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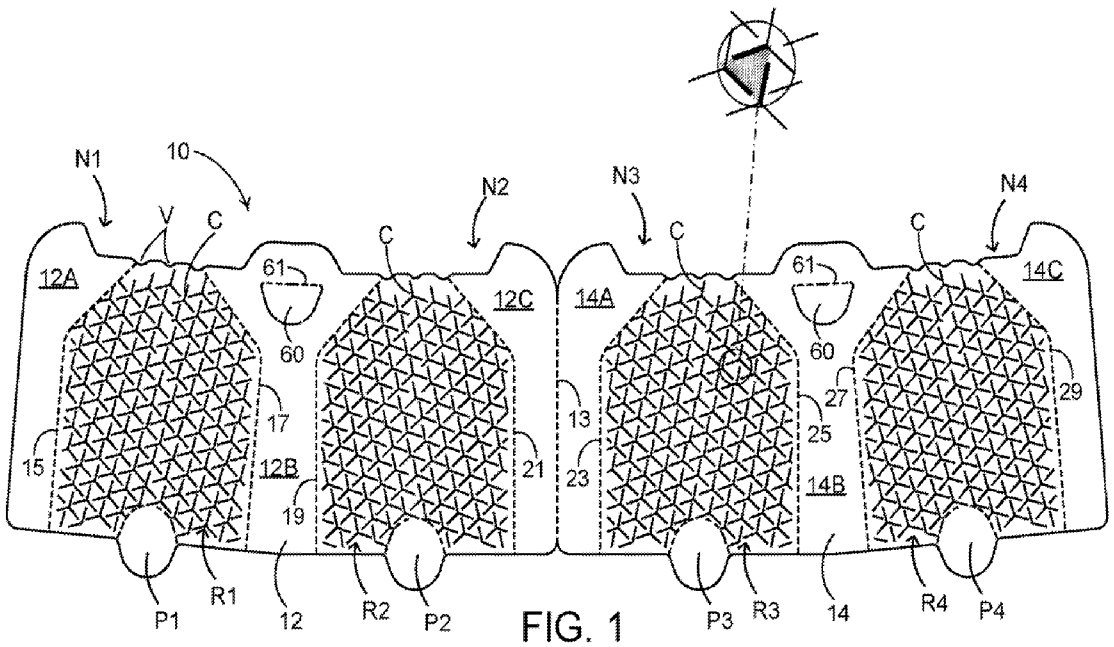


FIG. 1

(57) Abstract: Aspects of the disclosure relate to a carton (90, 190, 290, 390, 490, 590, 690) and carton blank (10; 110; 210; 310; 410; 510; 610; 710) comprising at least one panel having a deformable panel portion (R, Rl, R2, R3, R4) comprising an auxetic cut pattern. The auxetic cut pattern provides a tear opening device The auxetic cut pattern provides a stretchable panel conformable with a contoured surface of an article.

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CARTON AND CARTON BLANK

TECHNICAL FIELD

Aspects of the present invention relate to a carton and a blank for forming the same more specifically, but not exclusively, to a carton comprising a cut pattern for creating a tear opening feature and/or a stretchable panel portion.

BACKGROUND

In the field of packaging it is often required to provide consumers with a package comprising multiple primary product containers. Such multi-packs are desirable for shipping and distribution purposes and for the display of promotional information. For cost and environmental considerations, such cartons or carriers need to be formed from as little material as possible and cause as little wastage as possible in the materials from which they are formed. Another consideration is the strength of the packaging and its suitability for holding and transporting large weights of articles.

It is desirable to provide a carton comprising a contoured panel stretched or deformed about the article or articles being packaged so as to form a close fit therewith. Another object of the present disclosure provides a tear opening feature for facilitating access to the carton's contents.

The present invention seeks to overcome or at least mitigate the problems of the prior art.

SUMMARY

According to a first aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises at least one panel having a deformable panel portion comprising an auxetic cut pattern. The auxetic cut pattern provides a tear opening device to facilitate access to the carton.

According to a second aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises at least one panel having a deformable panel portion comprising an auxetic cut pattern. The auxetic cut pattern provides a severable region for creating in an opening in the at least one panel to facilitate access to the carton.

Optionally, the at least one panel comprises a tear initiation tab adjacent to the deformable panel portion.

Optionally, the at least one panel comprises a tear initiation tab integral with the deformable panel portion.

Optionally, the deformable panel portion is disposed adjacent to an access flap, the access flap being defined by one or more severance lines, the deformable panel portion being deformable to facilitate severance of the one or more severance lines.

Optionally, the deformable panel portion defines an access opening in the at least one panel.

According to a third aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises a plurality of panels defining an interior, at least one of the plurality of panels comprises a deformable panel portion having an auxetic cut pattern. The auxetic cut pattern provides a tear opening device to facilitate access to the interior of the carton.

According to a fourth aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises a plurality of panels defining a tubular structure, each of the plurality of panels comprises a deformable panel portion having an auxetic cut pattern. The auxetic cut pattern provides a severable strip surrounding the tubular structure.

According to a fifth aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises a plurality of panels defining an interior, at least one of the plurality of panels comprises a deformable panel portion having an auxetic cut pattern. The auxetic cut pattern provides a stretchable panel conformable with a contoured surface of the one or more articles.

According to a sixth aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises a plurality of panels defining a plurality of external walls and defining an interior, at least one of the plurality of panels comprises a deformable panel portion having an auxetic cut pattern. The auxetic cut pattern provides a tear opening device to facilitate access to the carton.

Optionally, the deformable panel portion is deformable to form a first wall of the carton and to form a second adjacent wall of the carton.

Optionally, the auxetic cut pattern provides a tear opening device to facilitate access to the carton.

According to a seventh aspect of the present disclosure there is provided a carton for packaging one or more articles. The carton comprises a plurality of panels defining a plurality of external walls and defining an interior, at least one panel of the plurality of panels comprises a deformable panel portion having an auxetic cut pattern. The auxetic cut pattern provides a stretchable panel conformable with a contoured surface of the one or more articles.

Optionally, the deformable panel portion together with at least one other panel of the plurality of panels grips the one or more articles or a portion thereof.

Optionally, the at least one other panel of the plurality of panels comprises a second deformable panel portion having an auxetic cut pattern.

Optionally, a second region of the at least one panel outside of the deformable region is secured to the at least one other panel of the plurality of panels.

Optionally, a second region of the at least one panel outside of the deformable region is adhered to the at least one other panel of the plurality of panels.

Optionally, a second region of the at least one panel outside of the deformable region is secured to a third region of the at least one other panel of the plurality of panels, the third region is disposed outside of the second deformable region.

Optionally, the at least one panel of the plurality of panels comprises at least part of a handle structure.

Optionally, the at least one panel of the plurality of panels comprises an article receiving opening disposed adjacent to the deformable panel portion that together with the deformable panel portion forms an article retention device.

Optionally, the article retention device engages an upper end of an article.

Optionally, the article retention device engages a heel of an article.

Optionally, the article retention device engages a lower end portion of an article.

Optionally, the article receiving opening is defined at least in part by a tab hinged to one of the walls of the carton.

According to an eighth aspect of the present disclosure there is provided a blank for forming a carton. The blank comprises at least one panel having a deformable panel portion comprising an auxetic cut pattern. The auxetic cut pattern provides a tear opening device.

According to a ninth aspect of the present disclosure there is provided a blank for forming a carton. The blank comprises a plurality of panels for forming an interior chamber, at least one of the plurality of panels comprises a deformable panel portion having an auxetic cut pattern. The auxetic cut pattern provides a stretchable panel conformable with a contoured surface of an article.

Within the scope of this application it is envisaged or intended that the various aspects, embodiments, examples, features and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings may be considered or taken independently or in any combination thereof.

Features or elements described in connection with, or relation to, one embodiment are applicable to all embodiments unless there is an incompatibility of features. One or more features or elements from one embodiment may be incorporated into, or combined with, any of the other embodiments disclosed herein, said features or elements extracted from said one embodiment may be included in addition to, or in replacement of one or more features or elements of said other embodiment.

A feature, or combination of features, of an embodiment disclosed herein may be extracted in isolation from other features of that embodiment. Alternatively, a feature, or combination of features, of an embodiment may be omitted from that embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present disclosure will now be described with reference to the accompanying drawings, in which:

Figure 1 is a plan view from above of a blank for forming a carton according to a first embodiment of the disclosure;

Figure 2 is a perspective view from above of a carton formed from the blank of Figure 1;

Figure 3 is a plan view from above of a blank for forming a carton according to a second embodiment of the disclosure;

Figure 4 is a perspective view of a carton formed from the blank of Figure 3;

Figure 5 is a plan view from above of a blank for forming a carton according to a third embodiment of the disclosure;

Figure 6 is a perspective view of a carton formed from the blank of Figure 5;

Figure 7 is a plan view from above of a blank for forming a carton according to a fourth embodiment of the disclosure;

Figure 8 is a perspective view of a carton formed from the blank of Figure 7;

Figure 9 is a plan view from above of a blank for forming a carton according to a fifth embodiment of the disclosure;

Figure 10 is a perspective view of a carton formed from the blank of Figure 9;

Figure 11 is a perspective view of the carton of Figure 10 showing the carton in an open or severed condition;

Figure 12 is a plan view from above of a blank for forming a carton according to a sixth embodiment of the disclosure;

Figure 13 is a perspective view of a carton formed from the blank of Figure 12;

Figure 14 is a perspective view of the carton of Figure 13 showing the carton in an open or severed condition;

Figure 15 is a plan view from above of a blank for forming a carton according to a seventh embodiment of the disclosure;

Figure 16 is a perspective view of a carton formed from the blank of Figure 15; and

Figure 17 is a plan view from above of a blank for forming a carton according to an eighth embodiment of the disclosure.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Detailed descriptions of specific embodiments of the cut patterns, packages, blanks and cartons are disclosed herein. It will be understood that the disclosed embodiments are merely examples of the way in which certain aspects of the invention can be implemented and do not represent an exhaustive list of all of the ways the invention may be embodied. Indeed, it will be understood that the cut patterns, packages, blanks and cartons described herein may be embodied in various and alternative forms. The Figures are not necessarily to scale and some features may be exaggerated or minimised to show details of particular components. Well-known components, materials or methods are not necessarily described in great detail in order to avoid obscuring the present disclosure. Any specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the invention.

In the embodiments detailed herein, the terms "carton" and "carrier" refer, for the non-limiting purpose of illustrating the various features of the invention, to a container 90; 190; 290; 390; 490; 590; 690 for engaging and carrying articles B, such as primary product containers B. It is contemplated that the teachings of the invention can be applied to various product containers B, which may or may not be tapered and/or cylindrical. Other exemplary containers include bottles (for example metallic, glass or plastics bottles), cans (for example aluminium cans), tins, cups, pots, pouches, packets and the like.

The blanks 10; 110; 210; 310; 410; 510; 610; 710 are formed from a sheet of suitable substrate. It is to be understood that, as used herein, the term "suitable substrate" includes all manner of foldable sheet material such as paperboard, corrugated board, cardboard, plastic, combinations thereof, and the like. It should be recognised that one or other numbers of blanks may be employed, where suitable, for example, to provide the carrier structure described in more detail below.

The packaging structure or cartons 90; 190; 290; 390; 490; 590; 690 described herein may be formed from a sheet material such as paperboard, which may be made of or coated with materials to increase its strength. An example of such a sheet material is tear-resistant NATRALOCK® paperboard made by WestRock Company. It should be noted that the tear resistant materials may be provided by more than one layer, to help improve the tear-resistance of the package. Typically, one surface of the sheet material may have different characteristics to the other surface. For example, the surface of the sheet material that faces outwardly from a finished package may be particularly smooth and may have a coating such as a clay coating or other surface treatment to provide good printability. The surface of the

sheet material that faces inwardly may, on the other hand, be provided with a coating, a layer, a treatment or be otherwise prepared to provide properties such as one or more of tear-resistance, good glue-ability, heat sealability, or other desired functional properties.

In the illustrated embodiments, the blanks 10; 110; 210; 310; 410; 510; 610; 710 are configured to form a carton or carrier 90 for packaging an exemplary arrangement of exemplary articles B. For example, in the embodiment illustrated in Figure 17 the arrangement is an m x n matrix or array, having two rows (m=2) and three columns (n=3); two rows of three articles B are provided, and the articles B are 500ml beverage cans.

The blank 10; 110; 210; 310; 410; 510; 610; 710 can be configured to form a carrier for packaging other types, number and size of articles B and/or for packaging articles B in a different arrangement or configuration to that shown.

Referring to Figures 1 and 2 there is shown a blank 10 for forming a carton 90 capable of accepting an input of primary products such as, but not limited to cans or bottles, hereinafter referred to as articles B.

The blank 10 comprises a first main panel 12 hinged to a second main panel 14 by a hinged connection in the form of a fold line 13. The blank 10 forms a carton 90 having a front wall 12 and a rear wall 14. In the illustrated embodiment, the blank 10 is adapted to package two articles B.

Optionally, the main panels 12, 14 each comprise an opening, together the openings form a handle structure H, see Figure 2. One or both of the openings may be defined, at least in part, by a tab 60 hingedly connected to the respective one of the first and second main panels 12, 14 by a hinged connection in the form of a fold line 61.

The first main panel 12 comprises at least one front stretchable or deformable region R1, R2. In the illustrated embodiment the first main panel 12 comprises two front stretchable or deformable regions R1, R2.

The second main panel 14 may comprises at least one rear stretchable or deformable region R3, R4. In the illustrated embodiment the second main panel 14 comprises two rear stretchable or deformable regions R3, R4.

A first one R1 of the front deformable regions R3, R4 is configured to be disposed in opposition to a first one R1 of the rear deformable regions R1, R2.

A second one R3 of the front deformable regions R3, R4 is configured to be disposed in opposition to a second one R4 of the rear deformable regions R3, R4.

The first one R1 of the front deformable regions R1, R2 is spaced apart from the second one R2 of the front deformable regions R1, R2. An intermediate panel portion 12B is provided between the first and second front deformable regions R1, R2.

The first front deformable region R1 is spaced apart from a free side edge of the first main panel 12 to provide a first front wing panel portion 12A. The second front deformable region R2 is spaced apart from a hinged side edge of the first main panel 12 to provide a second front wing panel portion 12C.

The first front wing panel portion 12A may be hingedly connected to the first front deformable region R1 by a hinged connection the form of a fold line 15.

The front intermediate panel portion 12B may be hingedly connected to the first front deformable region R1 by a hinged connection the form of a fold line 17.

The front intermediate panel portion 12B may be hingedly connected to the second front deformable region R2 by a hinged connection the form of a fold line 19.

The second front wing panel portion 12C may be hingedly connected to the second front deformable region R2 by a hinged connection the form of a fold line 21.

The first one R4 of the rear deformable regions R3, R4 is spaced apart from the second one R3 of the rear deformable regions R3, R4. An intermediate panel portion 14B is provided between the first and second rear deformable regions R3, R4.

The first rear deformable region R4 is spaced apart from a free side edge of the second main panel 14 to provide a first rear wing panel portion 14C. The second rear deformable region R3 is spaced apart from a hinged side edge of the second main panel 14 to provide a second rear wing panel portion 14A.

The first rear wing panel portion 14C may be hingedly connected to the first rear deformable region R4 by a hinged connection the form of a fold line 29.

The rear intermediate panel portion 14B may be hingedly connected to the first rear deformable region R4 by a hinged connection the form of a fold line 27.

The rear intermediate panel portion 14B may be hingedly connected to the second rear deformable region R3 by a hinged connection the form of a fold line 25.

The second rear wing panel portion 14A may be hingedly connected to the second rear deformable region R3 by a hinged connection the form of a fold line 23.

A first end edge of the first main panel 12 may comprise one or more cutaways or recess N1, N2. The illustrated embodiment comprises a recess N1, N2 adjacent to each of the first and second front deformable regions R1, R2. The fold lines 15, 17 defining edges of the first front deformable region R1 extend from a first recess N1. The fold lines 19, 21 defining edges of the second front deformable region R2 extend from a second recess N2.

The fold lines 15, 17 defining edges of the first front deformable region R1 are non-linear and converge towards each other as they approach first end edge of the first main panel 12.

The fold lines 19, 21 defining edges of the second front deformable region R2 are non-linear and converge towards each other as they approach first end edge of the first main panel 12.

A first end edge of the second main panel 14 may comprise one or more cutaways or recess N3, N4. The illustrated embodiment comprises a recess N3, N4 adjacent to each of the first and second rear deformable regions R4, R3. The fold lines 27, 29 defining edges of the first rear deformable region R4 extend from a fourth recess N4. The fold lines 23, 25 defining edges of the second rear deformable region R3 extend from a third recess N3.

The fold lines 27, 29 defining edges of the first rear deformable region R4 are non-linear and converge towards each other as they approach first end edge of the second main panel 14.

The fold lines 23, 25 defining edges of the second rear deformable region R3 are non-linear and converge towards each other as they approach first end edge of the second main panel 14.

The first end edges of the first and second main panels 12, 14 may comprise a one or more notches V. The notches V are located on the first end edge of the first and second main panels 12, 14 in the recesses N1, N2, N3, N4; the notches V are disposed on a region of the edge of the recesses N1, N2, N3, N4 between the pairs of fold lines 15/17, 19/2, 23/25, 27/29 defining the side edges of the deformable regions R1, R2, R3, R4.

The first end edges of the first and second main panels 12, 14 form upper end edges in normal use.

A second end edge of the first main panel 12 may comprise protuberance or lobe P1, P2 projecting from each of the first and second front deformable regions R1, R2.

A second end edge of the second main panel 14 may comprise protuberance or lobe P3, P4 projecting from the first and second rear deformable regions R4, R3.

The lobes P1, P2, P3, P4 may form tab which engages the articles B when applied thereto. It also may serve as an opening feature, a pull tab, for a user to engage and initiate tearing, separation or severance of the cut pattern to open the carton 90.

Each of the deformable regions R1, R2, R4, R3 comprises a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed, such as, but not limited to, Kagome-cut pattern, Square-cut pattern, Z-shaped cut pattern, S-shaped cut pattern, I-shaped cut pattern or rhombi-trihexagonal cut pattern.

The Y-shaped cut pattern comprises a repeating pattern of Y-shaped cuts, a leg of each of three adjacently disposed Y-shaped cuts defines a substantially triangular region; the triangular region comprises two truncated corners or vertices. In this way the deformable regions R1, R2, R3, R4 comprise a plurality of triangular regions each partially connected to the adjacent triangular regions.

In order to form a carton 90, as shown in Figure 2, the blank 10 is folded about a group of articles B. Glue or other adhesive treatment is applied to the wing portions 12A, 12C, 14A, 14C and the intermediate portions 12B, 14B of one or both of the first and second main panels 12, 14.

The first front wing portion 12A is brought into face contacting relationship with the first rear wing portion 14C. The first front wing portion 12A is secured to the first rear wing portion 14C.

The second front wing portion 12C is brought into face contacting relationship with the second rear wing portion 14A. The second front wing portion 12C is secured to the second rear wing portion 14A.

The front intermediate portion 12B is brought into face contacting relationship with the rear intermediate portion 14B. The front intermediate portion 12B may be secured to the rear intermediate portion 14B.

When the blank 10 is formed into the carton 90 the deformable regions R1, R2, R3, R4 deform or expand. The deformable regions R1, R2, R3, R4 adapt their shape to substantially conform to the shape of the articles B, or at least the region of the articles B with which they are in contact. The cuts C in the first and second main panels 12, 14 may expand or open up to varying extent.

End closures Cp of the articles B are disposed in the recess N1, N2, N3, N4 provided in the first and second main panels 12, 14.

The wing portions 12A, 12C, 14A, 14C may extend below or engage a flange or protrusion provided by the articles B. The intermediate portions 12B, 14B may extend below the flange or protrusion on an opposing side of the articles B to that which the wing portions 12A, 12C, 14A, 14C engage or extend.

A portion of the first end edge of the first and second main panels 12, 14 is disposed below the flange and may provide support to the articles B.

Referring now to Figures 3 and 4, there is shown an additional embodiment of the present disclosure.

Figure 3 shows a blank 110 for forming a carton 190 (see Figure 4), the blank 110 comprises a plurality of main panels 112, 114, 116, 118, 120, 122, 124, 126 hinged one to the next in a linear series. The blank 110 forms a carton 190 of a basket style.

The plurality of main panels 112, 114, 116, 118, 120, 122, 124, 126 comprises a first side wall panel 112 hinged to a first bridging panel 114 by a hinged connection in the form of a fold line

113. The first bridging panel 114 is hinged to a first base panel 116 by a hinged connection such as a fold line 115. The first base panel 116 is hinged to the first intermediate or partition panel 118 by a hinged connection in the form of a fold line 117. The first intermediate or partition panel 118 is hinged to a second intermediate or partition panel 120 by a hinged connection such as a fold line 119. The second intermediate or partition panel 120 is hinged to a second base panel 122 by a hinged connection such as a fold line 121. The second base panel 122 is hinged to a second bridging panel 124 by a hinged connection in the form of a fold line 123. The second bridging panel 124 is hinged to a second side panel 126 by a hinged connection such as a fold line 125.

The first side wall panel 112 comprises a first securing flap 128A hingedly connect to a first side edge by a hinged connection in the form of a fold line 129A.

The first side wall panel 112 comprises a second securing flap 128B hingedly connect to a second side edge by a hinged connection in the form of a fold line 129B.

The second side wall panel 126 comprises a third securing flap 130A hingedly connect to a first side edge by a hinged connection in the form of a fold line 131A.

The second side wall panel 126 comprises a fourth securing flap 130B hingedly connect to a second side edge by a hinged connection in the form of a fold line 131B.

Optionally, the blank 110 comprises a handle structure. The handle structure comprises an opening A1 in each of the first and second intermediate panels 118, 120. The openings A1 are arranged to be disposed in registry with each other when the first intermediate panel 118 is folded into face to face relationship with the second intermediate panel 120. One or both of the openings A1 may be defined, at least in part, by a tab 160 hingedly connected to the respective one of the first and second intermediate panels 118, 120 by a hinged connection in the form of a fold line 161.

Each of the first and second side wall panels 112, 126 comprises at least one deformable region R1, R2, R4, R3. In the illustrated embodiment, the first and second side wall panels 112, 126 each comprise two deformable regions R1, R2, R3, R4.

The deformable regions R1, R2, R3, R4 each comprise a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed.

In order to form a carton 190, as shown in Figure 4, glue or other adhesive treatment is applied to one or both of the first and second intermediate panels 118, 120. The blank 10 is folded about the fold line 119 to bring the second intermediate panel 120 into face-contacting relationship with the first intermediate panel 118. The second intermediate panel 120 is secured to the first intermediate panel 118.

The first base panel 116 is folded with respect to the first intermediate panel 118, about fold line 117, to be substantially perpendicular thereto. The first bridging panel 114 is folded with respect to the first base panel 116, about fold line 115, and the first side panel 112 is folded, about fold line 113, to be substantially perpendicular to the first base panel 116.

The first and second securing flaps 128A, 128B are folded with respect to the first side panel 112, about fold lines 129A, 129B respectively. Glue or other adhesive treatment is applied to the first and second securing flaps 128A, 128B or alternatively to corresponding regions of the first intermediate panel 118.

The first side panel 112 is deformed or shaped such that first and second securing flaps 128A, 128B are brought into face contacting relationship with the first intermediate panel 118.

The first and second securing flaps 128A, 128B are secured to the first intermediate panel 118.

In doing so a first chamber is formed on a first side of a divider wall 118/120 formed from the first and second intermediate panels 118, 120.

The second base panel 122 is folded with respect to the second intermediate panel 120, about fold line 121, to be substantially perpendicular thereto. The second bridging panel 124 is folded with respect to the second base panel 122, about fold line 123, and the second side panel 126 is folded, about fold line 125, to be substantially perpendicular to the second base panel 122.

The third and fourth securing flaps 130A, 130B are folded with respect to the second side panel 126, about fold lines 131A, 131B respectively. Glue or other adhesive treatment is applied to the third and fourth securing flaps 130A, 130B or alternatively to corresponding regions of the second intermediate panel 120.

The second side panel 126 is deformed or shaped such that third and fourth securing flaps 130A, 130B are brought into face contacting relationship with the second intermediate panel 120.

The third and fourth securing flaps 130A, 130B are secured to the second intermediate panel 120.

In doing so a second chamber is formed on a second side of the divider wall 118/120 formed from the first and second intermediate panels 118, 120.

Each of the first and second chambers is arranged to accommodate one or more articles therein.

The deformable regions R1, R2, R3, R4 may be deformed in order to construct the carton 90 from the blank 10. The deformable regions R1, R2, R3, R4 may further deform or stretch when one or more articles B are loaded into each of the first and second chambers.

The deformable regions R1, R2, R3, R4 may adapt their shape to substantially conform to the shape of the articles B, or at least the region of the articles B with which they are in contact. The cuts C in the first and second side wall panels 112, 126 may expand or open up to varying extent.

Referring now to Figures 5 and 6, there is shown an additional embodiment of the present disclosure.

Figure 5 shows a blank 210 for forming a carton 290 (see Figure 6), the blank 210 comprises a plurality of main panels 212, 214 hinged one to the next. The blank 210 forms a carton 290 of a top-gripping style.

A first main panel 212 is hinged to a second main panel 214 by a hinged connection in the form of a fold line 213. The blank 210 forms a carton 290 having an upper ply 212 and a lower ply 214. In the illustrated embodiment, the blank 210 is adapted to package six articles B.

Optionally, the blank 210 comprises a handle structure. The handle structure comprises an opening in each of the first and second main panels 212, 214. The openings are arranged to be disposed in registry with each other when the first main panel 212 is folded into face to face relationship with the second main panel 214. One or both of the openings may be defined, at

least in part, by a tab 260, 262 hingedly connected to the respective one of the first and second main panels 212, 214 by a hinged connection in the form of a fold line 261, 263.

The second main panel 214 comprises at least one article retention structure RT. The illustrated embodiment comprises six article retention structures RT each for receiving and retaining an upper portion of an article B.

The article retention structures RT each comprise an aperture A2 struck from, or defined within, the second main panel 214. The apertures A2 are each surrounded by a plurality of teeth or tabs 250. The illustrated embodiment comprises eight tabs 250 surrounding the aperture A2; other embodiments may comprise a different arrangement or number of tabs 250.

Each tab 250 is hingedly connected to the second main panel 214 by a hinged connection in the form of a fold line 255.

Each tab 250 is defined by a pair of radial cut lines 251, 253 extending radially outward from the aperture A2.

Each tab 250 comprises an engaging edge disposed opposite a hinged edge defined by the fold line 255.

The first main panel 212 comprises at least one deformable region R. In the illustrated embodiment, the first main panel 212 comprises one deformable region R having a plurality of lobes. Each lobe is arranged to be disposed substantially above a respective one of the article retention structures RT in the second main panel 214. In other embodiments, the first main panel 212 may comprise a plurality of distinct or separate deformable regions R.

The deformable region R comprises a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed.

In order to form a carton 290, as shown in Figure 6. The glue or other adhesive treatment is applied to the first main panel 212 outside the deformable region R. That is to say, the deformable region R is free from adhesive and remains unsecured to the second main panel 214.

The blank 210 is folded about the fold line 213 to bring the second main panel 214 into face-contacting relationship with the first main panel 212. The second main panel 214 is secured to the first main panel 212.

The carton 290 in this form can be readily shipped to distributed to a convertor plant for assembly with a group of articles B.

In order to form a package, the carton 290 is lowered with respect to the group of articles B. Upper ends of the articles B pass through the lower ply 214 of the carton 290 provided by the second main panel 214. Each article retention structure RT receives a respective one of the articles B in the group. The tabs 250 fold or deform out of the plane of the second main panel 214 upwardly toward the first main panel 212.

The deformable region R is displaced upwardly or stretched as the articles B pass through the second main panel 214. The first main panel 212 remain above the articles B and deforms thereabout. The tabs 50 of the article retention structure RT engage below flange or protrusion provided on the articles B so as to engage the articles B and prevent or inhibit them from being withdrawn or removed.

As shown in Figure 6 regions of the first main panel 212 in registry with the article retention structures RT provided in the second main panel 214 provide a contour upper surface extending over or about the upper ends of the articles B received in the lower ply 214 of the carton 290.

The upper ply 212 may increase or improve the security or stability of the articles B in the carton 290 by holding or encouraging the lower ply into engagement or contact with the articles B.

Referring now to Figures 7 and 8, there is shown an additional embodiment of the present disclosure.

Figure 7 shows a blank 310 for forming a carton 390 (see Figure 8), the blank 310 comprises a plurality of main panels 312, 314, 316, 318 hinged one to the next. The blank 310 forms a carton 390 of a top-engaging style.

The plurality of main panels 312, 314, 316, 318 comprises a first base wall panel 312 hinged to a first handle panel 314, also referred to herein as first engaging panel 314, by a hinged

connection in the form of a fold line 313. The first handle panel 314 is hinged to a second handle panel 316, also referred to herein as second engaging panel 316, by a hinged connection such as a fold line 315. The second handle panel 316 is hinged to a second base panel 318 by a hinged connection such as a fold line 317.

The first base panel 312 comprises at least one aperture A3 for receiving an upper end of an article; the illustrated embodiment comprises two apertures A3.

The second base panel 318 comprises at least one aperture A3 for receiving an upper end of an article; the illustrated embodiment comprises two apertures A3. Each aperture A3 in the second base panel 318 is arranged to be disposed in registry with one of the apertures A3 in the first base panel 312, when the first base panel 312 and second base panel 318 are brought into face contacting relationship to form a composite base panel 312/318.

The first handle panel 314 comprises an opening forming part of a handle structure. The opening may be defined, at least in part, by a tab 360 hingedly connected to the first handle panel 314 by a hinged connection in the form of a fold line 361.

The second handle panel 316 comprises an opening forming part of a handle structure. The opening may be defined, at least in part, by a tab 360 hingedly connected to the second handle panel 316 by a hinged connection in the form of a fold line 361.

The first handle panel 314 comprises an engaging structure for securing an article in engagement with the carton 390. The engagement structure comprises at least one opening and at least one deformable region R1, R2. In the illustrated embodiment, the first handle panel 314 comprises two deformable regions R1, R2. Each deformable region R1, R2 and each opening is arranged to be disposed in vertical registry with one of the apertures A3 in the composite base panel 312/318. The openings may be formed from a tab 370 or aperture, the tabs 370 may be hinged to the first handle panel 314 or may be separable therefrom.

The second handle panel 316 comprises an engaging structure for securing an article in engagement with the carton 390. The engagement structure comprises at least one opening and at least one deformable region R3, R4. In the illustrated embodiment, the second handle panel 316 comprises two deformable regions R3, R4. Each deformable region R3, R4 and each opening is arranged to be disposed in vertical registry with one of the apertures A3 in the composite base panel 312/318. The openings may be formed from a tab 370 or aperture, the tabs 370 may be hinged to the second handle panel 316 or may be separable therefrom.

The deformable regions R1, R2, R3, R4 comprise a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed.

The blank 310 is formed into a carton 390 by folding the blank about fold line 313, 315, 317 to form a tubular structure having a triangular cross-sectional shape. Glue or other adhesive treatment is optionally applied to one or both of the first and second base panels 312, 318; in some embodiments the first and second base panels 312, 318 are folded into face contacting relationship without application of glue, and are held in position upon application to the articles. The first and second base panels 312, 318 are folded into face contacting relationship with one another. The first and second base panels 312, 318 are secured to each other.

In the erected carton 390 a first deformable region R1 provided in the first engaging panel 314 is disposed opposite a third deformable region R3 provided in the second engaging panel 316 and a second deformable region R2 provided in the first engaging panel 314 is disposed opposite a fourth deformable region R4 provided in the second engaging panel 316.

An article B is inserted or received in each of the apertures A3 in the composite base panel 312/318. The article B is engaged by the first and second engaging panels 314, 316 on opposing sides thereof. The deformable regions R1/R3, R2/R4 are displaced or deformed outwardly of the tubular structure and deform about the upper ends of the article. The deformable regions R1/R3, R2/R4 engage the article. The openings 370 in each of first and second engaging panels 314, 316 engage or receive a portion of the article and provide an engaging edge for engaging with a flange, protrusion or undercut of the article.

Referring now to Figures 9, 10 and 11, there is shown an additional embodiment of the present disclosure.

Figure 9 shows a blank 410 for forming a carton 490 (see Figure 10), the blank 410 comprises a plurality of main panels, referred to generally by 412, 414, 416, 418, 420, 422, 424, 426, 428 hinged one to the next in a linear series by fold lines, referred to generally by 413, 415, 417, 419, 421, 423, 425, 427 respectively. Each main panel 412, 414, 416, 418, 420, 422, 424, 426, 428 comprises an upper portion 412a, 414a, 416a, 418a, 420a, 422a, 424a, 426a, 428a and a lower portion 412b, 414b, 416b, 418b, 420b, 422b, 424b, 426b, 428b. Each fold line comprises an upper portion 413a, 415a, 417a, 419a, 421a, 423a, 425a, 427a and a lower portion 413b, 415b, 417b, 419b, 421b, 423b, 425b, 427b.

Each main panel 412, 414, 416, 418, 420, 422, 424, 426, 428 comprises a deformable region or tear region R1, R2, R3, R4, R5, R6, R7, R8, R9 disposed between the upper portion 412a, 414a, 416a, 418a, 420a, 422a, 424a, 426a, 428a and the lower portion 412b, 414b, 416b, 418b, 420b, 422b, 424b, 426b, 428b.

The plurality of main panels 412, 414, 416, 418, 420, 422, 424, 426, 428 form a tubular structure having a tubular axis and providing an interior of the carton 490 for receiving one or more articles B.

Each end of the tubular structure is at least partially closed by an end closure structure. The end closure structures comprise an end closure panel 430A, 430B hingedly connected to an end edge of one of the plurality of main panels 412, 414, 416, 418, 420, 422, 424, 426, 428 by a hinged connection in the form of a fold line 431A, 431B. A first end closure panel 430A comprises at least one securing flap 432a, 432b, 432c, 432d, 432e, 432f, 432g hingedly connected thereto by a hinged connection in the form of a fold line 433a, 433b, 433c, 433d, 433e, 433f, 433g. A second end closure panel 430B comprises at least one securing flap 434a, 434b, 434c, 434d, 434e, 434f, 434g hingedly connected thereto by a hinged connection in the form of a fold line 435a, 435b, 435c, 435d, 435e, 435f, 435g.

The deformable regions R1, R2, R3, R4, R5, R6, R7, R8, R9 comprise a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a Square-cut pattern, however in other embodiments other cut patterns may be employed. The Square -cut pattern comprises a repeating pattern of four cut lines defining a square, see the highlighted region of Figure 9; each of the four cut lines is spaced apart from the adjacent cut lines. In this way the deformable regions R1, R2, R3, R4, R5, R6, R7, R8, R9 comprise a plurality of square regions each partially connected to the adjacent square regions.

The deformable regions R1, R2, R3, R4, R5, R6, R7, R8, R9 form a linear strip extending across the blank 410.

The carton 490 is formed by folding the plurality of main panels 412, 414, 416, 418, 420, 422, 424, 426, 428 to form a tubular structure having an octagonal cross-sectional shape. A first main panel 412 is secured in face contacting relationship with a ninth main panel 428.

The deformable regions R1, R2, R3, R4, R5, R6, R7, R8, R9 form a continuous band about the tubular structure and surrounding the tubular axis of the carton 490.

The carton 490 is loaded with an article B through an open end thereof.

The ends of the tubular structure are closed by folding the first and second end closure panels 430A, 430B about the fold lines 431A, 431B respectively. The securing flaps 432a, 432b, 432c, 432d, 432e, 432f, 432g are folded with respect to the first end closure panel 430A, and secured to a respective one of the main panels 412, 414, 416, 418, 420, 422, 424, 426, 428. The securing flaps 434a, 434b, 434c, 434d, 434e, 434f, 434g are folded with respect to the second end closure panel 430B and secured to a respective one of the main panels 412, 414, 416, 418, 420, 422, 424, 426, 428.

The securing flaps 432a, 432b, 432c, 432d, 432e, 432f, 432g, 434a, 434b, 434c, 434d, 434e, 434f, 434g may be secured to an inner surface of the main panels 412, 414, 416, 418, 420, 422, 424, 426, 428 as illustrated in Figure 10 or to an outer surface of the main panels 412, 414, 416, 418, 420, 422, 424, 426, 428 as illustrated in Figure 11.

The carton 490 can be opened by twisting -although other actions which sever the connecting portions of the deformable regions R1, R2, R3, R4, R5, R6, R7, R8, R9 may be employed- an upper portion of the carton 490, provided by the upper portions 412a, 414a, 416a, 418a, 420a, 422a, 424a, 426a, 428a of the main panels 412, 414, 416, 418, 420, 422, 424, 426, 428, with respect to a lower portion of the carton 490, provided by the lower portions 412b, 414b, 416b, 418b, 420b, 422b, 424b, 426b, 428b of the main panels 412, 414, 416, 418, 420, 422, 424, 426, 428.

Referring now to Figures 12, 13 and 14, there is shown an additional embodiment of the present disclosure.

Figure 12 shows a blank 510 for forming a carton 590 (see Figure 13), the blank 510 comprises a plurality of main panels 512, 514, 516, 518, 520 hinged one to the next in a linear series by fold lines 513, 515, 517, 519.

A securing flap 512 is hinged to a base panel 514 by a hinged connection in the form of a fold line 513. A first side wall panel 516 is hinged to the base panel 514 by a hinged connection such as a fold line 515. The first side wall panel 516 is hinged to a top panel 518 by a hinged connection such as a fold line 517. The top panel 518 is hinged to a second side wall panel 520 by a hinged connection in the form of a fold line 519.

The plurality of main panels 512, 514, 516, 518, 520 of the blank 510 form walls of a tubular structure in a set-up condition. The tubular structure is at least partially closed by end closure structures. The tubular structure has a tubular axis defining a longitudinal direction.

The blank 510 comprises end closure panels 522A, 524A, 526A, 528A, 522B, 524B, 526B, 528B forming end walls of the carton 590.

End closure panels 522A, 524A, 526A, 528A are configured to close a first end of the carton 590 and end closure panels 522B, 524B, 526B, 528B are configured to close a second end of the carton 590.

A first end closure panel 522A is hinged to a first end of the base panel 514 by a hinged connection such as a fold line 523A. A second end closure panel 524A is hinged to a first end of the first side panel 516 by a hinged connection such as a fold line 525A. A third end closure panel 526A is hinged to a first end of the top panel 518 by a hinged connection such as a fold line 527A. A fourth end closure panel 528A is hinged to a first end of the second side panel 520 by a hinged connection such as a fold line 529A.

A fifth end closure panel 522B is hinged to a second end of the base panel 514 by a hinged connection such as a fold line 523B. A sixth end closure panel 524B is hinged to a second end of the first side panel 516 by a hinged connection such as a fold line 525B. A seventh end closure panel 526B is hinged to a second end of the top panel 518 by a hinged connection such as a fold line 527B. An eighth end closure panel 528B is hinged to a second end of the second side panel 520 by a hinged connection such as a fold line 529B.

The blank 510 comprises an access feature for facilitating access to the contents of the carton 590. The access feature comprises a deformable region R defined within at least the top panel 518.

The deformable region R comprises a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed.

The Y-shaped cut pattern comprises a repeating pattern of Y-shaped cuts, a leg of each of three adjacently disposed Y-shaped cuts defines a substantially triangular region; the triangular region comprises two truncated corners or vertices. In this way the deformable

region R comprise a plurality of triangular regions each partially connected to the adjacent triangular regions by a connecting portion.

The carton 590 can be formed by a series of sequential folding operations in a straight-line machine so that the carton 590 may not be required to be rotated or inverted to complete its construction. The folding process is not limited to that described below and may be altered according to particular manufacturing requirements.

Turning to the construction of the carton 590 as illustrated in Figure 13, the blank 510 is folded about fold line 515 to bring the securing flap 512 into overlying arrangement with the top panel 518 and the base panel 514 into overlying arrangement with the first side panel 516 and the top panel 518.

Glue or other adhesive treatment is applied to the securing flap 512 or alternatively to a corresponding region of the second side wall panel 520.

The second side wall panel 520 is folded about fold line 519 to bring it into face contacting relationship with the securing flap 512. The second side wall panel 520 is secured to the securing flap 512.

The blank 510 is thus formed into a flat collapsed tubular structure which can be readily shipped or distributed.

In order to erect the carton 590, the flat collapsed tubular structure is formed into a tubular structure by unfolding the second side wall panel 520 with respect to the top panel 518 such that the second side wall panel 520 is disposed substantially perpendicularly with respect to the top and base panels 518, 514.

The carton 590 in its open-ended tubular form, may be loaded with articles or product through one or both open ends thereof. It will be appreciated that in some embodiments one of the open ends of the carton 590 may be closed before loading the interior with articles or product through the remaining open end.

Once the carton 590 has been loaded with articles or product the open ends of the carton 590 are closed.

A first end of the tubular structure is closed by folding the second end closure panel 524A about fold line 525A and by folding the fourth end closure panel 528A about fold line 529A.

Glue or other adhesive treatment may be applied to a first portion of an inner surface of the first end closure panel 522A. In alternative embodiments glue or other adhesive treatment may be applied to a corresponding portion of an outer surface of the second end closure panel 524A.

Glue or other adhesive treatment may be applied to a second portion of an inner surface of the first end closure panel 522A. In alternative embodiments glue or other adhesive treatment may be applied to a corresponding portion of an outer surface of fourth end closure panel 528A.

The first end closure panel 522A is then folded about the fold line 523A to be brought into contact with the second and fourth end closure panels 524A, 528A. The first end closure panel 522A may be secured to each of the second and fourth end closure panels 528A.

Glue or other adhesive treatment is applied to a portion of an inner surface of the third end closure panel 526A. In alternative embodiments glue or other adhesive treatment may be applied to a portion of an outer surface of the first end closure panel 522A.

The third end closure panel 526A is then folded about the fold line 527A to be brought into contact with the first end closure panel 522A and optionally into contact with the second and fourth end closure panels 524A, 528A.

The third end closure panel 526A is secured to the first end closure panel 522A. The third end closure panel 526A may be secured to the second and fourth end closure panels 524A, 528A, for example by glue or other adhesive treatment.

In alternative embodiments the first end closure panel 522A may be folded about fold line 523A after folding the third end closure panel 526A about fold line 527A. It will be appreciated that in such embodiments the first end closure panel 522A is disposed outermost.

A second end of the tubular structure is closed by folding the sixth end closure panel 524B about fold line 525B and by folding the eighth end closure panel 528B about fold line 529B.

The fifth end closure panel 522B is then folded about the fold line 523B to be brought into contact with the sixth and eighth end closure panels 524B, 528B. Optionally, the fifth end closure panel 522B may be secured to each of the sixth and eighth end closure panels 524B, 528B.

Glue or other adhesive treatment is applied to a portion of an outer surface of the fifth end closure panel 522B. Alternatively, glue may be applied in alternative patterns such as glue spots. In alternative embodiments glue or other adhesive treatment may be applied to a portion of an inner surface of the seventh end closure panel 526B.

The seventh end closure panel 526B is then folded about the fold line 527B to be brought into contact with the fifth end closure panel 522B and optionally into contact with the sixth and eighth end closure panels 524B, 528B.

The seventh end closure panel 526B is secured to the fifth end closure panel 522B. Optionally, the seventh end closure panel 526B may be secured to the sixth and eighth end closure panels 524B, 528B, for example by glue or other adhesive treatment.

In other embodiments alternative securing means may be employed to secure the end closure panels 522A, 524A, 526A, 528B, 522B, 524B, 526B, 528B for example, but not limited to, mechanical locking devices such as staples or punch locks integrally formed within the end closure panels 522A, 524A, 526A, 528B, 522B, 524B, 526B, 528B.

The carton 590 is shown in Figure 13, the carton 90 comprises an access feature in the top panel 518. Figure 14 shows the access feature in a deployed condition; the connecting portions between at least some of the cuts forming the auxetic cut pattern have been severed or broken. The deformable region R has been severed or broken to remove or partially detach a portion thereof. The contents of the carton 590 can be removed through the opening created in the top panel 518.

Referring now to Figures 15 and 16, there is shown an additional embodiment of the present disclosure.

Figure 15 shows a blank 610 for forming a carton 690 (see Figure 16), the blank 610 comprises a plurality of main panels 612, 614, 616, 618, 620 hinged one to the next in a linear series by fold lines 613, 615, 617, 619.

A first first side panel portion 612 is hinged to a base panel 614 by a hinged connection in the form of a fold line 613. A second side panel 616 is hinged to the base panel 614 by a hinged connection such as a fold line 615. The second side panel 616 is hinged to a top panel 618 by a hinged connection such as a fold line 617. The top panel 618 is hinged to a second first side panel portion 620 by a hinged connection in the form of a fold line 619.

The plurality of main panels 612, 614, 616, 618, 620 of the blank 610 form walls of a tubular structure in a set-up condition. The tubular structure is at least partially closed by end closure structures. The tubular structure has a tubular axis defining a longitudinal direction.

The blank 610 comprises end closure panels 622A, 624A, 626A, 628A, 630A, 622B, 624B, 626B, 628B, 630B forming end walls of the carton 690.

End closure panels 622A, 624A, 626A, 628A, 630A are configured to close a first end of the carton 690 and end closure panels 622B, 624B, 626B, 628B, 630B are configured to close a second end of the carton 690.

A first end closure panel 622A is hinged to a first end of the first first side panel portion 612 by a hinged connection such as a fold line 623A. A second end closure panel 624A is hinged to a first end of the base panel 614 by a hinged connection such as a fold line 625A. A third end closure panel 626A is hinged to a first end of the second side panel 616 by a hinged connection such as a fold line 627A. A fourth end closure panel 628A is hinged to a first end of the top panel 618 by a hinged connection such as a fold line 629A. A fifth end closure panel 630A is hinged to a first end of the second first side panel portion 620 by a hinged connection such as a fold line 631A.

A sixth end closure panel 622B is hinged to a second end of the first first side panel portion 612 by a hinged connection such as a fold line 623B. A seventh end closure panel 624B is hinged to a second end of the base panel 614 by a hinged connection such as a fold line 625B. An eighth end closure panel 626B is hinged to a second end of the second side panel 616 by a hinged connection such as a fold line 627B. A ninth end closure panel 628B is hinged to a second end of the top panel 618 by a hinged connection such as a fold line 629B. A tenth end closure panel 630B is hinged to a second end of the second first side panel portion 620 by a hinged connection such as a fold line 631B.

The blank 610 comprises an access feature D for facilitating access to the contents of the carton 690. The access feature D comprises an access flap 616a, 618a defined in part in the

second side panel 616 and in part in top panel 618. The access feature D comprises a deformable region R defined within at least the second side panel 616 adjacent to the portion of the access flap 616a, 618a defined therein. The access flap 616a, 618a is defined by a first severance line 641 defined in the top panel 618. The access flap 616a, 618a is defined by a second and third severance lines 643, 645 defined in the top panel 618 and extending into the second side panel 616. The second and third severance lines 643, 645 extend from opposed ends of the first severance line 641 so as to be contiguous therewith.

The second and third severance lines 643, 645 extend to the deformable region R provided in the second side panel 616. The deformable region R extends between a terminal end of the second severance line 643 and a terminal end of the third severance line 645.

The deformable region R comprises a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed.

The Y-shaped cut pattern comprises a repeating pattern of Y-shaped cuts, a leg of each of three adjacently disposed Y-shaped cuts defines a substantially triangular region; the triangular region comprises two truncated corners or vertices. In this way the deformable region R comprise a plurality of triangular regions each partially connected to the adjacent triangular regions by a connecting portion.

The shape of the deformable region R may be altered depending on the article diameter and shape being packaged. The illustrated embodiment employs a trapezoidal shaped deformable region R which may be visually interesting and may invite or encourage a user to utilise the deformable region R to open the package. The trapezoidal shape may also indicate in which direction the package opens. In the carton 690, the articles may be arranged and oriented such that the sides of the articles come into contact with the second side panel 616, with the cut pattern, while the ends of the articles may come into contact with the single-ply panels, top panel 618 and base panel 614, adjoining the second side panel 616.

The carton 690 can be formed by a series of sequential folding operations in a straight-line machine so that the carton 690 may not be required to be rotated or inverted to complete its construction. The folding process is not limited to that described below and may be altered according to particular manufacturing requirements.

Turning to the construction of the carton 690 as illustrated in Figure 16, the blank 610 is folded about fold line 615 to bring the first first side panel portion 612 into overlying arrangement with the top panel 618 and the base panel 614 into overlying arrangement with the second side panel 616 and the top panel 618.

Glue or other adhesive treatment is applied to the first first side panel portion 612 or alternatively to a corresponding region of the second first side panel portion 620.

Glue or other adhesive treatment is applied to the first and fifth end closure panels 622A, 622B or alternatively to corresponding regions of the fifth and tenth end closure panels 630A, 630B.

The second first side panel portion 620 is folded about fold line 619 to bring it into face contacting relationship with the first first side panel portion 612. The second first side panel portion 620 is secured to the first first side panel portion 612. The second first side panel portion 620 and the first first side panel portion 612 form a first side wall 612/620.

The first end closure panel 622A is brought into partial overlapping relationship with the fifth end closure panel 630A. The first end closure panel 622A is secured to the fifth end closure panel 630A to form a composite end closure panel 622A/630A.

The fifth end closure panel 622B is brought into partial overlapping relationship with the tenth end closure panel 630B. The fifth end closure panel 622B is secured to the tenth end closure panel 630B to form a composite end closure panel 622B/630B.

The blank 610 is thus formed into a flat collapsed tubular structure which can be readily shipped or distributed.

In order to erect the carton 690, the flat collapsed tubular structure is formed into a tubular structure by unfolding the first side wall 612/620 with respect to the top panel 618 such that the first side wall 612/620 is disposed substantially perpendicularly with respect to the top and base panels 618, 614.

The carton 690 in its open-ended tubular form, may be loaded with articles through one or both open ends thereof. It will be appreciated that in some embodiments one of the open ends of the carton 690 may be closed before loading the interior with articles through the remaining open end.

Once the carton 690 has been loaded with articles the open ends of the carton 690 are closed.

A first end of the tubular structure is closed by folding the first and fifth end closure panels 622A, 630B about fold lines 623A,625A and by folding the third end closure panel 626A about fold line 627A.

Glue or other adhesive treatment may be applied to a first portion of an inner surface of the second end closure panel 624A. In alternative embodiments glue or other adhesive treatment may be applied to a corresponding portion of an outer surface of the first and fifth end closure panels 622A, 630B.

Glue or other adhesive treatment may be applied to a second portion of an inner surface of the second end closure panel 624A. In alternative embodiments glue or other adhesive treatment may be applied to a corresponding portion of an outer surface of third end closure panel 626A.

The second end closure panel 624A is then folded about the fold line 625A to be brought into contact with the first and fifth end closure panels 622A, 630B and the third end closure panel 626A. The second end closure panel 624A may be secured to first and fifth end closure panels 622A, 630B and to the third end closure panel 626A.

Glue or other adhesive treatment is applied to a portion of an inner surface of the fourth end closure panel 628A. In alternative embodiments glue or other adhesive treatment may be applied to a portion of an outer surface of the second end closure panel 624A.

The fourth end closure panel 628A is then folded about the fold line 629A to be brought into contact with the second end closure panel 624A and optionally into contact with the first and fifth end closure panels 622A, 630B and the third end closure panel 626A.

The fourth end closure panel 628A is secured to the second end closure panel 624A. The fourth end closure panel 628A may be secured to the first and fifth end closure panels 622A, 630B and may be secured to the third end closure panel 626A, for example by glue or other adhesive treatment.

In alternative embodiments the second end closure panel 624A may be folded about fold line 625A after folding the fourth end closure panel 628A about fold line 629A. It will be appreciated that in such embodiments the second end closure panel 624A is disposed outermost.

A second end of the tubular structure is closed by folding the sixth, seventh, eighth, ninth and tenth end closure panels 622B, 624B, 626B, 628B, 630B in similar manner to that described above in relation to the first, second, third, fourth and fifth end closure panels 622A, 624A, 626A, 628A, 630A.

In other embodiments alternative securing means may be employed to secure the end closure panels 622A, 624A, 626A, 628A, 630A, 622B, 624B, 626B, 628B, 630B for example, but not limited to, mechanical locking devices such as staples or punch locks integrally formed within the end closure panels 622A, 624A, 626A, 628A, 630A, 622B, 624B, 626B, 628B, 630B.

The carton 690 is shown in Figure 16, the carton 690 comprises an access feature in the top panel 618 and second side panel 616. The deformable region R is severable to remove or partially detach a portion thereof so as to facilitate deployment or opening of the access flap 616a/618a. The contents of the carton 690 can be removed through the opening created in the top panel 618 and second side panel 616.

Referring now to Figure 17, there is shown an additional embodiment of the present disclosure.

Figure 17 shows a blank 710 for forming a carton (not shown), the blank 710 comprises a plurality of main panels 712, 714, 716, 718, 720, 722, 724, 728 for forming a tubular structure, hinged one to the next in a linear series by fold lines 713, 715, 717, 719, 721,723, 725, 727 respectively.

The plurality of main panels 712, 714, 716, 718, 720, 722, 724, 728 comprises: a first base panel 712, a first corner panel 714, a first side panel 716, a second corner panel 718, a top panel 720, a third corner panel 722, a second side panel 724, a fourth corner panel 726 and a second base panel 728.

In alternative embodiments, the first, second, third and fourth corner panels 714, 718, 722, 726 may be omitted, the fold lines 715, 717, 723, 725 may be omitted.

The first and fourth corner panels 714, 726 may be considered to form lower portions of the respective one of the first or second side panels 716, 724, or alternatively portions of the first or second base panels 712, 728, to which they are hingedly connected.

The second and third corner panels 718, 722 may be considered to form upper portions of the respective one of the first or second side panels 716, 724, or alternatively portions of the top panel 720, to which they are hingedly connected.

The blank 710 is foldable to form a package (not shown). The first and second base panels 712, 728 are engageable with one another in an overlapping relationship to form a composite base wall 712/728 of the carton. The blank 710 may comprise a complementary locking mechanism for securing the second base panel 728 to the first base panel 712. The first base panel 712 may comprise at least one first part M of the complementary locking mechanism. The second base panel 728 may comprise at least one second part F of the complementary locking mechanism. In the illustrated embodiment, the second base panel 728 comprises a plurality of female tabs F defining openings in the second base panel 728. The first base panel 712 comprises a plurality of male tabs M, the openings in the second base panel 728 being configured to receive a respective one of the male tabs M. The female tabs F are arranged to be displaced out of the second base panel 728 to form the openings and to bear against the male tabs M when received therein. In some embodiments the complementary locking mechanism M/F may be omitted, the first and second base panels 712, 728 may be secured to each other by other means such as but not limited to adhesive or staples.

Optionally, the first and second base panels 712, 728 may comprise at least one first aperture A1. In the illustrated embodiment, each of the first and second base panels 712, 728 comprises two first apertures A1. Optionally, the first and second base panels 712, 728 may comprise at least one second aperture A2. In the illustrated embodiment, each of the first and second base panels 712, 728 comprises one second apertures A2. The first and second apertures A1, A2 may be employed to facilitate construction of the carton. A packaging machine component may engage with the first and second apertures A1, A2 to enable the plurality of panels 712, 714, 716, 718, 720, 722, 724, 728 to be tightened about a group of articles (not shown). The first and second apertures A1, A2 may also be employed to facilitate alignment of the first and second base panels 712, 728 with respect to each other or to align the first part of the complementary locking mechanism with the second part of the complementary locking mechanism. The complementary locking mechanism illustrated and described is entirely optional.

The blank 710 comprise at least one heel engagement structure HT for engaging with a heel or lower portion of an article. The blank 710 illustrated in Figure 17 comprises six heel engagement structures HT each is provided for engaging a respective article.

Each of the heel engagement structures HT is substantially similar in construction and will be described by reference to heel engagement structures HT provided in the first side panel 716.

The heel engagement structure HT may comprise an opening. The opening is defined at least in part by a heel tab 740. The heel tab 740 is hingedly connected to the first base panel 712 by fold line 741. The heel tab 740 is struck, at least in part, from the first corner panel 714.

The fold line 741 interrupts the fold line 713 hingedly connecting the first base panel 712 to the first corner panel 714. The fold line 741 may be non-linear, in the illustrated embodiment the fold line 741 is curved or arcuate in shape, in other embodiments it may be formed from at least two linear fold lines divergently arranged with respect to each other and contiguous with each other.

The heel engagement structure HT comprises a deformable region R1, R2, R3. The deformable region R1, R2, R3 is defined in part in the first corner panel 714 and in part in the first side panel 716.

The deformable regions R1, R2, R3 interrupt the fold line 715 hingedly connecting the first side panel 716 to the first corner panel 714.

The deformable regions R1, R2, R3 are arranged in vertical registry with a respective one of the openings defined by the heel tabs 740.

The deformable regions R1, R2, R3 comprise a plurality of cuts C forming an auxetic cut pattern. In the illustrated embodiment the auxetic cut pattern comprises a plurality of Y-shaped cuts, however in other embodiments other cut patterns may be employed.

The top panel 720 may comprise an optional handle structure H. The handles structure H comprises a pair of foldable finger tabs 760. The finger tabs 760 are spaced apart from each other. The finger tabs 760 are hingedly connected to the top panel 720 by fold lines 761 and are defined in part by a cut line or severance line 763. A first one of the finger tabs 760 is hingedly connected to the top panel 720 in opposition to a second one of the finger tabs 760.

The blank 710 comprises end retention structures for preventing or inhibiting the contents of the carton from dislodging from the carton when said blank 710 is erected into the carton.

Each end retention structure comprises an anchoring portion 730A, 730B, 740A, 740B hingedly connected to the adjacent side panel 716, 724 along a fold line 729A, 729B, 743A, 743B. Each end retention structure comprises a gusset portion 732A, 732B, 738A, 738B hingedly connected to the anchoring portion 730A, 730B, 740A, 740B along a fold line 731A, 731B, 741A, 741B.

Each end retention structure comprises a web portion 734A, 734B, 736A, 736B hingedly connected to the gusset portion 732A, 732B, 738A, 738B along an extension 733A, 733B, 739A, 739B of respective one of the fold lines 719, 721. Each web portion 734A, 734B, 736A, 736B is hingedly connected to the top panel 720 by a fold line 735A, 735B, 737A, 737B.

An optional aperture A4 may be struck in part from the top panel 720, in part from the first or second side panel 716, 724 and/or second or third corner panel 718, 722, in part from the anchoring portion 730A, 730B, 740A, 740B and in part from the gusset portion 732A, 732B, 738A, 738B. The aperture A4 defines a terminus of each of the fold lines 719, 721; 729A, 729B, 743A, 743B; 731A, 731B, 741A, 741B; 733A, 733B, 739A, 739B; 735A, 735B, 737A, 737B and is disposed at a vertex of aforesaid fold lines.

Folding of each end retention structure is achieved during the erection of the carton. To form a top engaging structure out of each end retention structure, the anchoring portion 730A, 730B, 740A, 740B is folded about 180 degrees to bring it into a face-contacting relationship with the inside surface of the adjacent side panel 716, 724. The anchoring portion 730A, 730B, 740A, 740B is held in the folded position by being pressed by one of the packaged articles against the adjacent side panel 716, 724. The folding of the anchoring portion 730A, 730B, 740A, 740B causes the gusset portion 732A, 732B, 738A, 738B to be folded outwardly about the fold line 731A, 731B, 741A, 741B so that the gusset portion 732A, 732B, 738A, 738B extends outwardly from the fold line 731A, 731B, 741A, 741B along the side wall of the one packaged article. At the same time, the web portion 734A, 734B, 736A, 736B is caused to fold downwardly along the fold line 735A, 735B, 737A, 737B and is thereby brought to a folded position where it extends between the fold line 735A, 735B, 737A, 737B and the outer edge of the gusset portion 732A, 732B, 738A, 738B. The top-engaging structure thus completed tightly engages the top of an article.

Turning to the construction of a carton from the blank 710, the carton can be formed by a series of sequential folding operations in a straight-line machine so that the carton is not required to be rotated or inverted to complete its construction. The folding process is not

limited to that described below and may be altered according to particular manufacturing requirements.

A group of articles is assembled; for the embodiment illustrated six articles are arranged in a 2 x 3 array. The top panel 720 of the blank 710 is disposed above the group of articles to provide a top wall 720 of the carton.

The second and third corner panels 718, 722 are folded, with respect to the top panel 720 about fold lines 719, 721 respectively, about shoulders of the articles forming the group of articles.

The first and second side panels 716, 724 are folded, with respect to the respective one of the second and third corner panels 718, 722 about fold lines 717, 723 respectively, about opposing sides of the group of articles so as to be disposed about the opposing sides of the group of articles to form first and second side walls 716, 724 of the carton.

The anchor portions 730A, 730B, 740A, 740B may be folded into face contacting relationship with the respective one of the first and second side panels 716, 724 substantially simultaneously with folding the first and second side panels 716, 724, to form the top engaging structures described above.

Alternatively, the top engaging structures may be formed subsequent to erection of the carton into a tubular form. The anchor portions 730A, 730B, 740A, 740B may be tucked between the respective one of the first and second side panels 716, 724 to which they are hingedly connected and an adjacently disposed article.

The first and fourth corner panels 714, 726 are folded, with respect to the respective one of the first and second side panels 716, 724 about fold lines 715, 725 respectively, about the heels or lower portions of adjacently disposed articles.

The heel tabs 740 may folded out of the plane of the first and fourth corner panels 714, 726, about fold lines 741, prior to folding the first and fourth corner panels 714, 726 with respect to the respective one of the first and second side panels 716, 724.

The second base panel 728 is folded about the fold line 727 so as to be disposed adjacent to the base of the group of articles, the first base panel 712 is then folded about the fold line 713 so as to be in at least partial overlapping relationship with the second base panel 728; in doing

so each of the heel tabs 740 may be brought into engagement with a base of a respective article.

The first and second base panels 712, 728 are secured together. Each of the male tabs M is displaced inwardly out of the plane of the first base panel 712. In so doing, each of the female tabs F is displaced inwardly creating a corresponding opening in the second base panel 728. The male tabs M are received in respective ones of the openings so as to lock the first and second base panels 712, 728 together. In this way a tubular structure is formed about the group of articles.

The deformable regions R1, R2, R3, R4, R5, R6 in the first and second side panels 716, 724 are displaced or deformed outwardly when the blank 710 is erected into a carton. The first and second side panels 716, 724 stretch to accommodate a heel or lower portion of the articles. The cuts of the auxetic cut pattern may open up as a consequence.

The embodiments of the present disclosure provide a carton 90; 190; 290; 390; 490; 590; 690 for packaging one or more articles B. The carton 90; 190; 290; 390; 490; 590; 690 comprises at least one panel having an auxetic cut pattern.

The cut pattern may form or create at least part of a tear opening feature.

Additionally, or alternatively, the cut pattern may form or create at least one stretchable or deformable panel portion R, R1, R2, R3, R4. The stretchable panel portion R, R1, R2, R3, R4, when the carton 90; 190; 290; 390; 490; 590; 690 receives, or is applied to, at least one article B, conforms with, or deforms about, the contoured surface of the at least one article B.

The carton 90; 190; 290; 390; 490; 590; 690 forms a package with the at least one article B, said at least one panel forms an external panel of the package. In this way the external shape of the package adopts, at least in part the shape of the at least one article B.

The stretchable panel portion R, R1, R2, R3, R4, when the carton 90; 190; 290; 390; 490; 590; 690 receives the at least one article B, may be placed in a state of tension about at least a portion of the at least one article B. Together with one or more further panels of the carton 90; 190; 290; 390; 490; 590; 690 the stretchable panel portion R, R1, R2, R3, R4 clutches, grips or frictionally engage with the at least one article B to prevent or inhibit movement of the at least one article B.

One or more cuts C of the auxetic cut pattern provided in the stretchable panel portion R, R1, R2, R3, R4 may open up to expose to view a portion of the at least one article B.

The stretchable panel portion R, R1, R2, R3, R4 may be provided in a side panel, an upright or upstanding panel of the carton 90; 190; 290; 390; 490; 590; 690.

It can be appreciated that various changes may be made within the scope of the present invention. For example, the size and shape of the panels and apertures may be adjusted to accommodate articles of differing size or shape.

Whilst the foregoing embodiments have been described with reference to a fully enclosed carton it is envisaged that the dispenser may be employed in cartons of alternative design such as, but not limited to, wraparound style cartons, basket carries and top gripping clips.

It will be recognized that as used herein, directional references such as "top", "base", "front", "back", "end", "side", "inner", "outer", "upper" and "lower" do not limit the respective panels to such orientation, but merely serve to distinguish these panels from one another. Any reference to "hinged connection" should not be construed as necessarily referring to a single fold line only; indeed it is envisaged that a hinged connection can be formed from one or more of the following: a short slit, a frangible line or a fold line, without departing from the scope of the invention. It can be appreciated that various changes may be made within the scope of the present invention. For example, the size and shape of the panels and apertures may be adjusted to accommodate articles of differing size or shape.

As used herein, the term "cutaway" may refer to one of the following: a recess, a notch, a slot, an opening, a cutline, a line of perforations, a line of short slits, a line of half-cuts, a single half-cut, an interrupted cut line, aligned slits, a line of short scores and any combination of the aforesaid options, without departing from the scope of the invention.

As used herein, the terms "hinged connection" and "fold line" each refers to all manner of lines that define hinge features of the blank or substrate of sheet material, facilitate folding portions of the blank or substrate of sheet material with respect to one another, or otherwise indicate optimal panel folding locations for the blank or substrate of sheet material. Any reference to "hinged connection" should not be construed as necessarily referring to a single fold line only; indeed, a hinged connection can be formed from one or more fold lines.

As used herein, the term "fold line" may refer to one of the following: a scored line, an embossed line, a debossed line, a line of perforations, a line of short slits, a line of half-cuts, a single half-cut, an interrupted cut line, aligned slits, a line of short scores and any combination of the aforesaid options, without departing from the scope of the invention.

As used herein, the term "severance line" may refer to all manner of lines formed in the blank or substrate of sheet material that facilitate separating portions of the blank or substrate of sheet material from one another, or otherwise that indicate optimal separation locations on the blank or substrate. As used herein, the term "severance line" may refer to one of the following: a single cut line, a single partial-depth cut line (e.g., a single half-cut line), an interrupted cut line, a score line, an interrupted score line, a line of perforations, a line of short cuts, a line of short slits, a line of short partial-depth cuts (e.g., a line of short half cuts), and any combination of the aforementioned options.

It should be understood that hinged connections, fold lines and severance lines can each include elements that are formed in the blank or substrate of sheet material, including perforations, a line of perforations, a line of short slits, a line of half-cuts, a single half-cut, a cut line, an interrupted cut line, slits, scores, any combination thereof, and the like. The elements can be dimensioned and arranged to provide the desired functionality. For example, a line of perforations can be dimensioned or designed with degrees of weakness to define a fold line and/or a severance line. The line of perforations can be designed to facilitate folding and resist breaking to provide a fold line, to facilitate folding and facilitate breaking with more effort to provide a frangible fold line, or to facilitate breaking with little effort to provide a severance line.

CLAIMS

1. A carton for packaging one or more articles, the carton comprising a plurality of panels defining a plurality of external walls and defining an interior, at least one panel of the plurality of panels comprising a deformable panel portion having an auxetic cut pattern, the auxetic cut pattern providing a stretchable panel conformable with a contoured surface of the one or more articles.

2. A carton according to claim 1, wherein the deformable panel portion together with at least one other panel of the plurality of panels grips the one or more articles or a portion thereof.

3. A carton according to claim 2, wherein the at least one other panel of the plurality of panels comprises a second deformable panel portion having an auxetic cut pattern.

4. A carton according to claim 2, wherein a second region of the at least one panel outside of the deformable region is secured to the at least one other panel of the plurality of panels.

5. A carton according to claim 2, wherein a second region of the at least one panel outside of the deformable region is adhered to the at least one other panel of the plurality of panels.

6. A carton according to claim 3, wherein a second region of the at least one panel outside of the deformable region is secured to a third region of the at least one other panel of the plurality of panels, the third region is disposed outside of the second deformable region of the at least one other panel of the plurality of panels.

7. A carton according to claim 1, wherein the at least one panel of the plurality of panels comprises at least part of a handle structure.

8. A carton according to claim 1, wherein the at least one panel of the plurality of panels comprises an article receiving opening disposed adjacent to the deformable panel portion that together with the deformable panel portion forms an article retention device.

9. A carton according to claim 8, wherein the article retention device engages an upper end of an article.

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10. A carton according to claim 8, wherein the article retention device engages a heel of an article.

11. A carton according to claim 8, wherein the article retention device engages a lower end portion of an article.

12. A carton according to claim 8, wherein the article receiving opening is defined at least in part by a tab hinged to one of the walls of the carton.

13. A carton for packaging one or more articles, the carton comprising at least one panel having a deformable panel portion comprising an auxetic cut pattern, the auxetic cut pattern providing a tear opening device to facilitate access to the carton.

14. A carton for packaging one or more articles, the carton comprising at least one panel having a deformable panel portion comprising an auxetic cut pattern, the auxetic cut pattern providing a severable region for creating in an opening in the at least one panel to facilitate access to the carton.

15. A carton according to claim 13, wherein the at least one panel comprises a tear initiation tab adjacent to the deformable panel portion.

16. A carton according to claim 13, wherein the at least one panel comprises a tear initiation tab integral with the deformable panel portion.

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17. A carton according to claim 13, wherein the deformable panel portion is disposed adjacent to an access flap, the access flap being defined by one or more severance lines, the deformable panel portion being deformable to facilitate severance of the one or more severance lines.

18. A carton according to claim 13, wherein the deformable panel portion defines an access opening in the at least one panel.

19. A carton for packaging one or more articles, the carton comprising a plurality of panels defining an interior, at least one of the plurality of panels comprising a deformable panel portion having an auxetic cut pattern, the auxetic cut pattern providing a tear opening device to facilitate access to the interior of the carton.

20. A carton for packaging one or more articles, the carton comprising a plurality of panels defining a tubular structure, each of the plurality of panels comprising a deformable panel portion having an auxetic cut pattern, the auxetic cut pattern providing a severable strip surrounding the tubular structure.

21. A carton for packaging one or more articles, the carton comprising a plurality of panels defining a plurality of external walls and defining an interior, at least one of the plurality of panels comprising a deformable panel portion having an auxetic cut pattern, the auxetic cut pattern providing a tear opening device to facilitate access to the carton.

22. A carton according to claim 21, wherein the deformable panel portion is deformable to form a first wall of the carton and a second adjacent wall of the carton.

23. A carton according to claim 21, wherein the auxetic cut pattern provides a tear opening device to facilitate access to the carton.

24. A blank for forming a carton, the blank comprising at least one panel having a deformable panel portion comprising an auxetic cut pattern, the auxetic cut pattern providing a tear opening device.

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25. A blank for forming a carton, the blank comprising a plurality of panels for forming an interior chamber, at least one of the plurality of panels comprising a deformable panel portion having an auxetic cut pattern, the auxetic cut pattern providing a stretchable panel conformable with a contoured surface of an article.

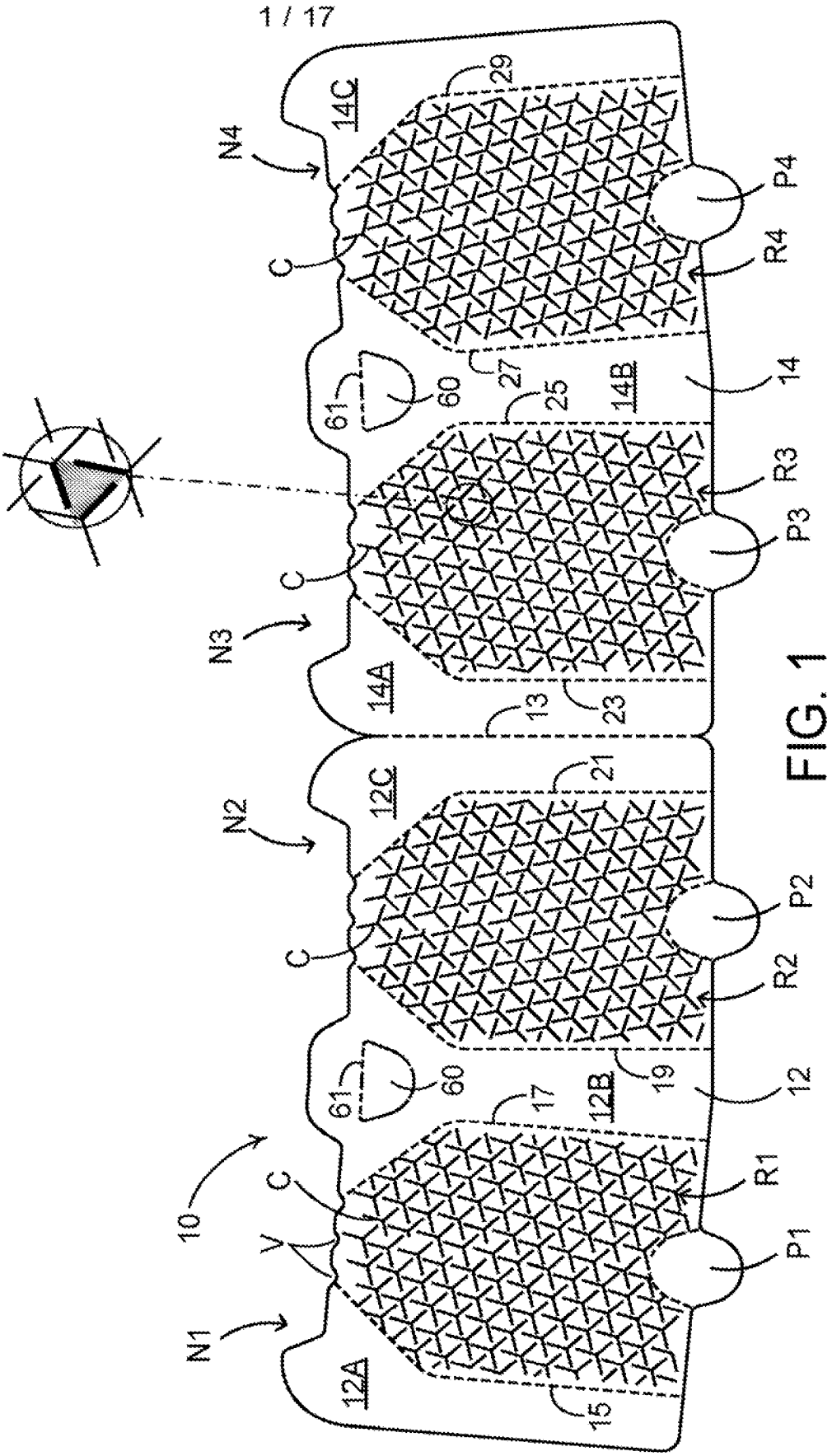

10
N1
N2
N3
N4
C
V
12A
12B
12C
14A
14B
14C
P1
P2
P3
P4
R1
R2
R3
R4
60
61
12
13
14
15
17
19
21
23
25
27
29

FIG. 1

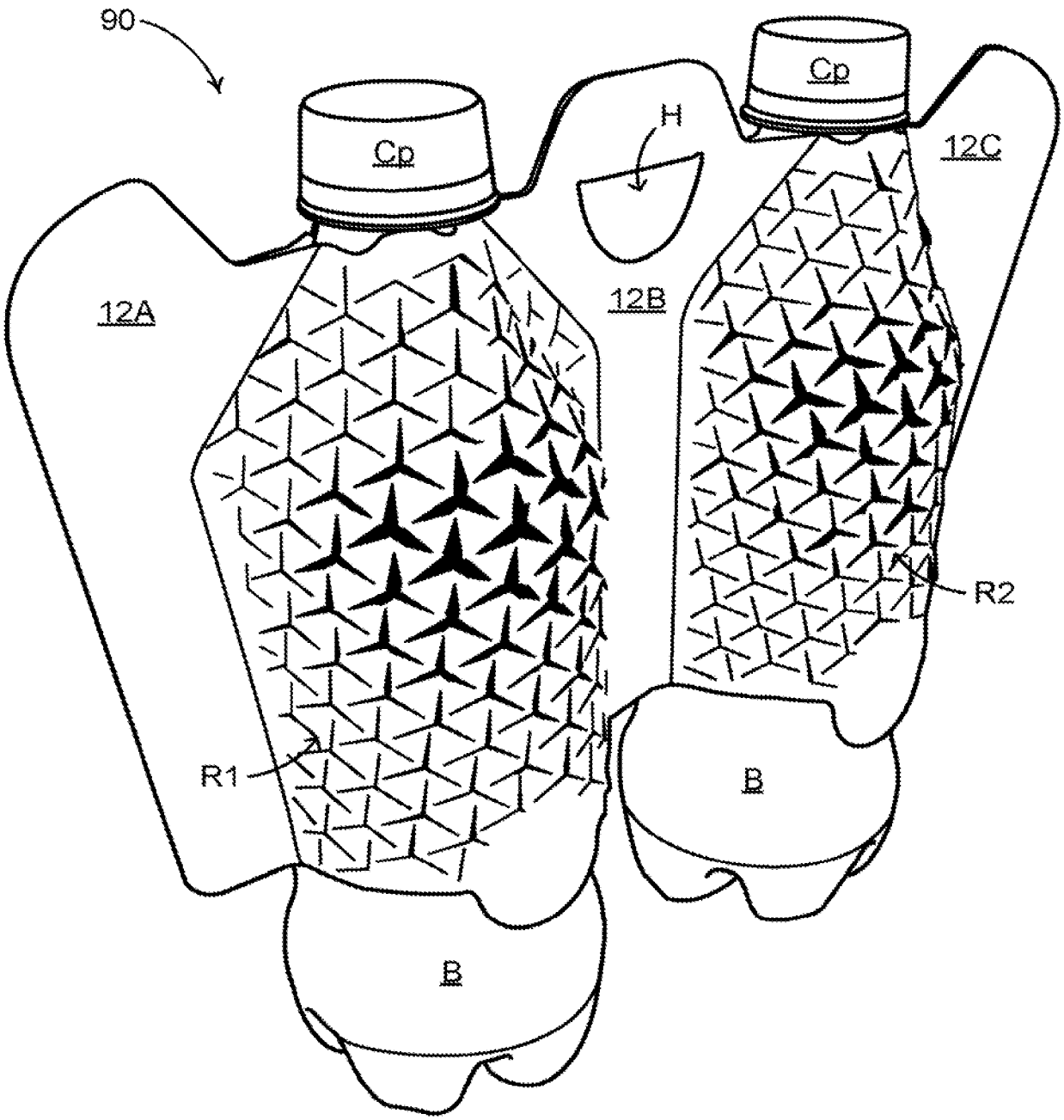


FIG. 2

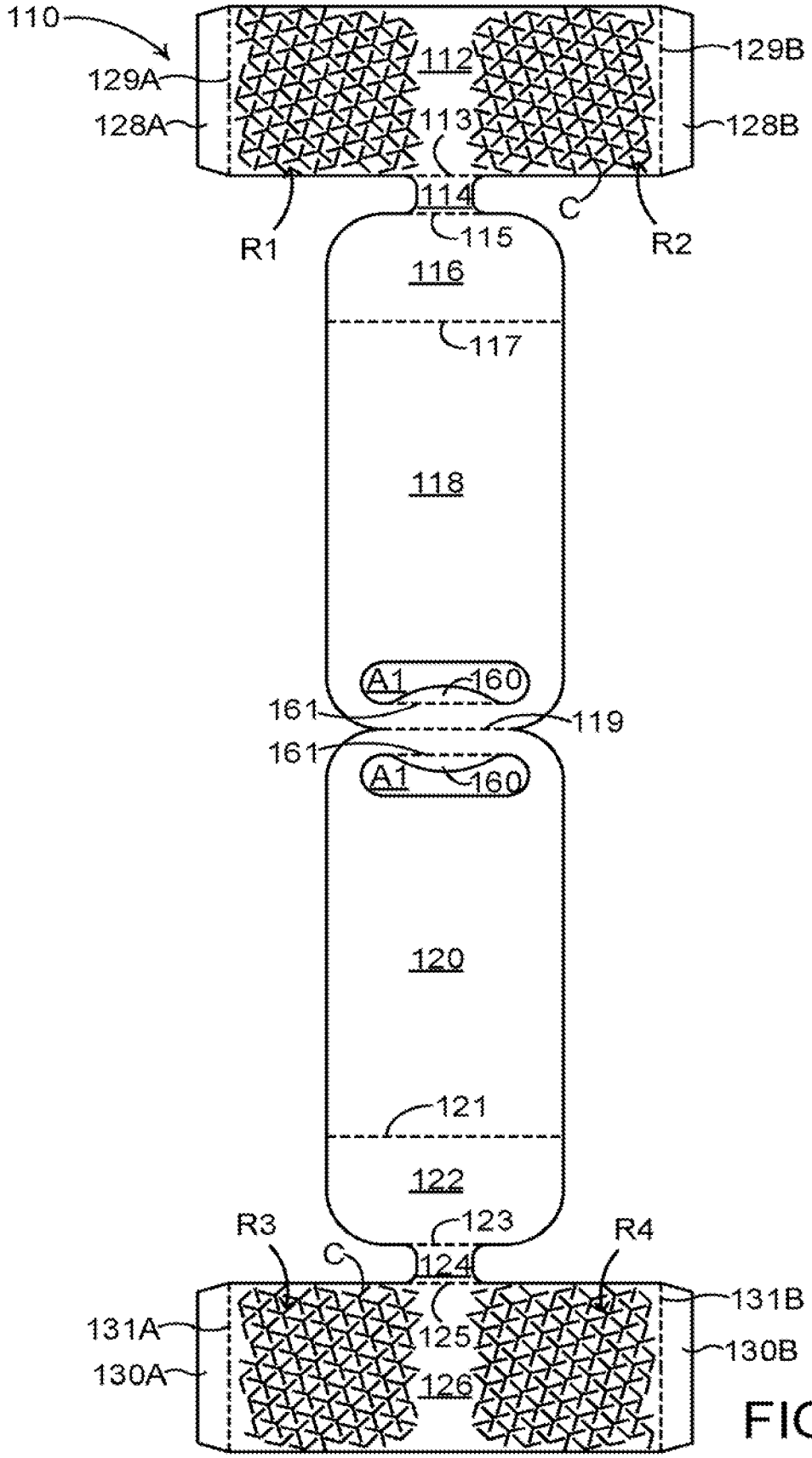

110
129A
112
129B
128A
113
128B
114
R1
115
R2
116
117
118
A1
160
161
119
161
A1
160
120
121
122
R3
123
R4
124
131B
131A
125
130B
130A
126

FIG. 3

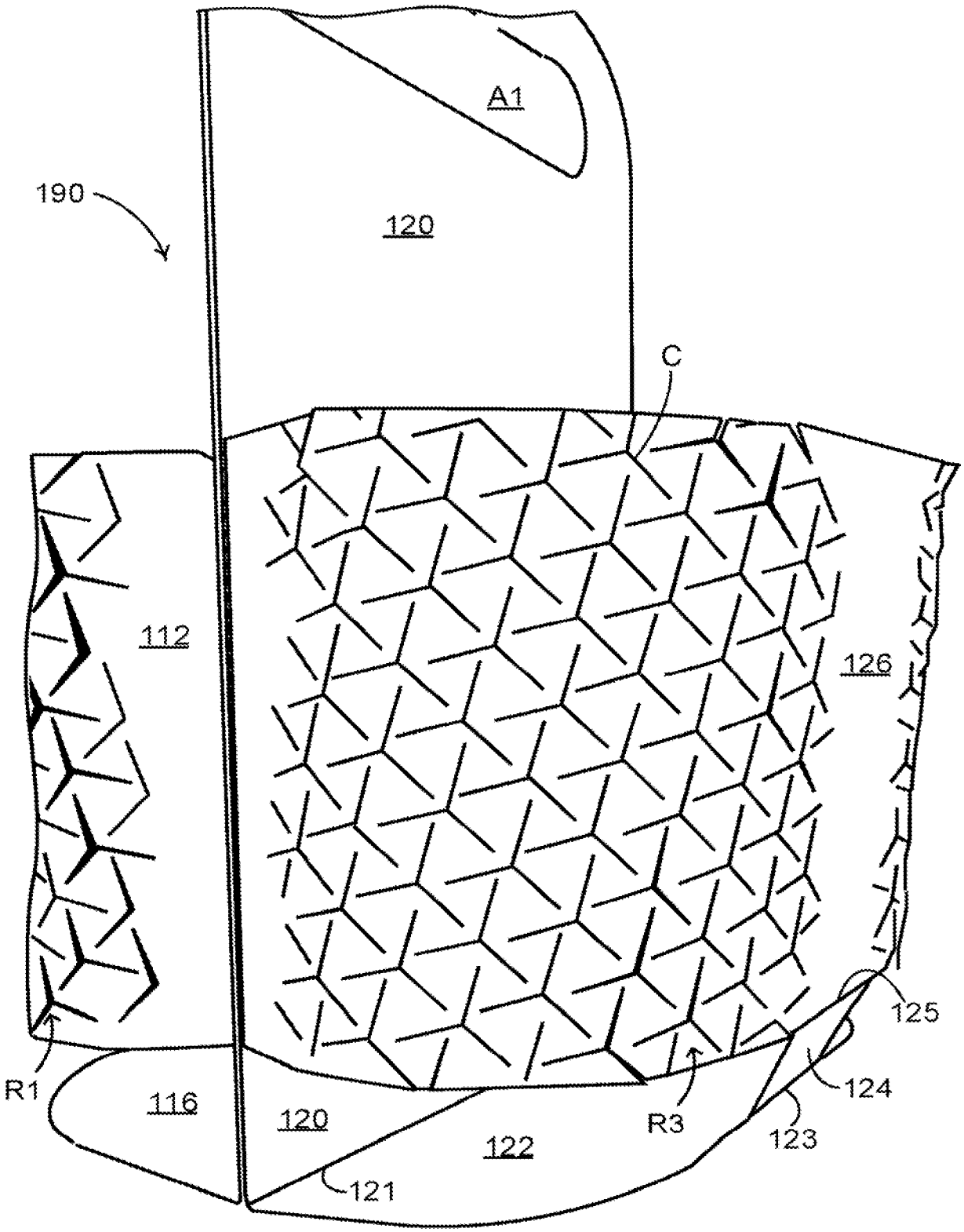


FIG. 4

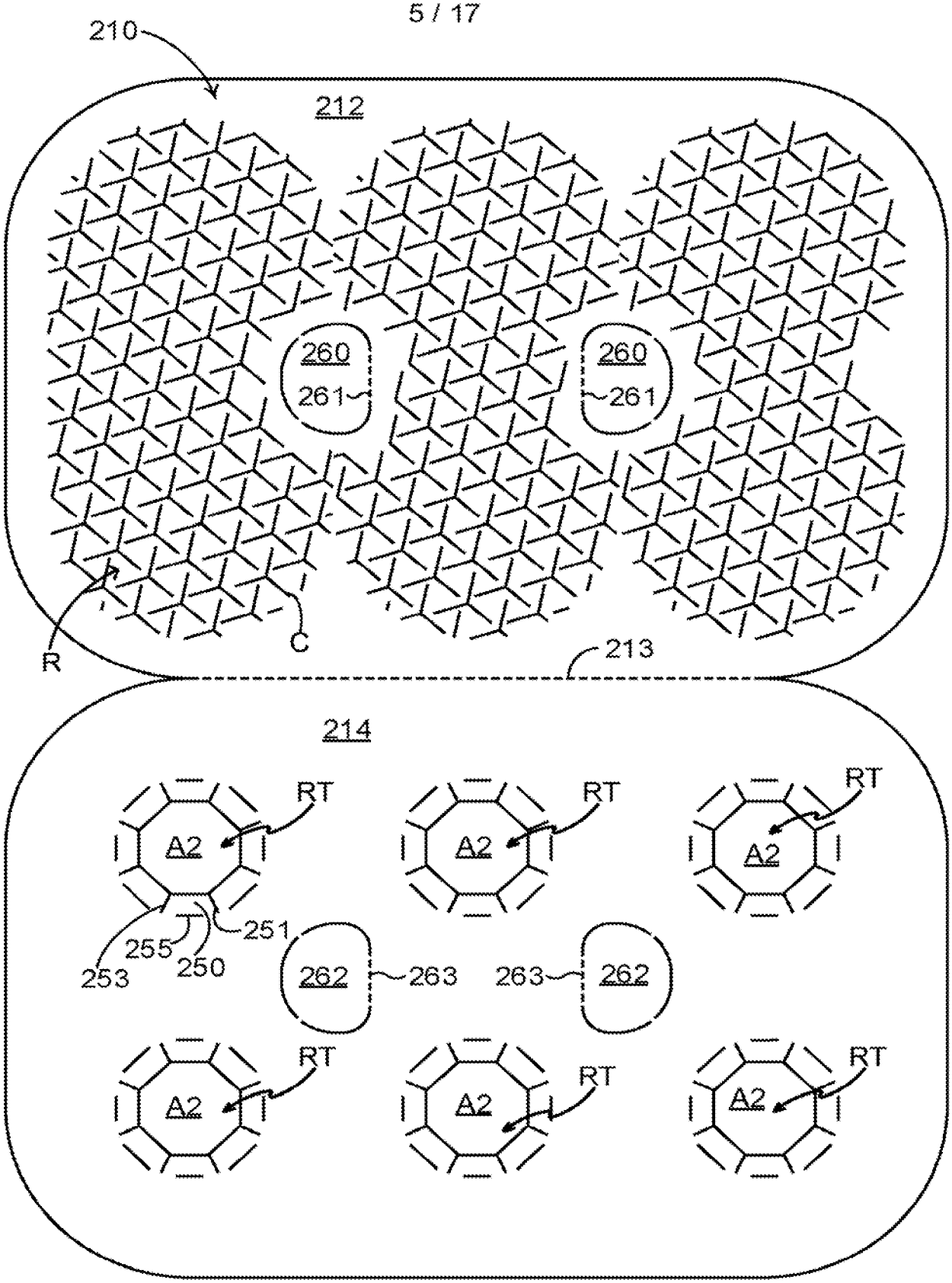

210
212
260
261
260
261
R
C
213
214
RT
A2
RT
A2
RT
A2
251
255
253
250
262
263
263
262
RT
A2
RT
A2
RT
A2

FIG. 5

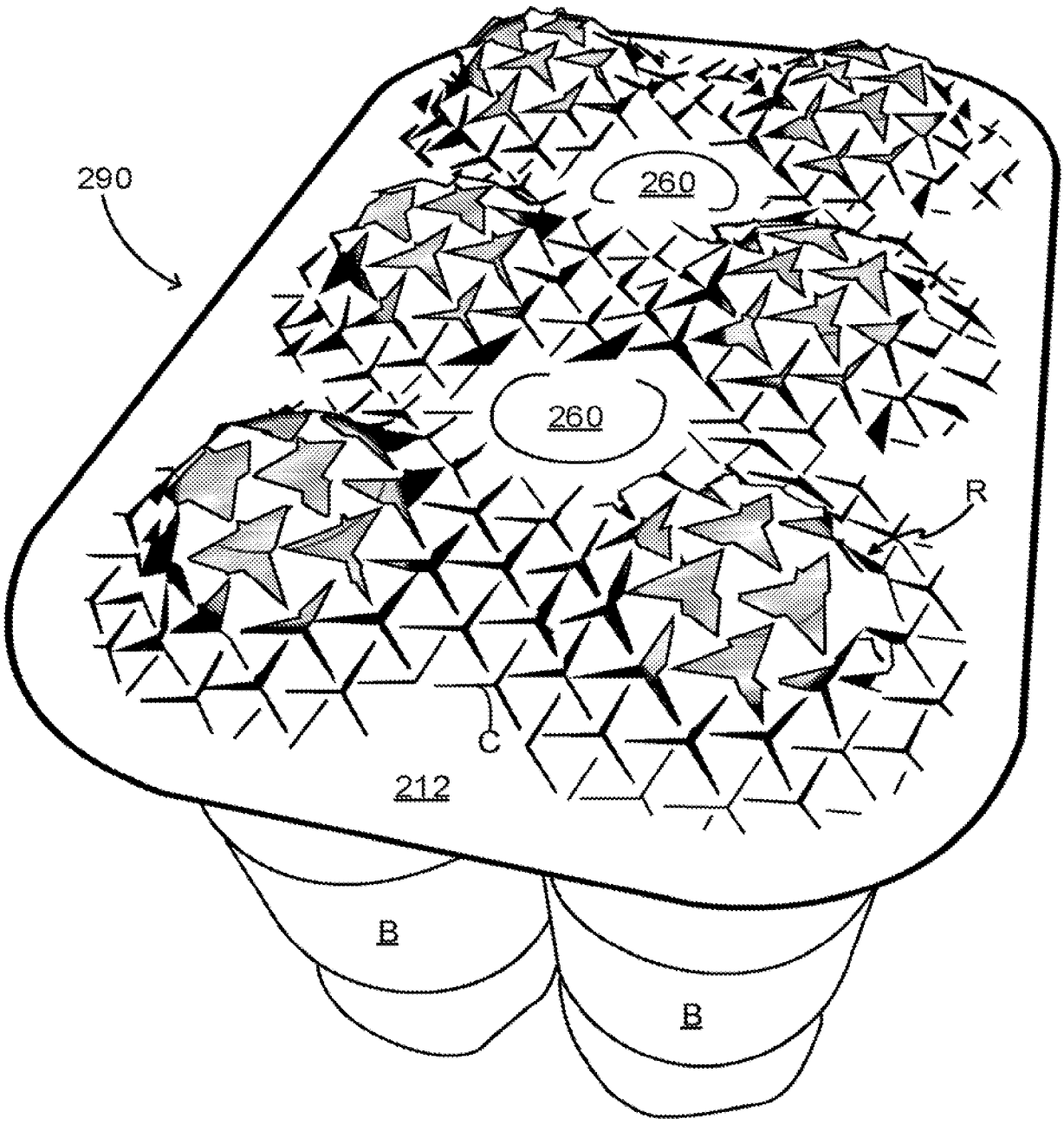


FIG. 6

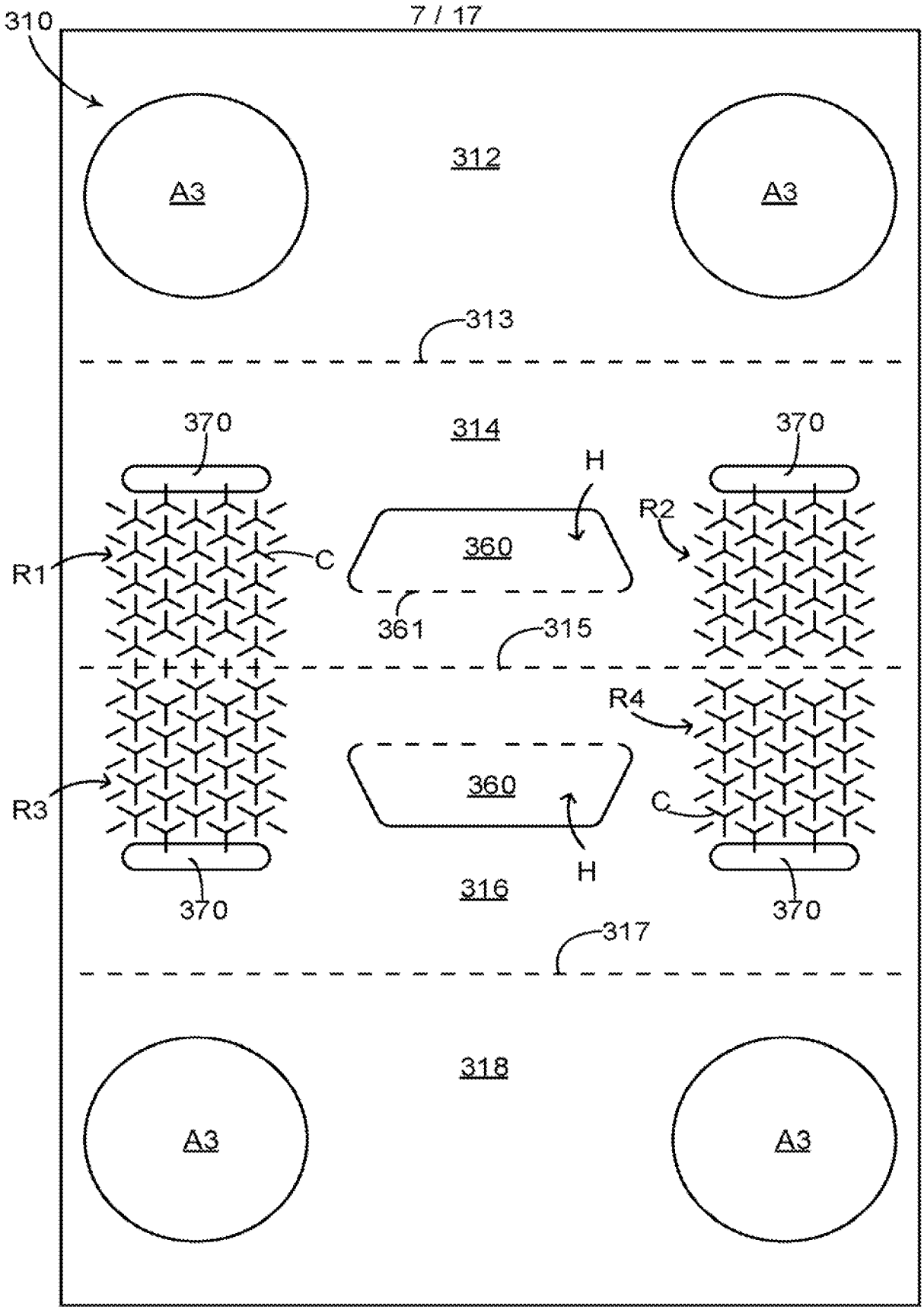

310
312
A3
A3
313
370
314
370
H
R2
R1
C
360
361
315
R4
R3
360
C
H
316
370
370
317
318
A3
A3

FIG. 7

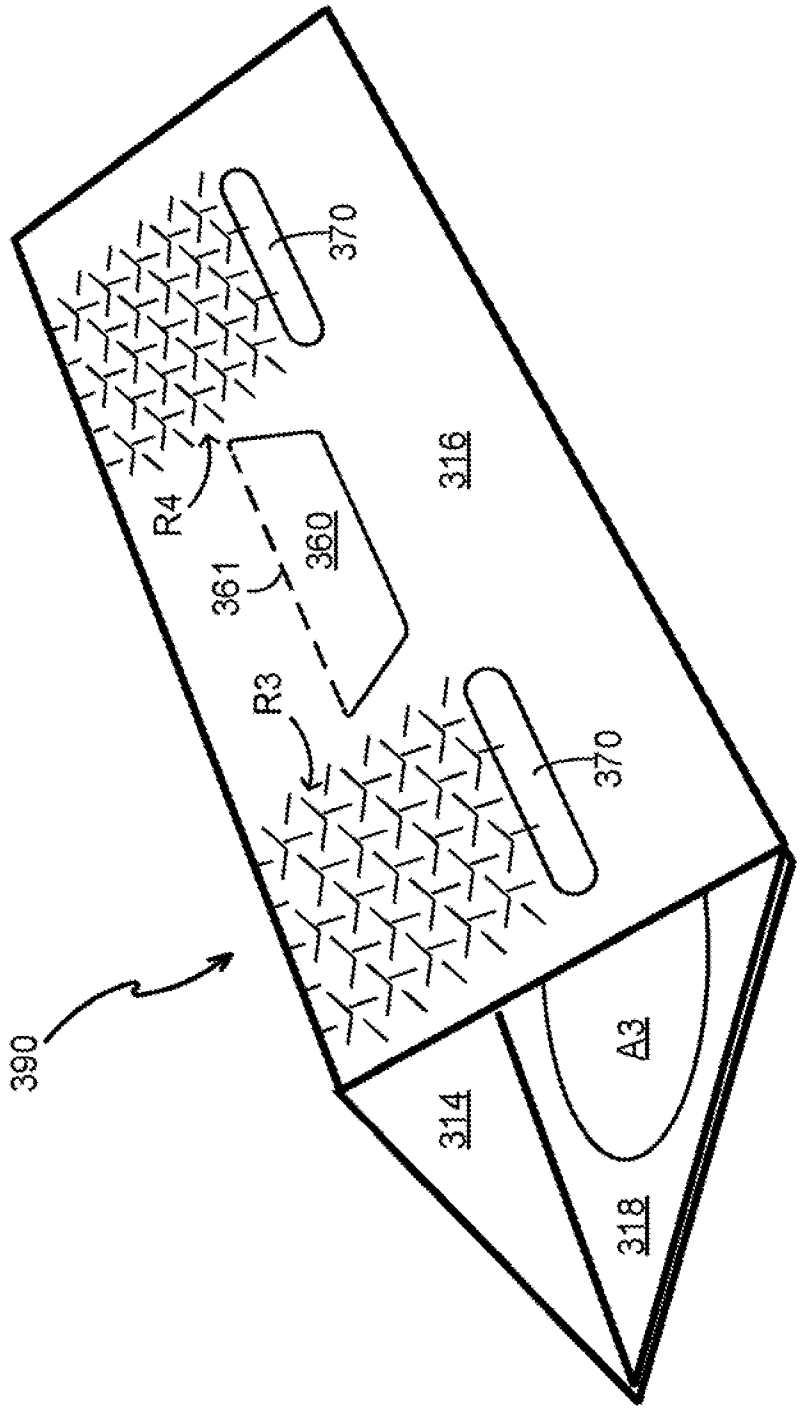


FIG. 8

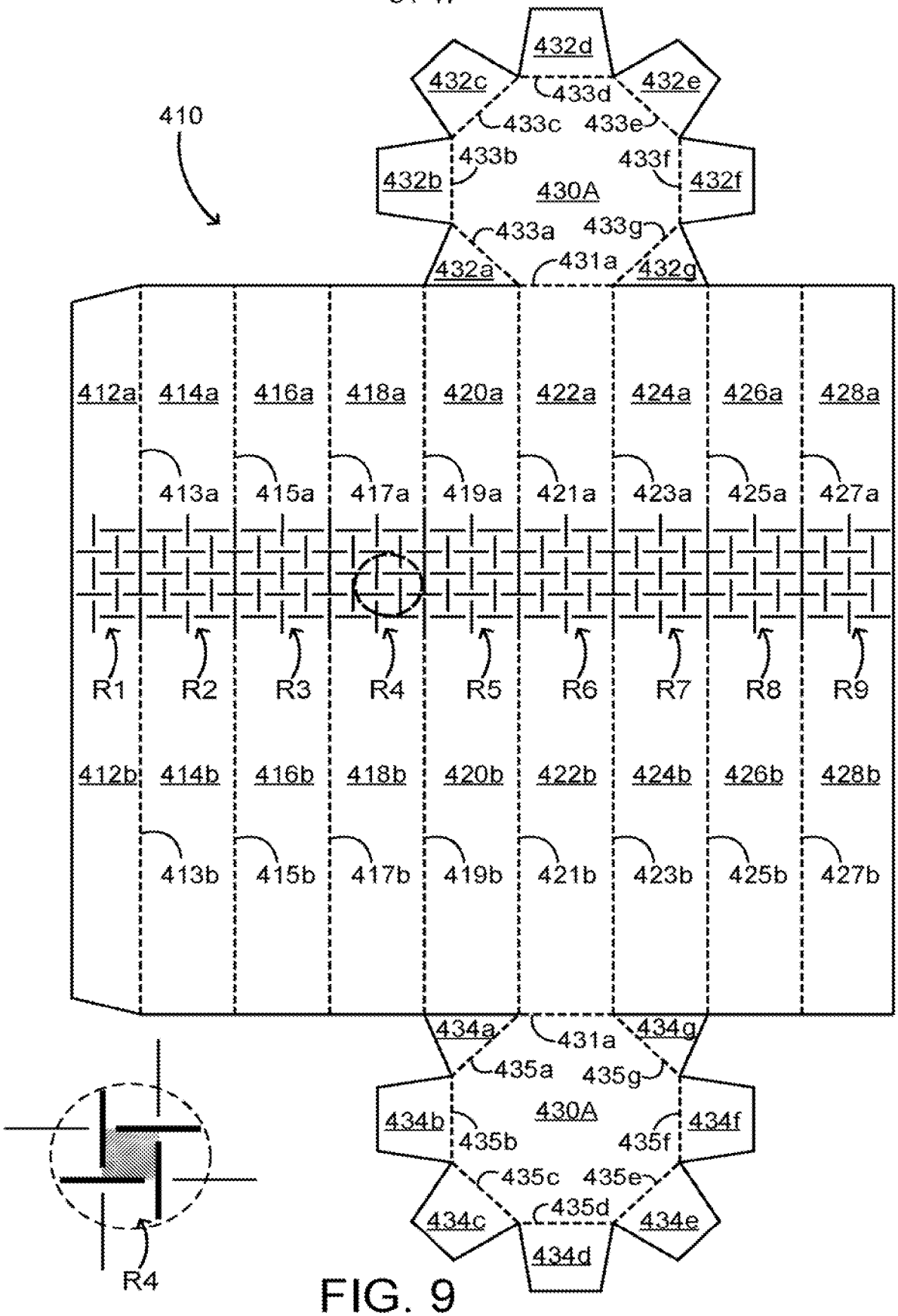

410
432d
432c
432e
433d
433c
433e
433b
433f
432b
432f
430A
433a
433g
432a
431a
432g
412a
414a
416a
418a
420a
422a
424a
426a
428a
413a
415a
417a
419a
421a
423a
425a
427a
R1
R2
R3
R4
R5
R6
R7
R8
R9
412b
414b
416b
418b
420b
422b
424b
426b
428b
413b
415b
417b
419b
421b
423b
425b
427b
434a
431a
434g
435a
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434e
434d
R4

FIG. 9

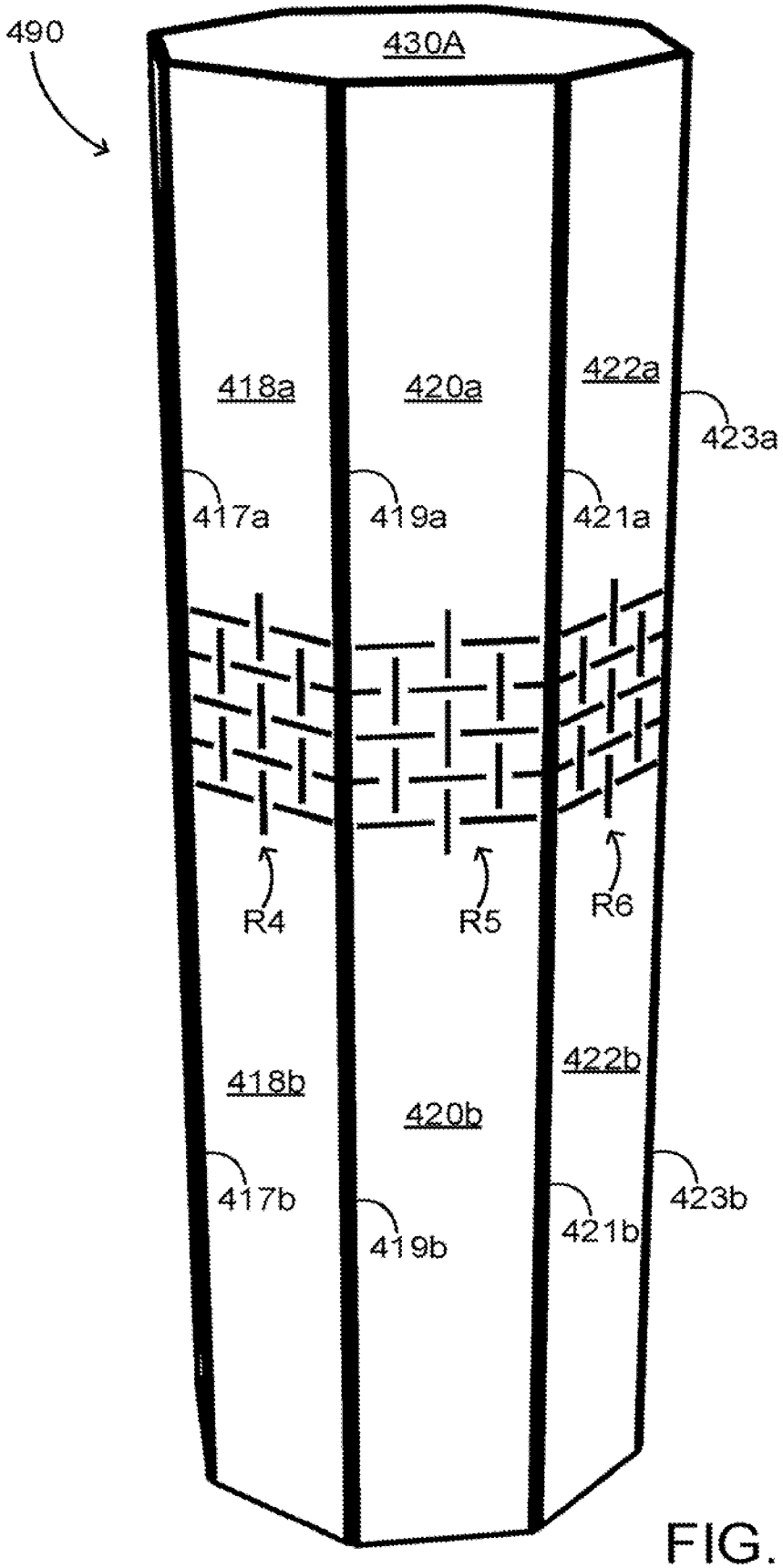

490
430A
418a
420a
422a
423a
417a
419a
421a
R4
R5
R6
418b
420b
422b
417b
419b
421b
423b

FIG. 10

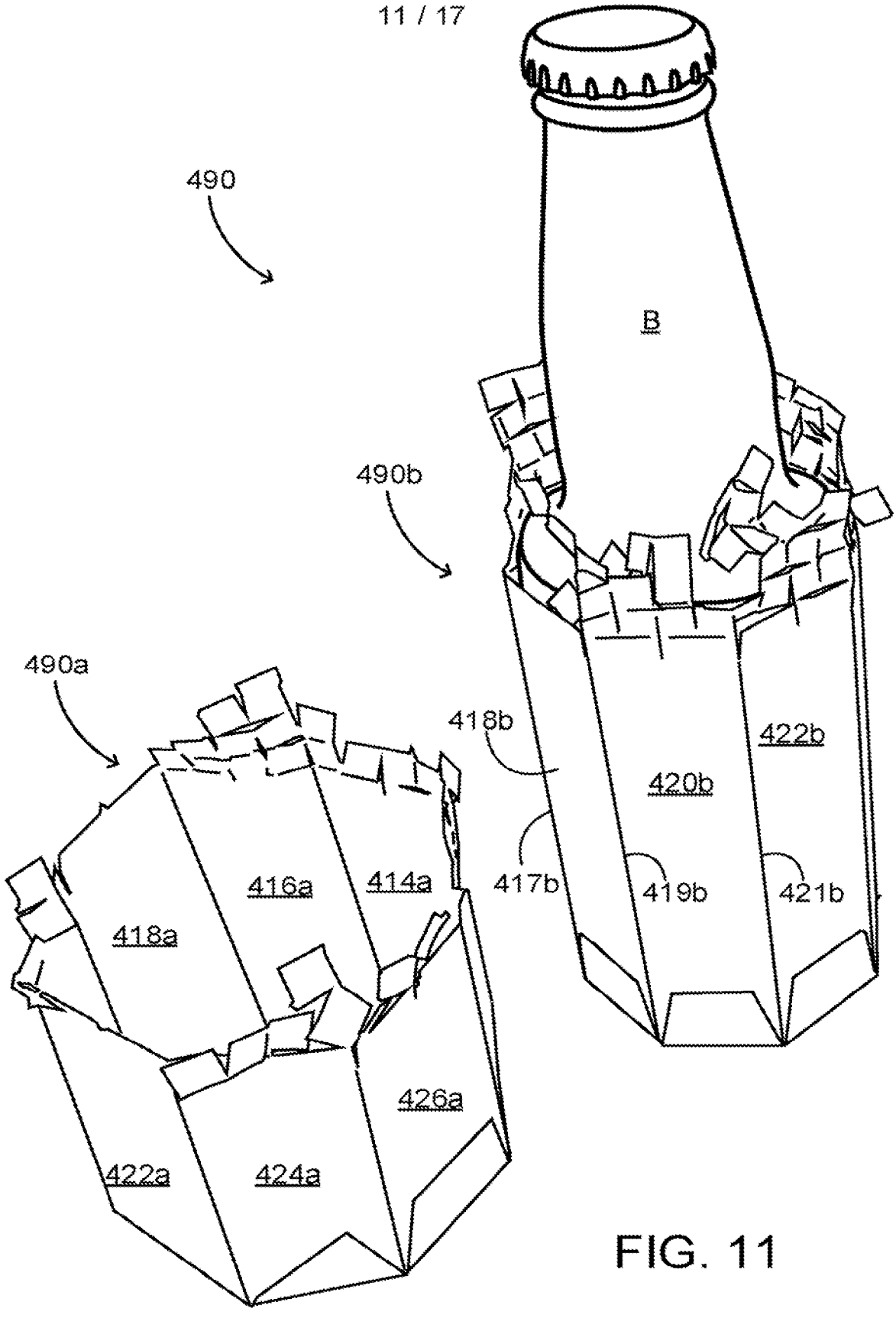

490
B
490b
490a
418b
422b
420b
416a
414a
417b
419b
421b
418a
426a
422a
424a

FIG. 11

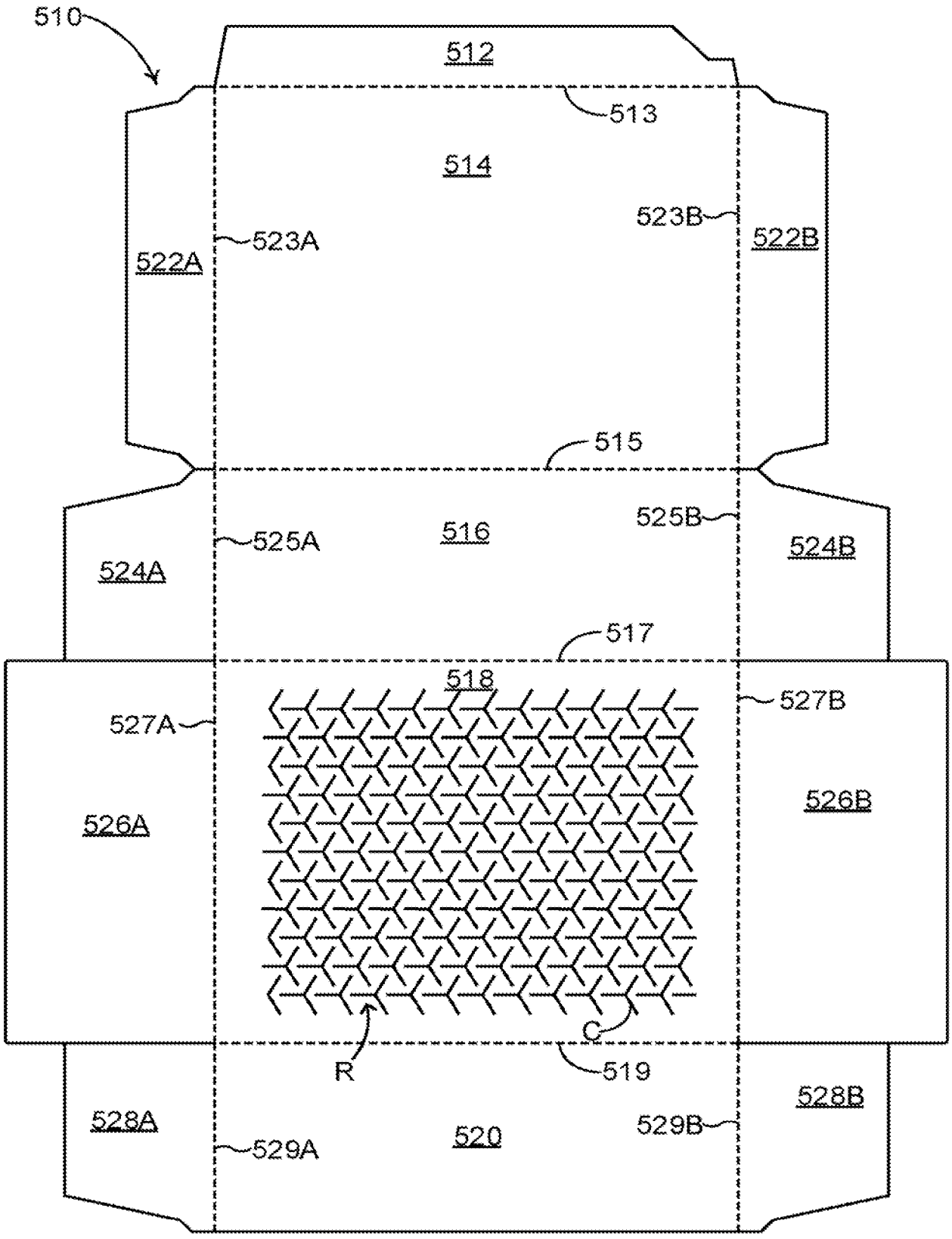

510
512
513
514
523B
522B
522A
523A
515
525B
525A
516
524B
524A
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526B
526A
C
R
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528B
528A
529B
520
529A

FIG. 12

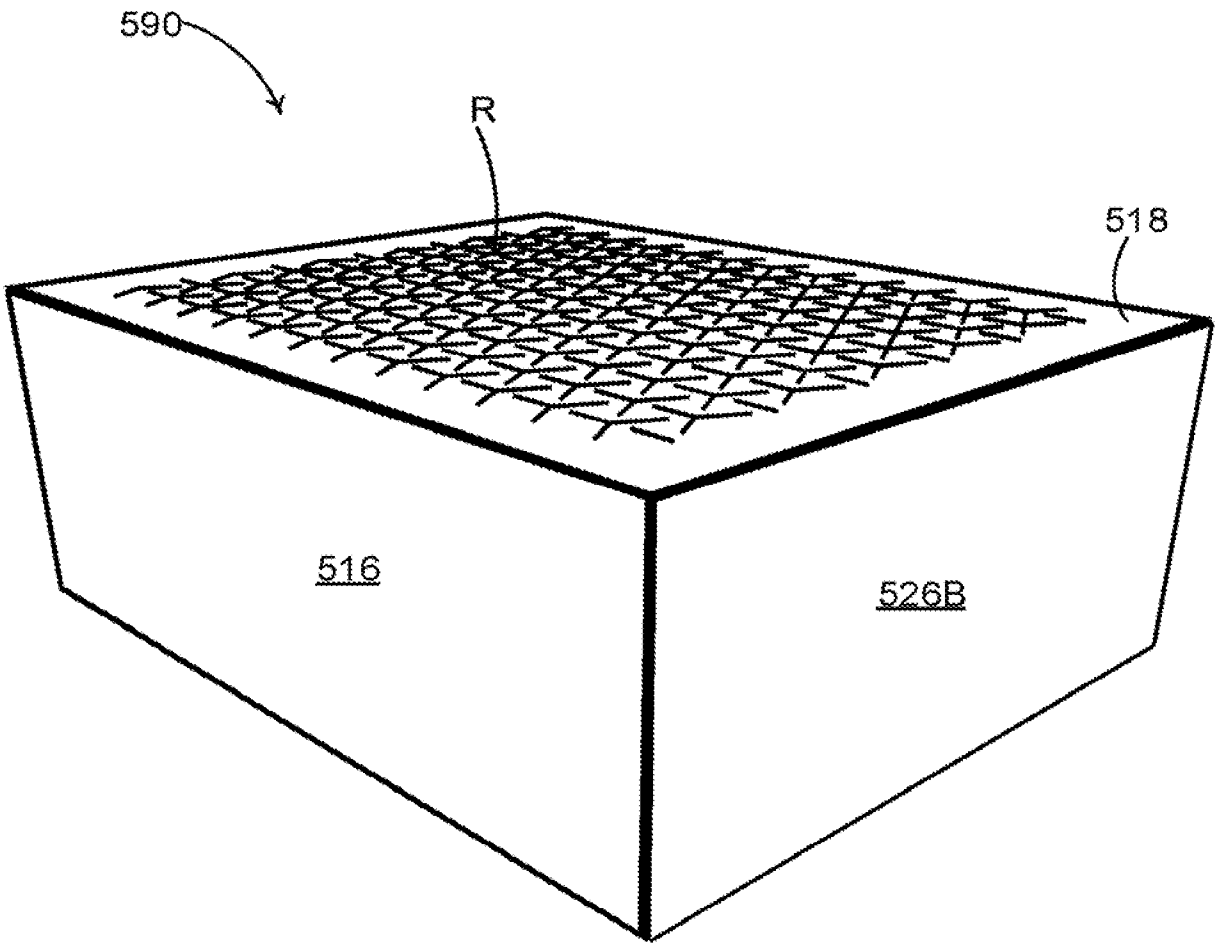


FIG. 13

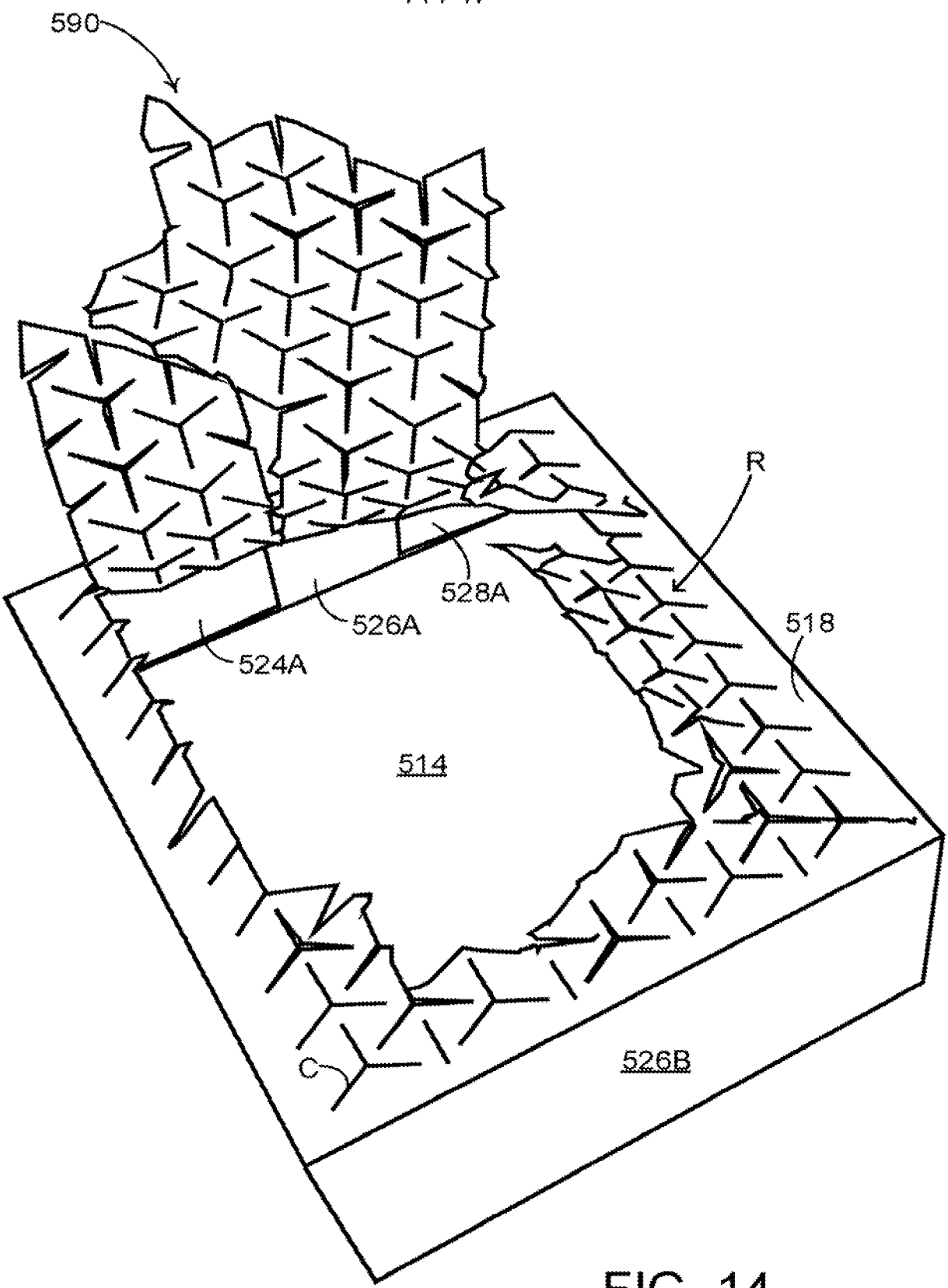


FIG. 14

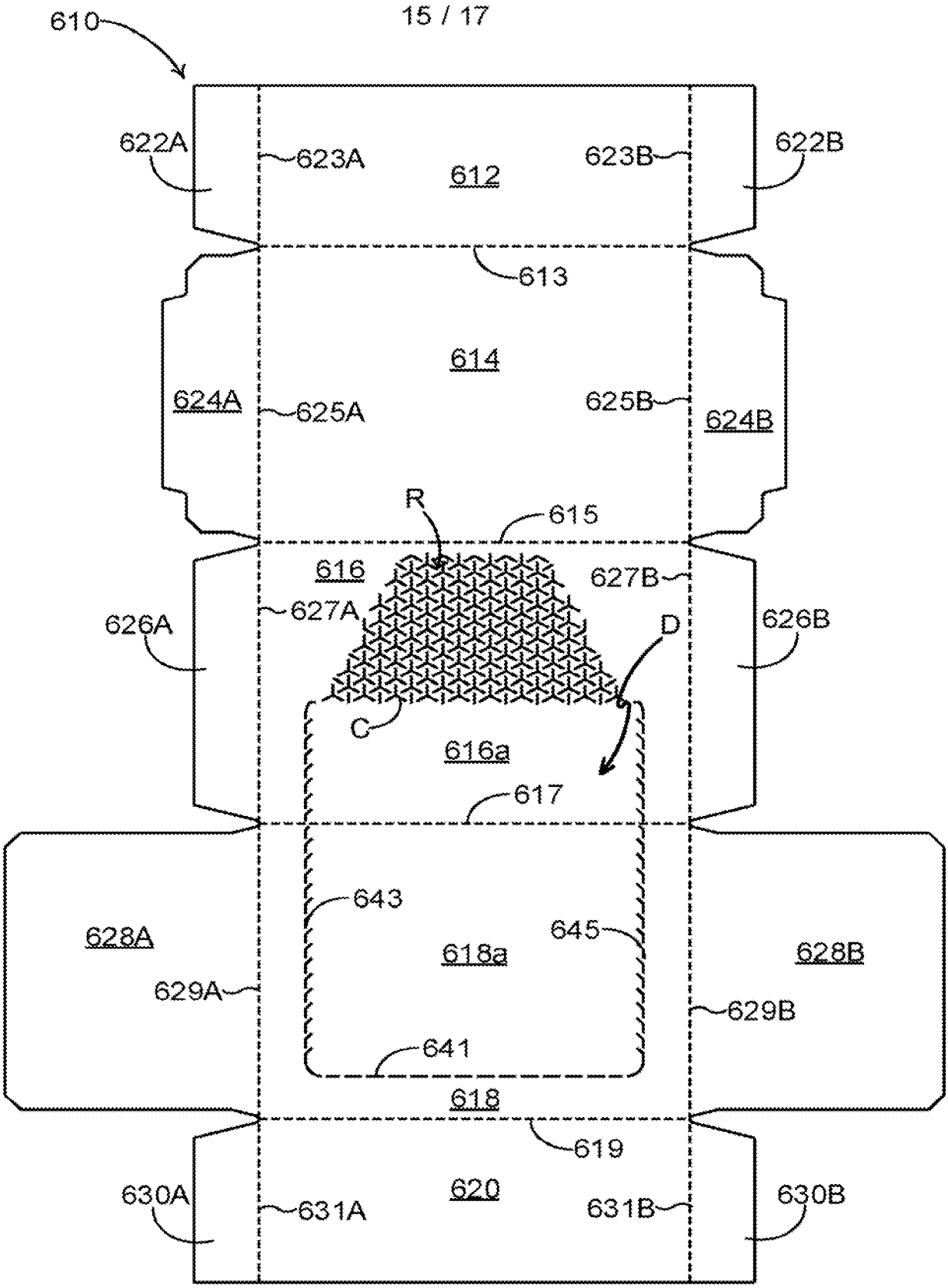

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631A
631B
630B

FIG. 15

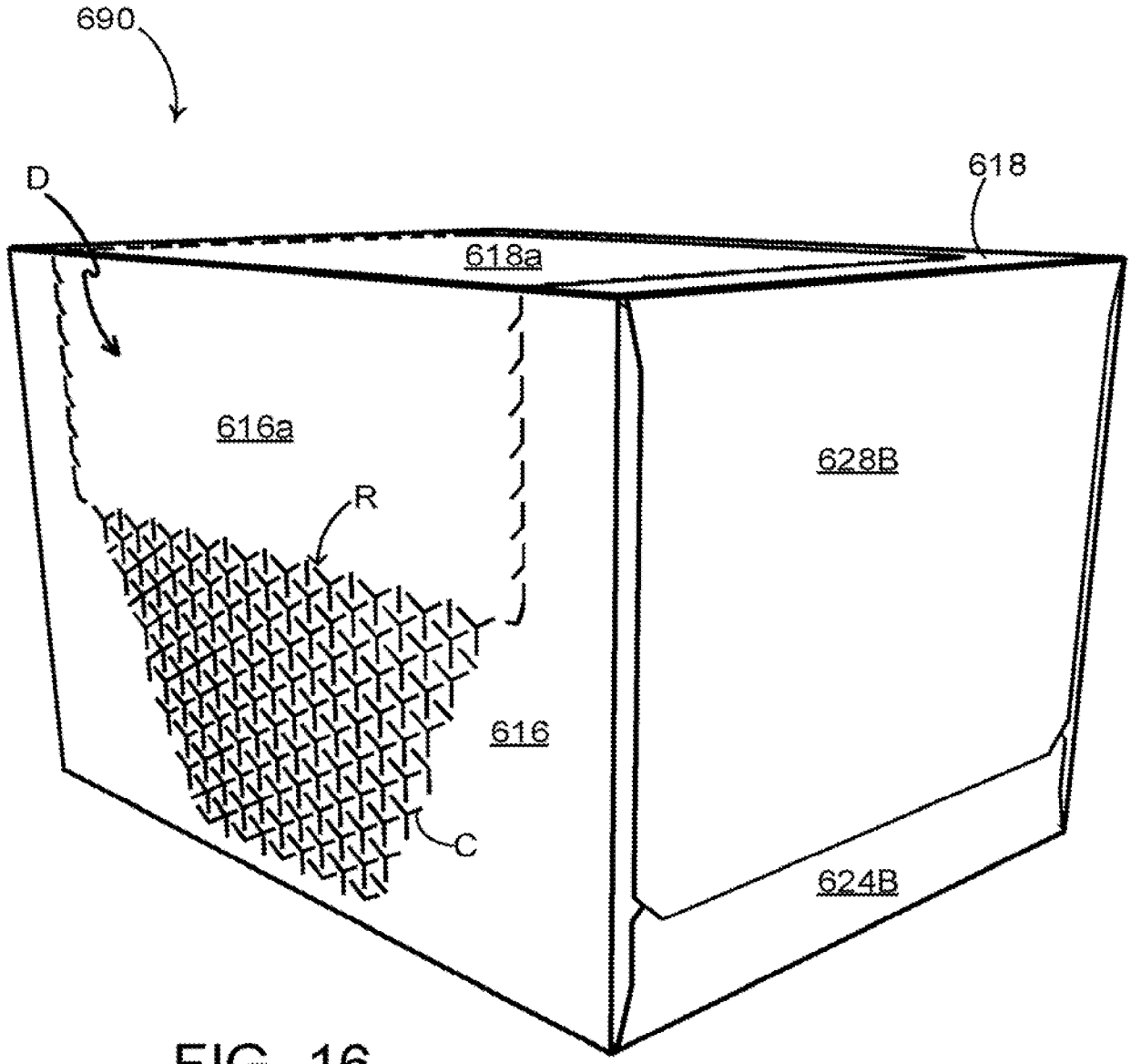


FIG. 16

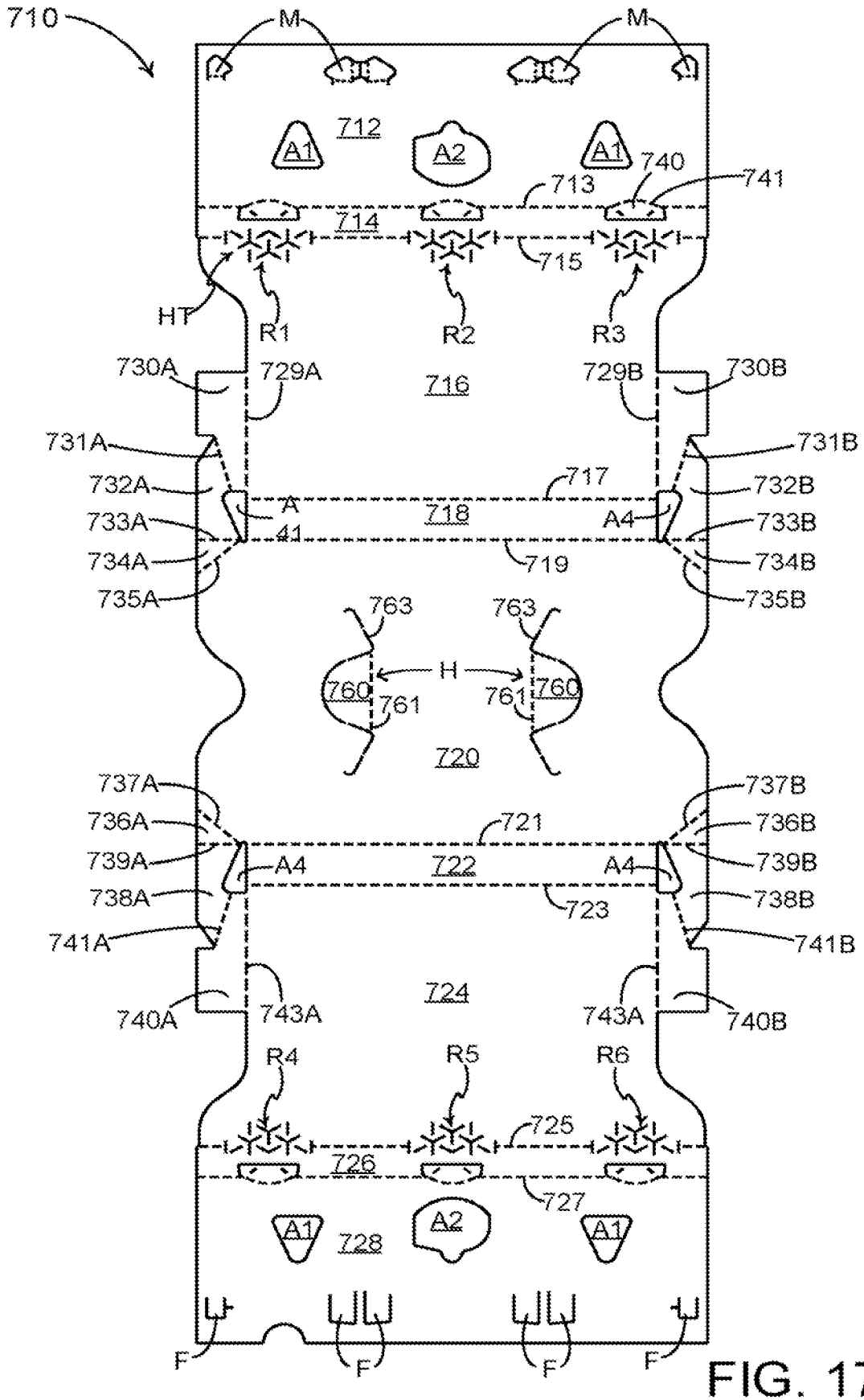

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Z28
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FIG. 17

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2021/032016

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D81/03
ADD.

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

B. FIELDS SEARCHED

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

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 99/44898 A2 (MEAD CORP [US]; CHARGUERAUD VINCENT [FR]) 10 September 1999 (1999-09-10)	1-12, 15-25
A	figures 1-5c	13,14

X	JP 2019 172379 A (OJI HOLDINGS CORP) 10 October 2019 (2019-10-10)	13,14
Y	figure 7 paragraph [0005]	1-12, 15-25

A	DE 20 2018 004808 U1 (OY PA HU [FI]) 14 November 2018 (2018-11-14) figures 1-4	1-25

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 August 2021	01/09/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Sacepe, Nicolas

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2021/032016

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