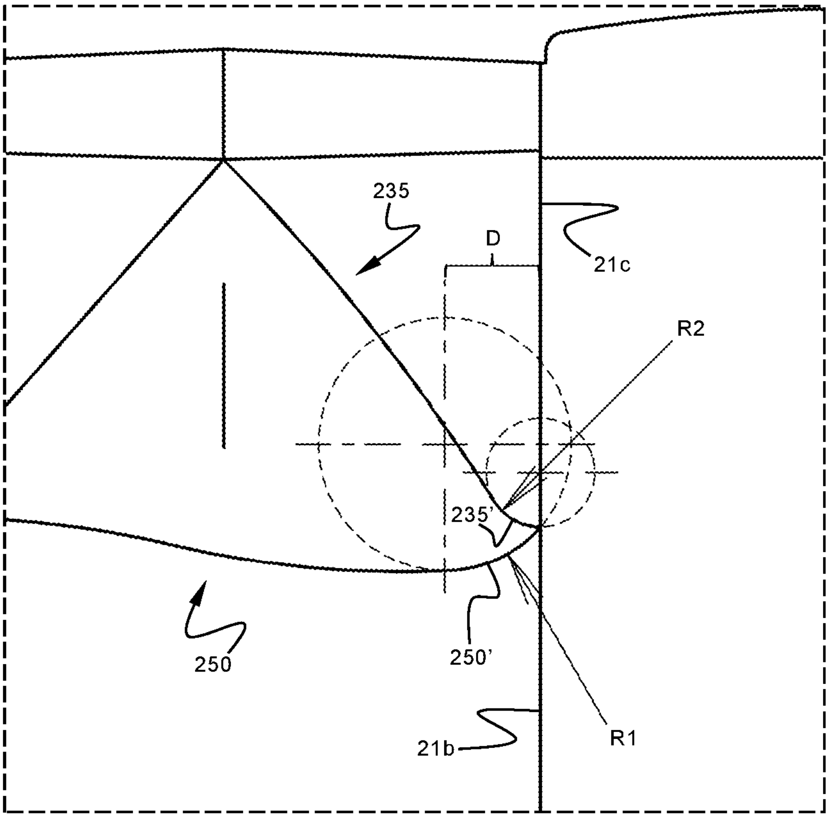

Fig. 4

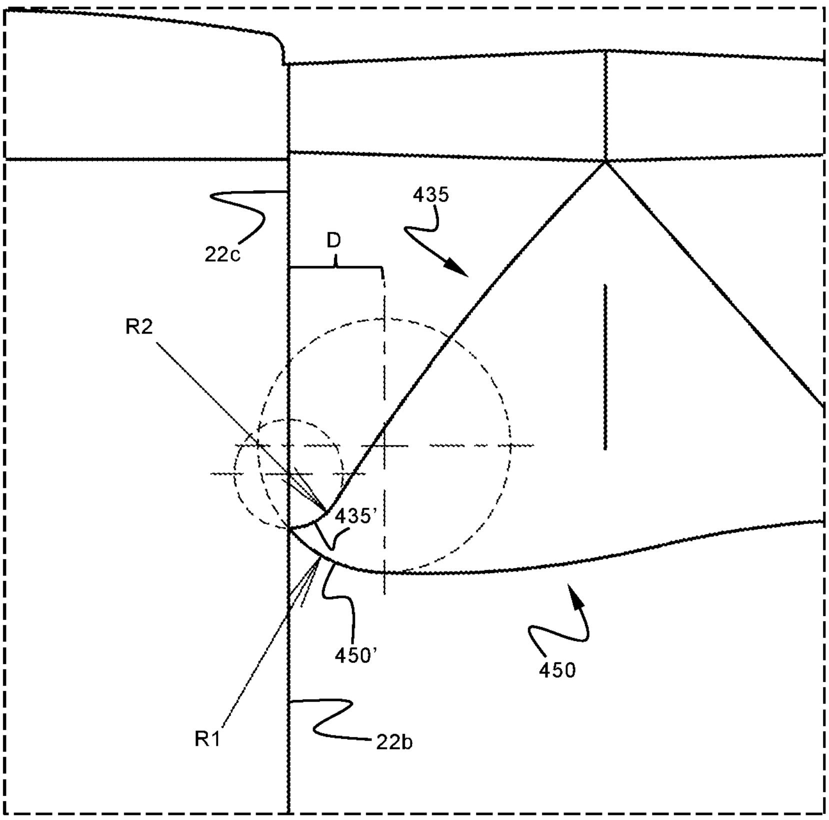

Fig. 5

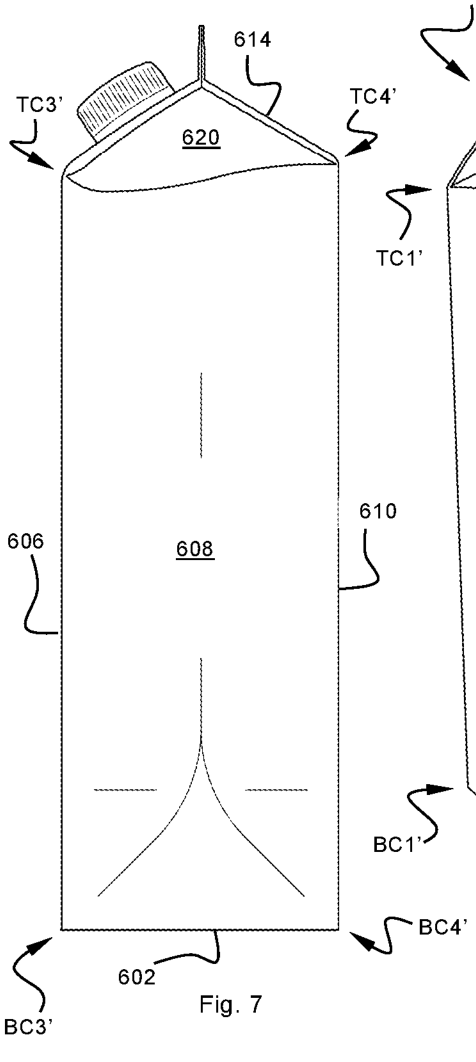

Fig. 7

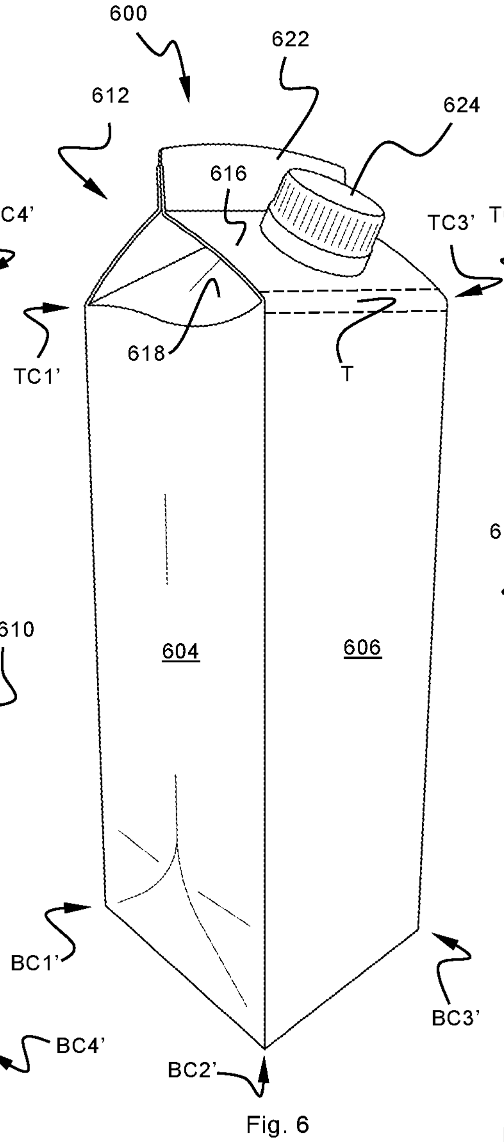

Fig. 6

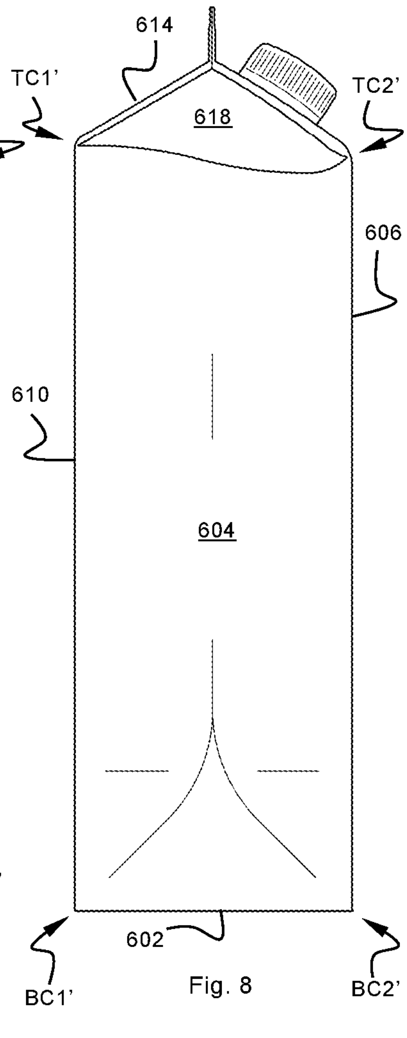

Fig. 8

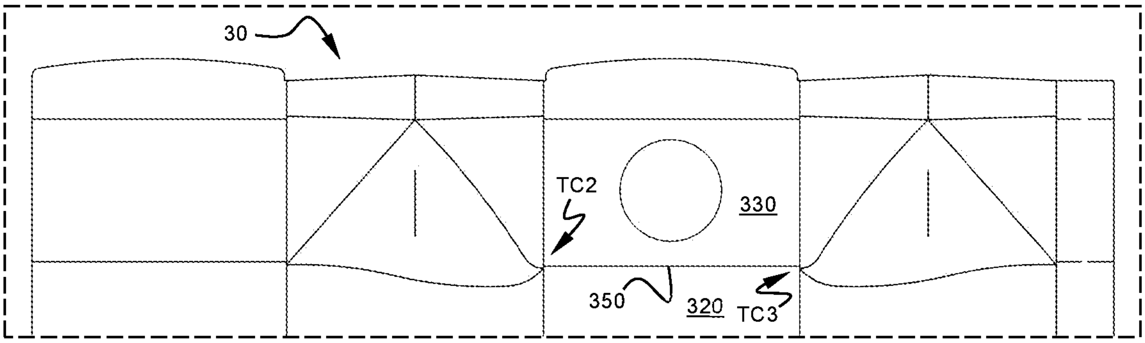

Fig. 9

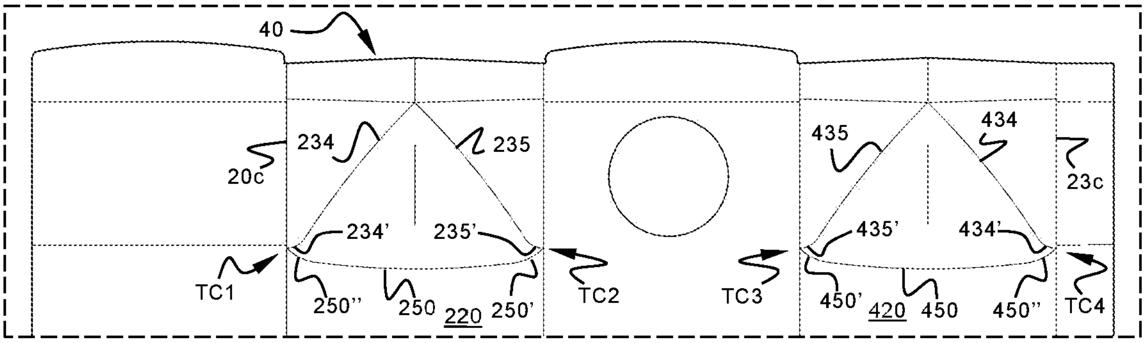

Fig. 10

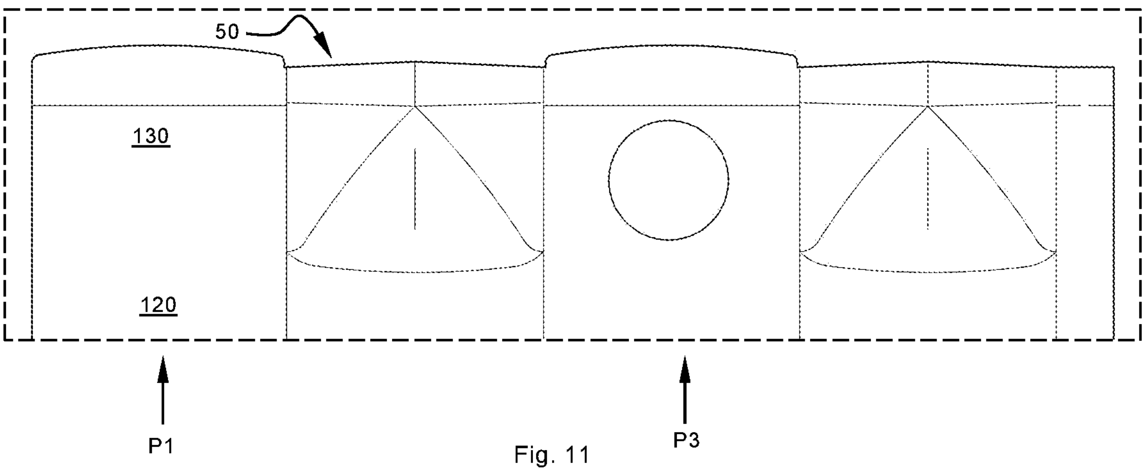

Fig. 11

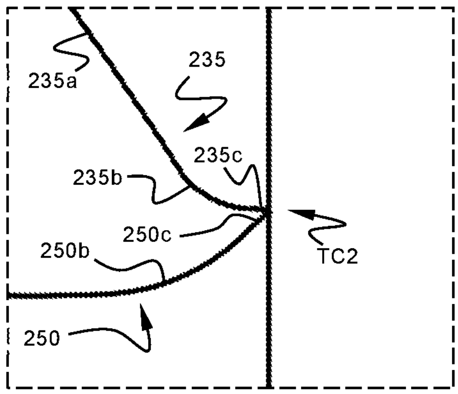

Fig. 12a

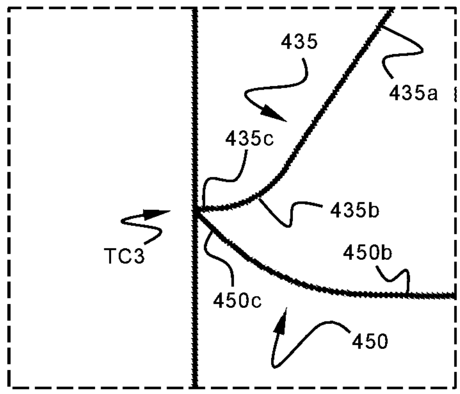

Fig. 12b

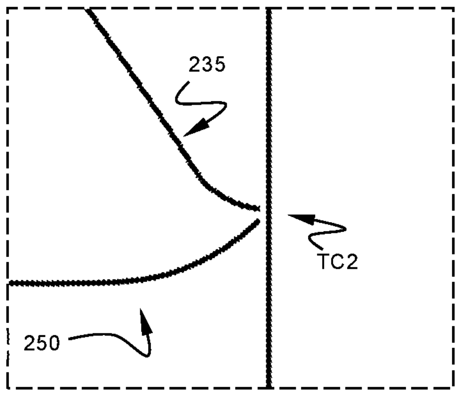

Fig. 13a

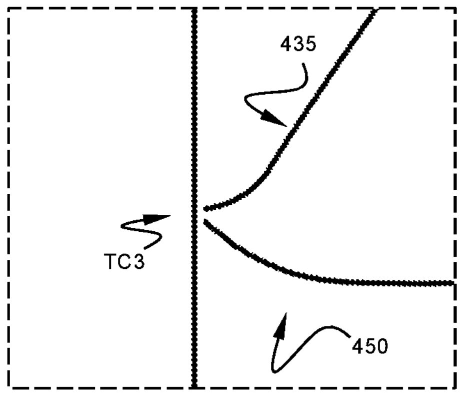

Fig. 13b