(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 718 915 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.10.2020 Bulletin 2020/41

(51) Int Cl.:
B65D 5/02 *(2006.01)* ***B65D 5/42*** *(2006.01)*
B31B 50/25 *(2017.01)* ***B31F 1/08*** *(2006.01)*

(21) Application number: **19166819.3**

(22) Date of filing: **02.04.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) A CREASE TOOL AND A SYSTEM AND METHOD FOR CREASING A PACKAGING MATERIAL

(57) A crease tool (60) is provided, comprising a plurality of protruding bars (66a-d), wherein at least one protruding bar (66a-d) has a transversal extension between a first lateral edge (66a1), configured to form a first folding line (56a1) in a packaging material (1), and an opposite lateral edge (66a2), configured to form a second folding line (56a2) in the packaging material (1).

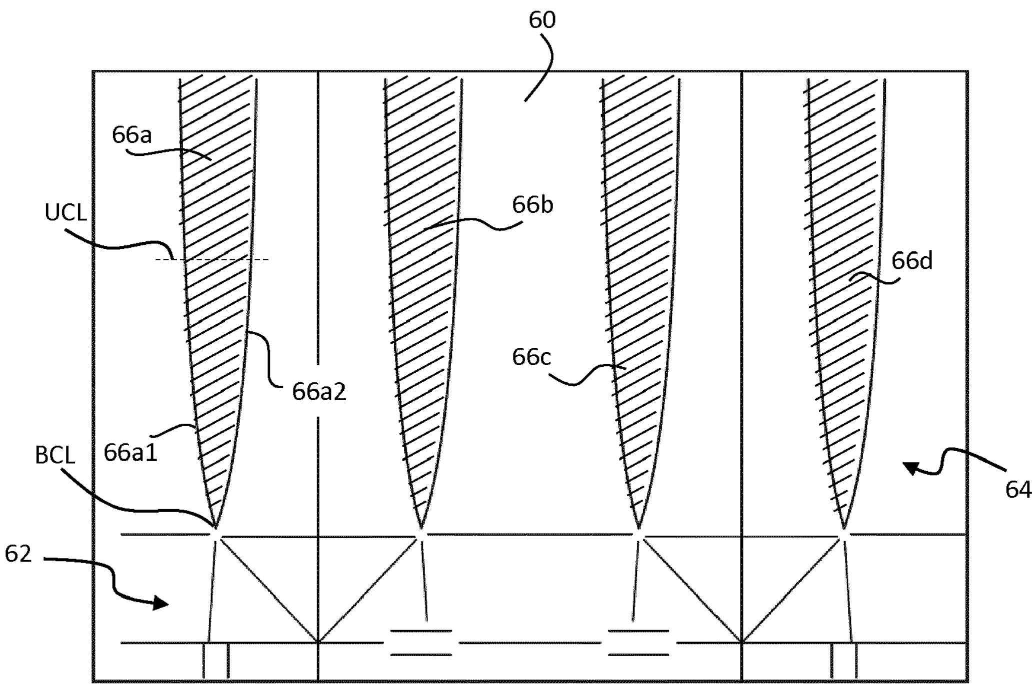

Fig. 4

EP 3 718 915 A1

Description

Technical Field

[0001] The present solution relates to a crease tool as well as to a system for providing a packaging material with crease lines for later forming of the packaging material into individual packages. The present solution also relates to a method of creasing a packaging material and to a packaging material obtained by using such a crease tool using such a method of creasing.

Background Art

[0002] In the field of carton based packaging for liquid food products, roll-fed systems have been particularly successful. In such systems, a web of packaging material is unwound from a roll and fed to a filling machine. The web of packaging material is shaped into a tube, which in turn is filled with a liquid food product. By successively making transversal seals in the lower part of the tube, the provided seal will actually form the upper seal for a downstream package, as well as a bottom seal for an upstream package. By cutting off the lower part of the tube simultaneously as the seal is formed, a sealed package is separated from the upstream tube.

[0003] Another type of form and seal machine requires separate sleeves of packaging material. In such blank-fed systems, the packaging material is prepared before being fed to the form and seal machine by cutting the packaging material into separate sheets, wherein each sheet corresponds to the packaging material required to form one package. The longitudinal ends are sealed such that each sheet of packaging material is shaped into a sleeve-shaped body before being fed into a filling machine where it is formed, filled, and sealed.

[0004] In order to facilitate raising of the packaging material into packaging containers the packaging material is provided with a suitable pattern of material weakening lines or crease lines along which the packaging material is to be folded. In addition to facilitating folding the crease lines when folded also contribute to the mechanical strength and stability of the final packages; the packages may thus be stacked and handled without the risk of being deformed or otherwise destroyed under normal handling. Further to this the crease lines may also allow specific geometries and appearances of the packages.

[0005] Some different methods for providing crease lines have been proposed. For example, according to a known method the packaging material is introduced into a nip between two so called crease rollers. One of the rollers is provided with a pattern of crease protrusions, while the other roller is provided with a corresponding pattern of recesses. As the packaging material is forced between the rigid protrusions/recesses of the crease rollers, the packaging material will consequently be exposed to considerable stresses resulting in a partly delaminated and thereby weakened packaging material.

[0006] In this context it should be noted that the packaging material is typically produced from a laminated sheet or web shaped packaging material comprising a relatively thick bulk layer, e.g. paper or paperboard, and outer liquid tight coatings made of polymer material. In certain cases, in particular in conjunction with especially perishable and oxygen gas sensitive products, the packaging material also includes an a barrier layer made for example of aluminum foil in order to impart to the packages superior gas and light barrier properties.

[0007] The crease protrusions and recesses will induce increased stress and strain in the packaging material especially at positions where the packaging material is arranged in close proximity to the vertical edges of the protrusions, i .e. the edges defining the width of the protrusions. Each protrusion/recess will thus give rise to a crease line having two zones of increased stress, i .e. induced strain, or shear fracture initiations; the zones extending along the crease line and being separated by a body of material, the width of the body being approximately the same as the width of the protrusions. The packaging material will thus be folded along two parallel fracture initiation lines or extensions of the zones of shear fracture initiations, along the crease line, placed at a distance from each other. The body of material between the fracture initiation zones turns into a larger fracture when folded, which fracture then forms a double acting hinge with two axes of rotation.

[0008] The folding can be symmetric with respect to the two fracture lines but is most often asymmetric with respect to the one or the other line. Since folding can occur with equal probability at both of the fracture initiation lines, circumstances decide along which line the packaging material will be non-symmetrically folded. Thus, the packaging material may be folded along a first fracture initiation line at some parts of the crease line and then switch over to be folded along the other line and back again.

[0009] Since the folding is thus difficult to predict it may result in a less distinct fold on a folded package. In order to improve dimensional stability of the packages it has been suggested to provide sharp edges and corners at the positions of the crease lines. With conventional creasing technology, a deeper imprint or embossment provides an improved crease and higher grip stiffness of a package produced with such folded creases. With deeper imprinted crease lines there will, however, be an increased risk of excessive disintegration of the bulk layer of the packaging material and even of cutting it or severely weakening it. In the case where the packaging material is laminated with a thin foil of aluminum acting as a barrier for oxygen, there is also an increased risk of crack formation in the aluminum foil, due to the deeper imprints causing air entrapments which make the aluminum foil weaker by being unsupported by adjacent layers.

[0010] There is therefore a need for an improved crease tool, as well as for a method for providing crease lines to a packaging material, which allows for sharper edges and corners when folding the packaging material into a package.

Summary

[0011] It is an object of the invention to at least partly overcome one or more of the above-identified limitations of the prior art. In particular, it is an object to provide a crease tool which provides for improved folding of the packaging material.

[0012] To solve these objects a crease tool is provided. The crease tool comprises a plurality of prortruding bars, wherein at least one protruding bar has a transversal extension between a first lateral edge, configured to form a first folding line in a packaging material, and an opposite lateral edge, configured to form a second folding line in the packaging material.

[0013] The at least one protruding bar may have a varying width along its length. This may be accomplished by configuring the lateral edges to be non-parallel along at least a part of their length. Hence, package panels may be designed with advanced appearance, still taking advantage of the improved folding.

[0014] The protruding bar may be configured to form an crease surface on a packaging material, which crease surface in turn is configured to form an intermediate panel, when said packaging material is folded into a package. A panel, which is formed by folding the package material at two spaced-apart folding lines, is thereby formed using only a single crease surface.

[0015] The width of the at least one protruding bar may be constantly increasing along its length. The width of the crease surface may thereby vary from very narrow to broad, resulting in a panel which provides for improved handling and gripping.

[0016] The at least one protruding bar may extend from a top portion to a set of protrusions intended to form bottom end crease lines of a packaging material, and the width of the at least one protruding bar may be at its minimum at its initial position close to the bottom end protrusions. In such manner, the panel formed by folding around the edges of the crease surface will grow along the height of the package, thereby improving appearance and handling of the package.

[0017] The height of the at least one protruding bar may be constant along its entire length, thereby providing a homogenous crease line along its length.

[0018] The crease tool may comprise four spaced apart protruding bars, each protruding bar having a varying width along its respective length. A symmetrical package is thereby accomplished, having panels at each corner, and wherein each panel is formed by crease surface resulting from the protruding bars of the crease tool.

[0019] The width of the at least one protruding bar may vary from less than 1 mm to more than 1 cm.

[0020] According to a second aspect, a system for providing a packaging material with crease lines and crease surfaces is provided. The system comprising a crease tool according to the first aspect, and an anvil arranged close to the crease tool such that a nip is formed therebetween. A packaging material is configured to be transported through said nip in order to be provided with said crease lines and crease surfaces.

[0021] The system may further comprise a creasing roller onto which the crease tool is mounted. Efficient inline creasing of the packaging material is thereby accomplished.

[0022] According to a third aspect, a packaging material is provided. The packaging material comprises a plurality of crease lines and crease surfaces, wherein at least one crease surface extends between one lateral edge and an opposite lateral edge, and wherein each lateral edge forms a separate folding line.

[0023] The at least one crease surface may have a varying width along its length.

[0024] According to a fourth aspect, a package is provided. The package comprises a main body of a packaging material according to the third aspect, and at least one intermediate panel being formed by folding said at least one crease surface along its edges.

[0025] The main body may be connected to a polymer top.

[0026] According to a fifth aspect, a method for providing crease lines and crease surfaces to a packaging material is provided. The method comprises providing a crease tool having at least one protruding bar which has a transversal extension between a first lateral edge, configured to form a first folding line in a packaging material, and an opposite lateral edge, configured to form a second folding line in the packaging material, and pressing said crease tool into a packaging material thereby resulting in the packaging material being provided with at least one crease surface extending between one lateral edge and an opposite lateral edge, wherein each lateral edge forms a separate folding line.

[0027] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0028] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1a is a schematic view of a method for forming and filling a package according to an embodiment,

Fig. 1b is an isometric view of a package according to an embodiment,

Fig. 2 is a schematic view of a filling machine for forming a package according to another embodiment,

Fig. 3 is a top view of a sheet of packaging material according to an embodiment,

Fig. 4 is a top view of a crease line pressing tool according to an embodiment,

Fig. 5 is a side view of system for providing crease lines according to an embodiment,

Fig. 6 is a cross-sectional view of a system for providing crease lines,

Fig. 7a is a side view of a packaging material being subject to the system of Fig. 6,

Fig. 7b is a side view of the packaging material of Fig. 7a being folded along the crease line,

Figs. 8a-b are cross-sectional views of a system for providing crease lines according to an embodiment,

Figs. 9a-b are side views of a packaging material being subject to the system of Figs. 8a-b, before and after folding along the crease line, and

Fig. 10 is a schematic view of a method for providing crease lines to a packaging material.

Detailed description

[0029] Referring to the drawings, Fig. 1a shows how a web 1 of packaging material is treated and stepwise advanced between different treatment and processing stations in order to be reformed into a package, and thereafter filled and sealed.

[0030] The packaging material is typically manufactured as a packaging laminate with a core layer of paper and layers of thin, liquid-tight polymer material, e.g. a thermoplastic such as polyethylene applied on either side thereof. The packaging material may also include additional layers, e.g a barrier layer which may be implemented as an aluminium foil or some type of polymer having barrier properties, such as for example a copolymer of ethylene vinyl alcohol (EVOH).

[0031] The web-shaped packaging material 1 is initially wound up on a magazine reel which is disposed at the first end of a filling machine, see reference A. When producing packages, the packaging material 1 is continuously or intermittently unwound from the reel and cut into sheets 2 of suitable dimensions, see reference C. One such sheet 2 is used for the production of one packaging container.

[0032] However, before the web 1 is cut into sheets 2 it may be subject to a treatment, e.g. a chemical sterilization agent, see reference B.

[0033] The sheet 2 is subsequently formed into a tubular package blank 7, see reference D, by sealing two longitudinal edges of the sheet 2 at an overlap joint 8.

[0034] The tubular package blank 7 is then, at one of its open ends, provided with a plastic top 9 by injection moulding of a thermoplastic material. For this, outer and inner moulds 10, 11 are used at reference E.

[0035] When the tubular package blank 7 has been provided with the plastic top 9, it is moved by conveying means (not shown) to a filling station 17. At reference F, sterilization of the semi-finished package is performed by means of a sterilizing unit 20. Downstream, at reference G, a filling pipe 21 is used to supply the desired content, e.g. milk, juice or fruit drink, to the package. Finally, at reference H, the package is treated by sealing means 22 for sealing, in a liquid-tight fashion, its upwardly facing bottom end. A planar bottom surface is also formed by folding of the packaging material 1. The packaging material 1 has preferably already initially been provided with crease lines, for facilitating the folding process.

[0036] In Fig. 1b, a package 30 is shown. The package 30 is preferably manufactured by the process described above with reference to Fig. 1a, and has a main body 32 of a packaging material 1 (the main body 32 corresponding to the tubular package blank 7), and a polymer top 9. The polymer top 9 is in turn provided with some kind of opening device, in this case a cap 34. The main body 32 is formed by four perpendicular panels 36a-d (although only two sides 36a-b are shown), thereby forming a generally rectangular cross-section. However, two adjacent panels 36a-b are connected to each other via an intermediate panel 38. The main body 32 may have four identical intermediate panels 38, however a lesser number of intermediate panels 38 may also be envisaged.

[0037] The intermediate panel 38 has a leaf-shape, meaning that the width of the panel 38 increases from the bottom end, at which the width of the panel 38 is essentially zero, towards the upper end (i.e. where the main body 32 is terminated and connected to the plastic top 9). In other embodiments, the cross-section of the package may be entirely rectangular, such as the TetraBrik® package, whereby one or more of the rectangular panels are formed as intermediate panels, as will be described below.

[0038] In Fig. 2 an example of a filling machine 40 is shown. As compared to the manufacturing method described above with reference to Fig. 1a, the filling machine 40 does not make use of any polymer tops but instead the package is entirely formed by the packaging material 1.

[0039] The packaging material 1 is in this embodiment provided as a web of material which is fed into the filling machine 40. The web of packaging material 1 is distributed in large rolls 41 of which the filling machine 40 is configured to feed the packaging material 1 through various treatment stations, such as sterilizers, forming sections 42, filling sections, and distribution sections of the filling machine. The web of packaging material 1 comprises a series of consecutive parts 2 (corresponding to the sheets of Fig. 1a), each part being configured to form a single package 30'.

[0040] The packaging material 1 may be formed into an open ended tube 45. The tube 45 is arranged vertically in the filling machine 40 and is subject to continuous filling as the packaging material is transported through the filling machine 40. As the packaging material 1, and thus the tube 45, is moving transversal seals are provided for forming individual packages of the tube. Each package is separated from the tube by a sealing and cutting tool 46 operating to provide a transversal seal and a corresponding cut in the sealing area, and the individual packages 30' are transported for allowing subsequent packages 30' to be separated from the tube 45.

[0041] The forming section 42 may also be configured to fold parts of the individual packages 30' e.g. in order to form flaps, planar ends, etc. As can be seen in Fig. 1 the forming section 42 is capable of rearranging the cylindrical shape of the tube 45 into a rectangular, or cuboid or box-like body having two closed ends. Such re-shaping is provided by folding the sealed part of the tube 45 along predefined crease lines. In particular, the package 30' may be provided with intermediate panels 38 in a similar configuration as has been described with reference to Fig. 1b.

[0042] Now turning to Fig. 3, a blank 2 of packaging material 1 is shown. The blank 2 is configured in order to form the main body 32 of the package 30 shown in Fig. 1b. For this, the blank 2 of packaging material 1 is provided with a set of crease lines and crease surfaces 50. The crease lines, excluding the crease surfaces 56a-56d , indicated by the solid lines in Fig. 3, are used as folding lines during forming of the main body 32. Each crease line forms a distinct interruption of the material homogeneity, such that folding is directed to the area of the crease line.

[0043] The crease lines and crease surfaces 50 are provided during manufacturing of the packaging material 1. In some embodiments they may be provided directly to a carton layer before lamination, while in some embodiments they are provided to the packaging material 1 after lamination of the carton layer.

[0044] The set of crease lines and crease surfaces 50 comprises a number of bottom end crease lines 52, configured to allow for folding and forming of the planar bottom end of the package, as well as a number of main body crease lines 54, configured to allow for folding and forming of the main body of the package. The main body crease lines 54 comprise all crease lines on the body of the raised packaging container other than the crease surfaces 56a-56d. Now, the crease surfaces 56a-56d are intended to form the intermediate panels 38 of a packaging container 30' raised from the blank. When a packaging container is raised from the blank 2, the packaging container 30' is folded along the lateral edges 56a1-56a2 of the crease surface 56a and likewise along the corresponding lateral edges of the other crease surfaces 56b, 56c and 56d. These lateral edges thus serve as folding lines.

[0045] While each bottom end crease line 52 is formed as a line of essentially constant width along its entire length, each intermediate panel 38 consists of a crease surface 56a-d with a decreasing width in the direction of the bottom crease lines 62. Optionally, each crease surface 56a-d may have an increasing width in the direction of the bottom crease lines 62. The crease surface 56a of the corresponding intermediate panel extends between one lateral edge 56a1 and an opposite lateral edge 56a2.

[0046] In order to provide for the crease surfaces 56a-d of a corresponding intermediate panel of Fig. 3, a crease tool 60 is used, as shown in Fig. 4. The crease tool 60 is a metal plate which may be plane or curved and is provided with a set of protruding bars 66a-d, a first set of protrusions 64 and a second set of protrusions 62. The first set of protrusions 64 are intended to form the main body crease lines 54 of Fig. 3 during creasing of the packaging material 2. Regarding the second set of protrusions 62, they are intended to form the bottom crease lines 52 during creasing. These bottom crease lines 52 will later form the bottom of the raised package. Finally, the set of protruding bars 66a-d is designed to form the creased surfaces 56a-56d during creasing which will form the intermediate panels on raised package.

[0047] While the second set of protrusions 62 is formed as a linear ridge of essentially constant width along its entire length, each protruding bar 66a-d has an increasing width along it length. Hence, the protruding bar 66a extends between one lateral edge 66a1 and an opposite lateral edge 66a2. The two edges 66a1-2 are non-parallel, such that the width of the bar 66a is varying along the length. The same is applicable also for protruding bars 66b-d.

[0048] It should however be mentioned that in one variant of the present embodiment, one or more protrusions in the second set of protrusions 62 may also be provided as a protruding bar with a certain, in some cases varying width also at the portion of the packaging material 1 which is intended to form the bottom end of the package 30.

[0049] Now turning to Fig. 5 an embodiment of a system 100 for providing crease surfaces and crease lines 50 to a packaging material 1 is shown. The system 100 comprises a crease tool 60 mounted on a pressing roller 110, and an anvil 120 in the form of an anvil roller. At least one of the rollers 110, 120 are driven such the packaging material 1 may be fed into and passing through a nip 130 formed between the rollers 110, 120. As is shown in Fig. 5, the packaging material 1 may for this embodiment preferably be provided as a web thus allowing continuous operation of the system 100.

[0050] The crease tool 60 is provided as a plate covering at least a part of the outer periphery of the pressing roller 110. The crease tool 60 may e.g. be a metal body which may be curved in order to adapt to the cylindrical shape of the roller 110, or the plate 60 may be formed by a plurality of curved segments which together form an outer shell of the roller 110.

[0051] The crease tool 60 comprises at least one protruding bar 66 or a ridge 62. 64 (see Fig. 4) extending in a normal direction, i .e. radially outwards towards the anvil roller 120.

[0052] The anvil 120 forms a roller which may have an outer layer 122; the outer layer 122 may be formed by elastic material being reversibly deformable, such as a material composition comprising a rubber or a polymer having elastomeric properties, or the outer layer may be formed by a plate having recesses mating with the bars and ridges of the crease tool 60. In case of elastic material, it preferably covers the entire surface of the roller 120 being in contact with the packaging material to be creased.

[0053] In Fig. 6 a part of a system 100 is shown. The system has a crease tool 60 with a protruding bar 66 having a rectangular profile. The crease tool 60 is arranged adjacent to an anvil 120 having a recess 124 for mating with the protruding bar 66. During operation the packaging material 1 is urged towards the anvil 120 thereby forcing the packaging material 1 to conform to the shape of the bar/recess interface. For the first and second set of protrusions 64 and 62, the shape of the pressing roller 110 and the anvil 120 are made according to what is known in the art and will not be described in detail here.

[0054] This method of providing crease surfaces to a packaging material will create two shear fracture initiations 58 in the packaging material 1 at positions corresponding to the positions of the vertical sidewalls of the protruding bar 66. The shear fracture initiations 58, in combination with the in between material, will reduce the bending resistance locally whereby a large fracture will be formed between the two fracture initiations 58 when the packaging material 1 is subsequently folded.

[0055] This is shown in Fig. 7a, in which the packaging material 1 is illustrated after being provided with crease surfaces 56 by means of the system 100 shown in Fig. 6. The result of the crease surface, i .e. the fracture 59 , may be described as a double acting hinge, i .e. a hinge having more than one axis of rotation.

[0056] In Fig. 7b an example is shown of folding along the edges of the crease surface 56 thus forming a fracture 59. Due to the two shear fracture initiations 58, each of which is forming a rotational axis for folding, the packaging material 1a on a first side of the fracture 59 may be folded individually and separately from the packaging material 1b on the opposite side of the fracture 59.

[0057] After folding the fracture 59 thus forms a continuous hinge, or a piano hinge, having a length corresponding to the entire length of the fold. The double action is typically provided by two axes, running in parallel along the entire length and corresponding to the position of the shear initiations 58, around which the fold may occur.

[0058] Each protruding bar/recess will thus give rise to a crease surface having two zones of increased stress, by stress meaning induced strain, or shear fracture initiations; the zones extending along the crease line and being separated by a body of material, the width of the body being approximately the same as the width of the bar. The packaging material will thus be folded along two parallel fracture initiation lines placed at a distance from each other.

[0059] In order to improve forming of the intermediate panels 38 of the package 30, by folding along the edges of the crease surfaces 56, these crease surfaces 56 are formed such that they across the entire width of the parts of the packaging material 1 intended to form the intermediate panels 38.

[0060] In Fig. 8a, the cross-section of the creasing system 100 is shown, at a position BCL (see Fig. 4) located to form the bottom part of the crease surface 56a, i.e. where the edges 66a1 and 66a2 of the protruding bar 66a are at a minimum distance from each other. In Fig. 8b the cross-section of the creasing system 100 is shown, at a position UCL (see Fig. 4) located to form an upper part of the crease surface 56a, i.e. where the edges 66a1 and 66a2 of the associated protruding bar 66a are at an increased distance from each other. Preferably, and as is shown in Fig. 3, the width of the protruding bar 66a is increasing continuously along its length. The width increase may be either constant, or varying. For example, the width of the protruding bar 66a may be constant for some part, then increasing during a part of its length, before decreasing to its initial width. By varying the width of the protruding bar 66a along its length, advanced shapes for the resulting intermediate panels 38 can be accomplished, still benefiting from the improved folding.

[0061] However, other embodiments are also possible in which the width of the crease bar 66a is not increasing but instead decreasing, or even constant, along a part of its length. In all embodiments described herein, the protruding bar 66a has two opposite edges 66a1, 66a2, wherein each edge 66a1, 66a2 will result in a crease surface edge 56a1, 56a2 that forms its own folding line. In some embodiments, the edges 66a1, 66a2 are non-parallel along at least a part of their length such that the width of the protruding bar 66a, and thereby also the width of any resulting crease line 56a, is varying along that particular part of its length.

[0062] In Figs. 9a and 9b folding of the packaging material at the protruding bar 66a is shown. These figures illustrate folding at the position UCL located to an upper part of the crease surface 56a. When the packaging material 1 is folded a fracture initiation 58 will reduce the bending resistance locally, whereby one small fracture 59, in the form of a body of deformed material will be created adjacent to the fracture initiation 58. The small fracture 59 forms a hinge mechanism which due to its singularity, i.e. because of the very narrow lateral dimension of the respective edge 66a1, 66a2 of the crease tool 60, will be provided only with a single axis of rotation. This is shown in Fig. 9a, in which the packaging material 1 is illustrated after being provided with a crease line 66a by means of the system 100 shown in Figs. 8a-b. The formed fracture 59, i.e. the formation of the hinge mechanism, may be described as a single acting hinge, i.e. a hinge having only one axis of rotation. Consequently, a much improved folding of the intermediate panels 38 is accomplished.

[0063] Now turning to Fig. 10, a method 200 for providing crease surfaces or lines to a packaging material is schematically shown. The method comprises a first step 202 of providing a crease tool 60 having at least one protruding bar 66a-d which has a transversal extension between a first lateral edge 66a1, configured to form a first folding line 56a1 in a packaging material 1, and an opposite lateral edge 66a2, configured to form a second folding line 56a2 in the packaging material 1, and a step 204 of pressing said crease tool 60 into a packaging material 1 thereby resulting in the packaging material 1 being provided with at least one creased area 56a-d extending between one lateral edge 56a1 and an opposite lateral edge 56a2, and wherein each lateral edge 56a1, 56a2 forms a separate folding line.

[0064] From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

Claims

1. A crease tool (60), comprising a plurality of protruding bars (66a-d) and protrusions (62, 64), wherein said at least one protruding bar (66a-d) has a transversal extension between a first lateral edge (66a1) and an opposite lateral edge (66a2), the at least one protruding bar (66a-d) configured to form a crease surface (56a-d) in a packaging material (1), while the protrusions (62, 64) are configured to form crease lines in the packaging material (1) and wherein the first and second opposite lateral edges (66a1-a2) are configured to form the edges of the crease surface (56a-d) .

2. The crease tool (60) according to claim 1, wherein the at least one protruding bar (66a-d) has a varying width along its length.

3. The crease tool (60) according to claim 1 or 2, wherein crease surface (56a-d) in turn is configured to form an intermediate panel (38), when said packaging material (1) is folded into a package (30, 30').

4. The crease tool (60) according to any one of claims 1-3, wherein said lateral edges (66a1-a2) are non-parallel along at least a part of their length.

5. The crease tool (60) according to any of the preceding claims, wherein the at least one protruding bar (66a-d) along its length has a linearly increasing width.

6. The crease tool (60) according to any of the preceding claims, wherein the at least one protruding bar (66a-d) extends from a top portion towards a bottom portion of the crease tool (60), the bottom portion intended to form bottom end crease lines (52) on the packaging material (1), and wherein the width of the at least one protruding bar (66a-d) is at its minimum at its initial position close to the bottom end protrusions (62).

7. The crease tool (60) according to any of the preceding claims, wherein the height of the at least one protruding bar (66a-d) is constant along its entire length.

8. The crease tool (60) according to any of the preceding claims, comprising four spaced apart protruding bars (66a-d), each protruding bar (66a-d) having a varying width along its respective length.

9. The crease tool (60) according to any of the preceding claims, wherein the width of the at least one protruding bar (66a-d) varies from less than 1 mm to more than 1 cm.

10. A system (100) for providing a packaging material (1) with crease lines (52, 54) and crease surfaces (56a-d), comprising a crease tool (60) according to any of the preceding claims, and an anvil (120) arranged close to the crease tool (60) such that a nip (130) is formed therebetween, wherein a packaging material (1) is configured to be transported through said nip (130) in order to be provided with said crease lines (50, 52, 54, 56a-d)

11. The system (100) according to claim 9, further comprising a creasing roller (110) onto which the crease tool (60) is mounted.

12. Packaging material (1), comprising a plurality of crease lines (52, 54) and crease surfaces (56a-d), wherein at least one crease surface (56a-d) extends between one lateral edge (56a1) and an opposite lateral edge (56a2), and wherein each lateral edge (56a1, 56a2) forms a separate folding line.

13. The packaging material according to claim 12, wherein the at least one crease surface (56a-d) has a varying width along its length.

14. A package (30, 30'), comprising a main body (32) of a packaging material (1) according to claim 12 or 13, and at least one intermediate panel (38) being formed by folding said at least one crease surface (56a-d) along its edges (56a1-2).

15. The package (30) according to claim 14, wherein the main body (32) is connected to a polymer top (9).

16. A method for providing crease lines (50, 52, 54, 56a-d) to a packaging material (1), said method comprising

providing a crease tool (60) having at least one protruding bar (66a-d) which has a transversal extension between a first lateral edge (66a1), configured to form a first folding line (56a1) in the packaging material (1), and an opposite lateral edge (66a2), configured to form a second folding line (56a2) in the

packaging material (1), and
pressing said crease tool (60) into a packaging material (1) thereby resulting in the packaging material (1) being provided with at least one crease surface (56a-d) extending between one lateral edge (56a1) and an opposite lateral edge (56a2), wherein each lateral edge (56a1, 56a2) forms a separate folding line.

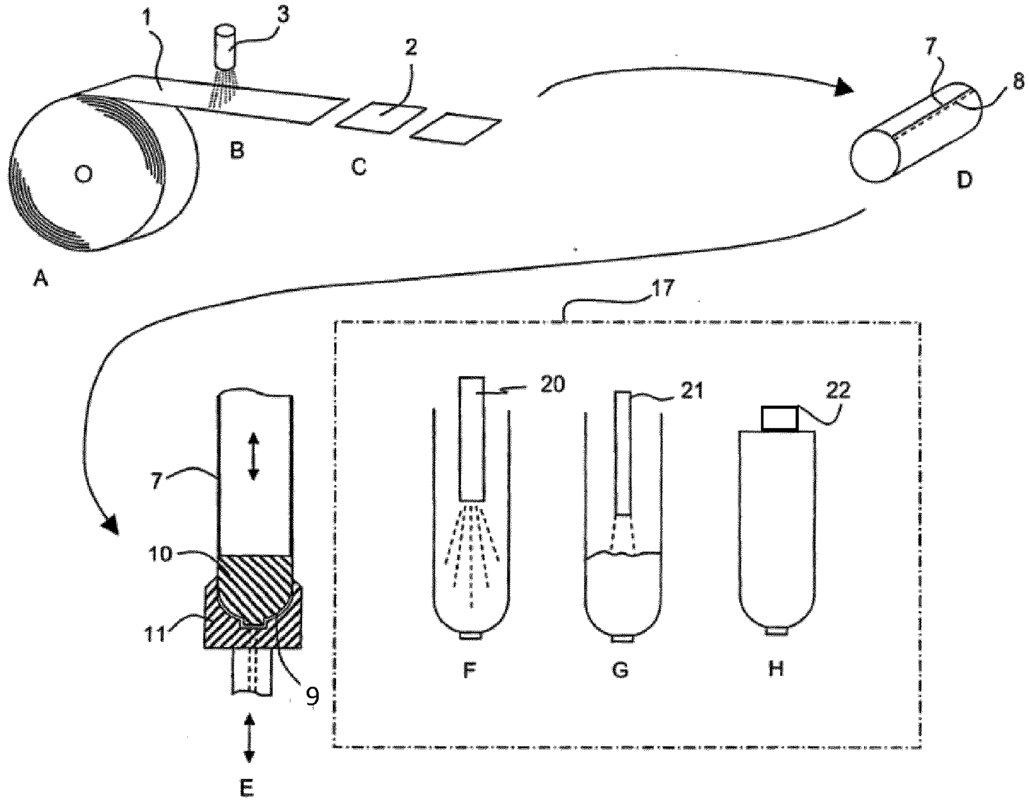

Fig. 1a

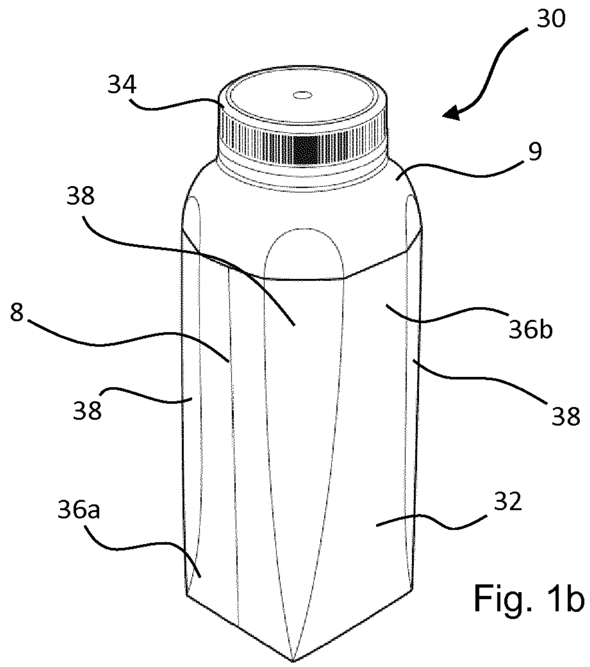

Fig. 1b

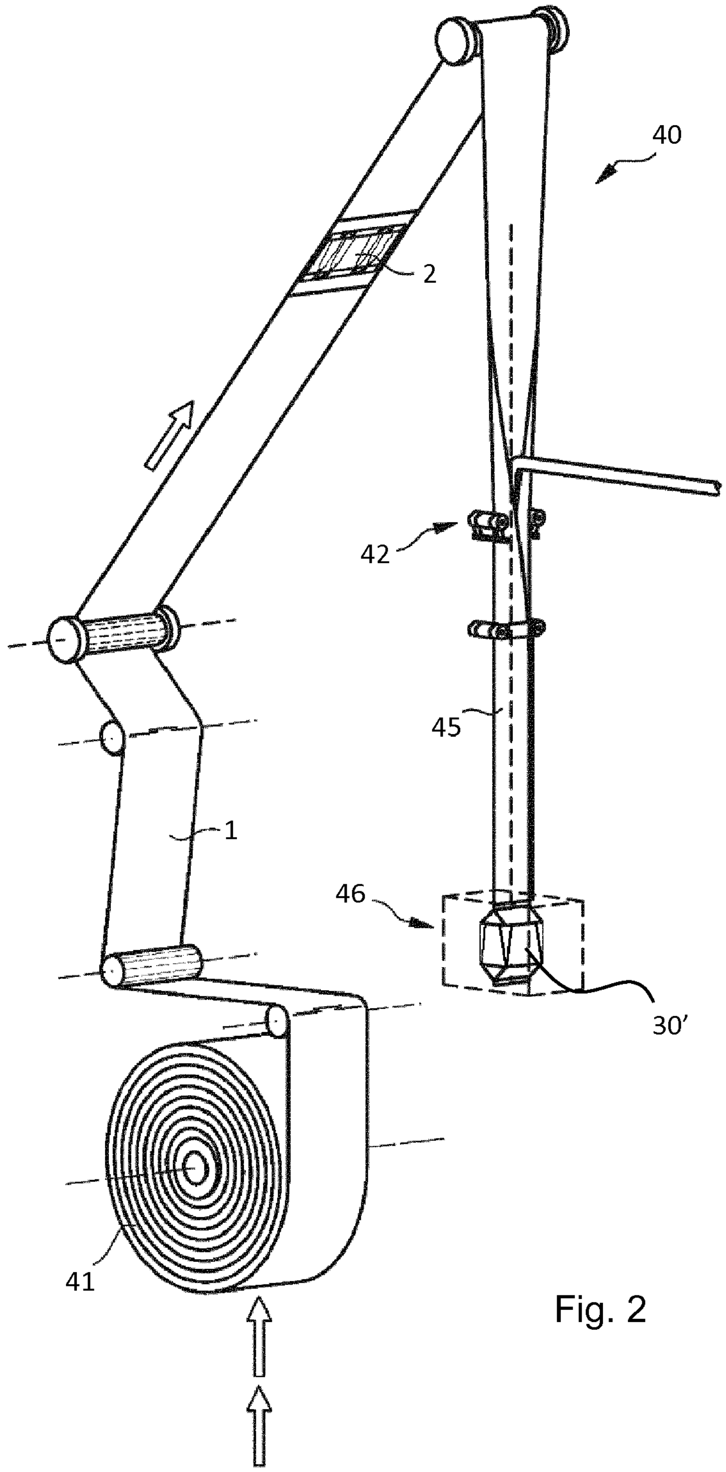

Fig. 2

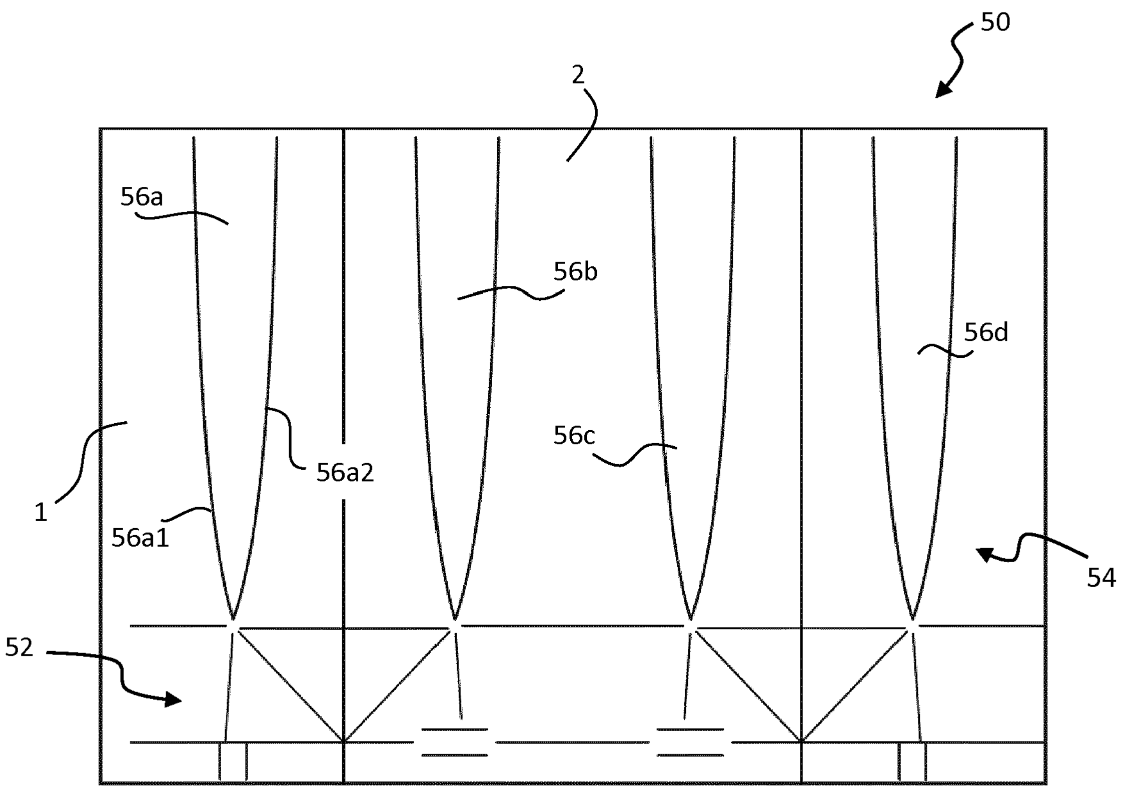
50
2
56a
56b
56d
1
56a2
56c
56a1
54
52

Fig. 3

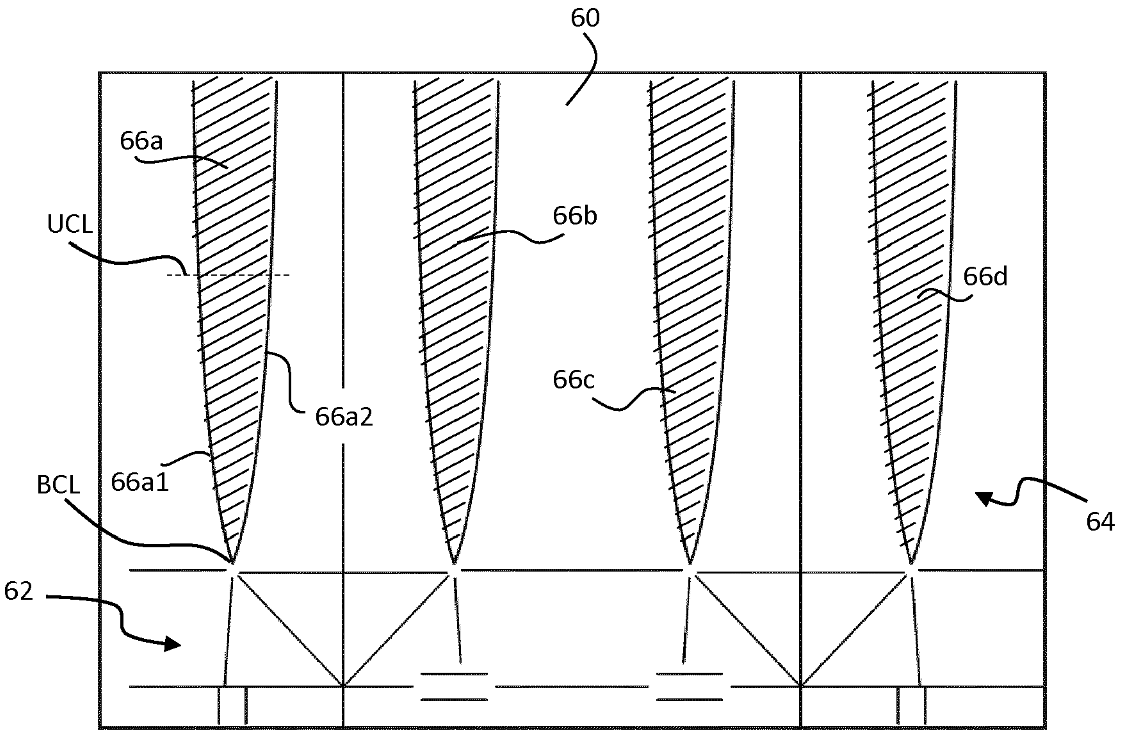
60
66a
UCL
66b
66d
66c
66a2
BCL
66a1
64
62

Fig. 4

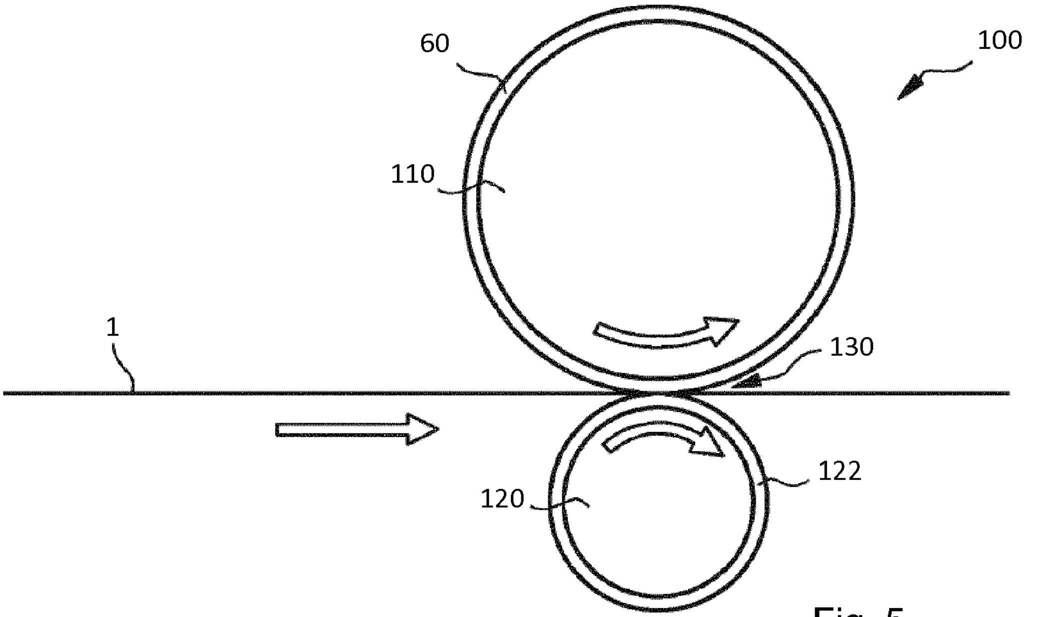

Fig. 5

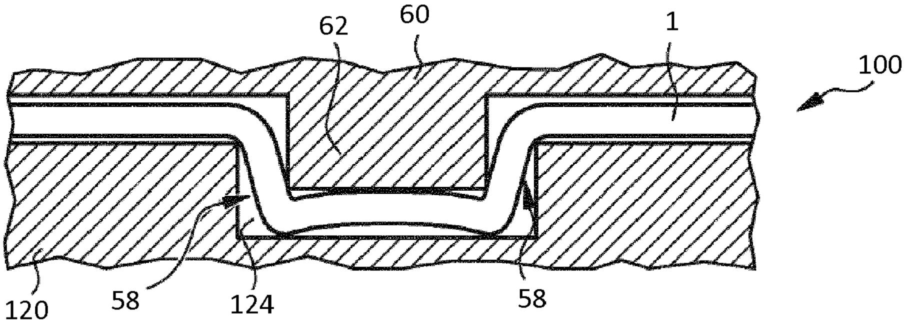

Fig. 6

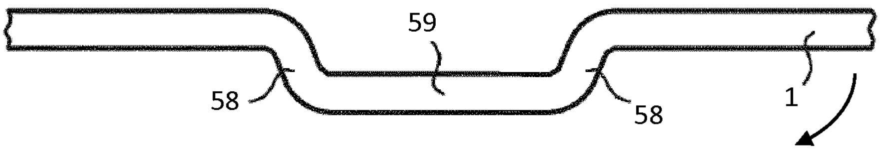

Fig. 7a

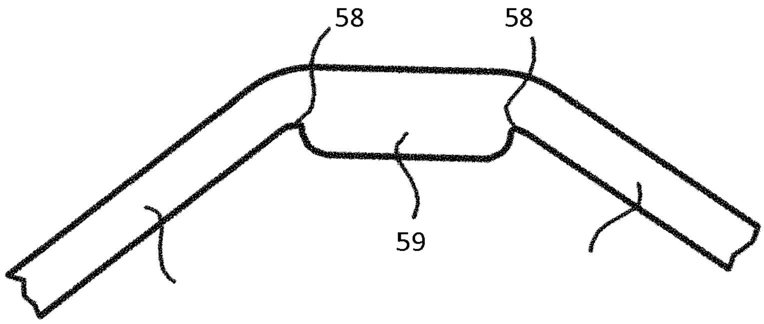

Fig. 7b

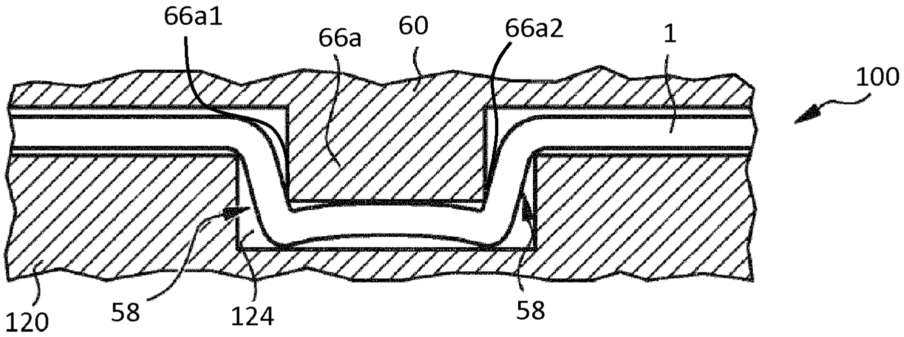

Fig. 8a

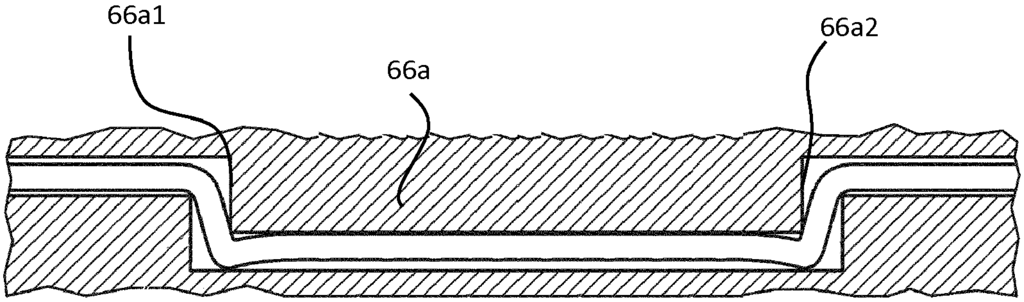

Fig. 8b

Fig. 9a

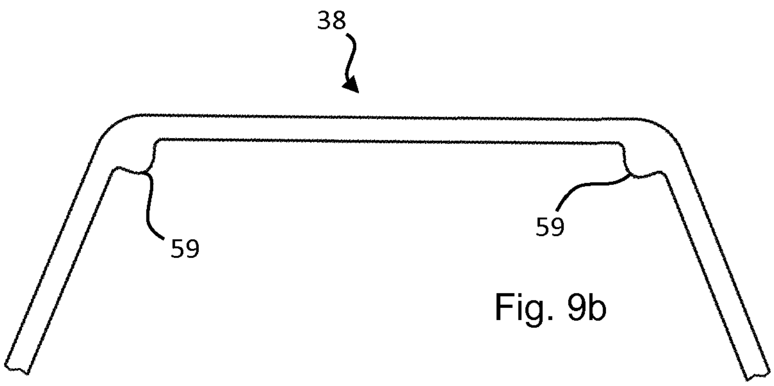

Fig. 9b

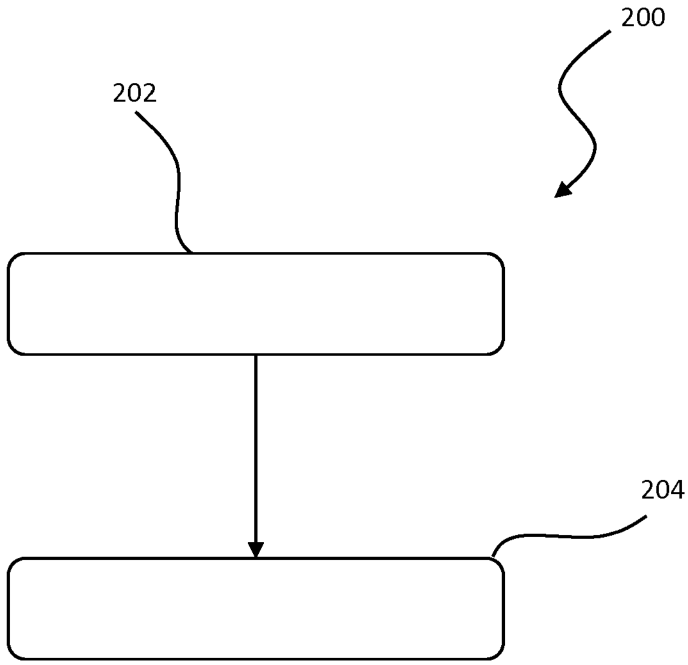

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 6819

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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B65D
B31B
B31F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 September 2019	Johne, Olaf

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L : document cited for other reasons

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20-09-2019

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