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Smorch et al.

(54) **CARTON AND CORRUGATED BOARD WITH VAPOR LINER**

(75) Inventors: **Patrick M. Smorch**, Sugar Hill, GA (US); **Chester D.L. Garner**, Richmond, IN (US); **Edward M. Gallegos**, Suwanee, GA (US)

Correspondence Address:
PATENT GROUP GA030-43
GEORGIA-PACIFIC CORPORATION
133 PEACHTREE STREET, N.E.
ATLANTA, GA 30303-1847 (US)

(73) Assignee: **Georgia-Pacific Corporation**, Atlanta, GA

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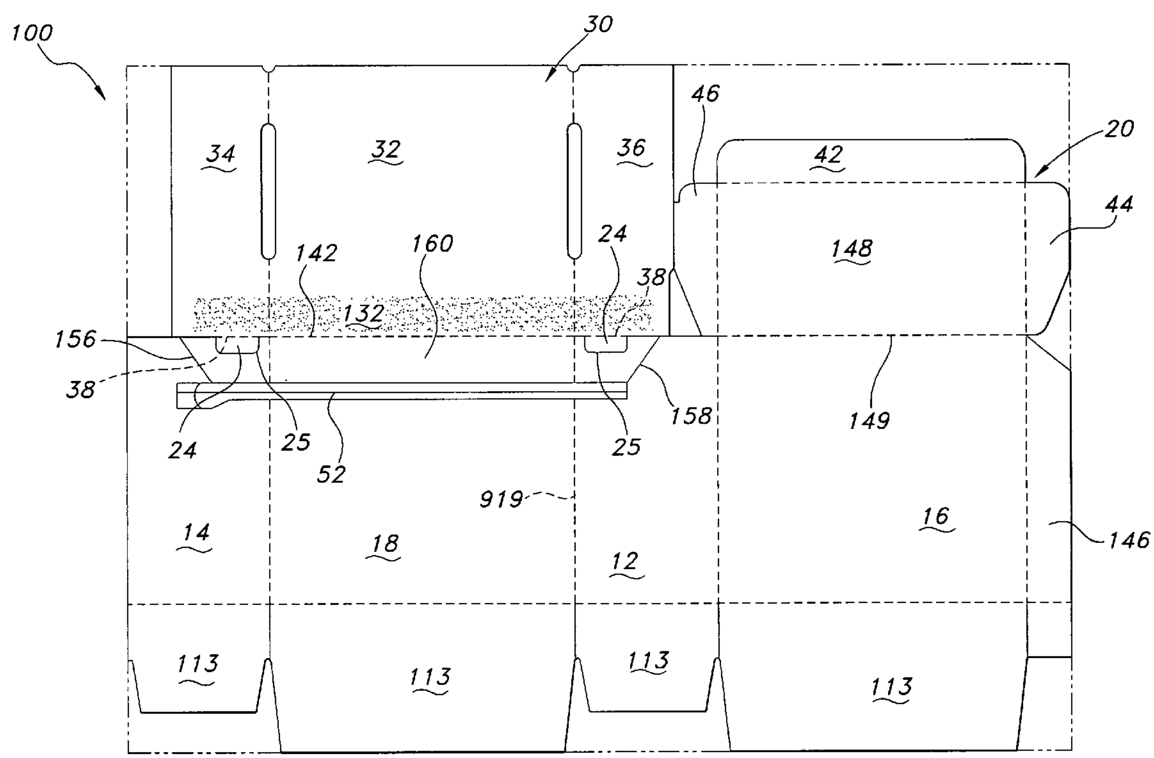
(57) **ABSTRACT**

A click-lock re-closable carton is provided that may be simply and securely re-closed. According to one embodiment, the click-lock re-closable carton includes a pair of opposing side panels, a back panel joined to the side panels, a cover pivotally attached to the back panel having a pair of opposing side flanges, and a pair of locking tabs. The locking tabs may be on opposite side panels of the carton and may be offset from one another with respect to the back panel. The carton may be formed from a blank made of low moisture vapor transmission rate corrugated board. One liner face of the corrugated board may include a moisture-resistant extrudate partially absorbed into a first side of a fiberboard substrate, which is bonded to the microflute tips of the corrugated board.



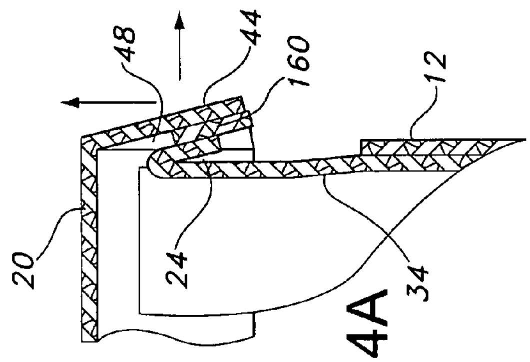


FIG. 4A

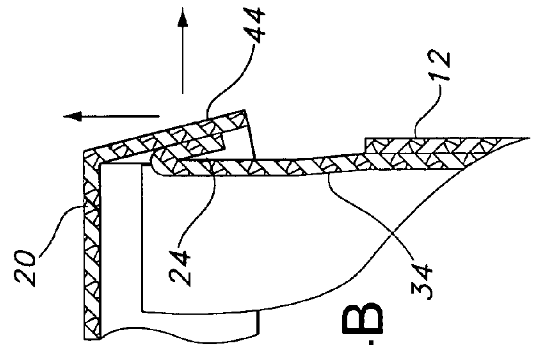


FIG. 4B

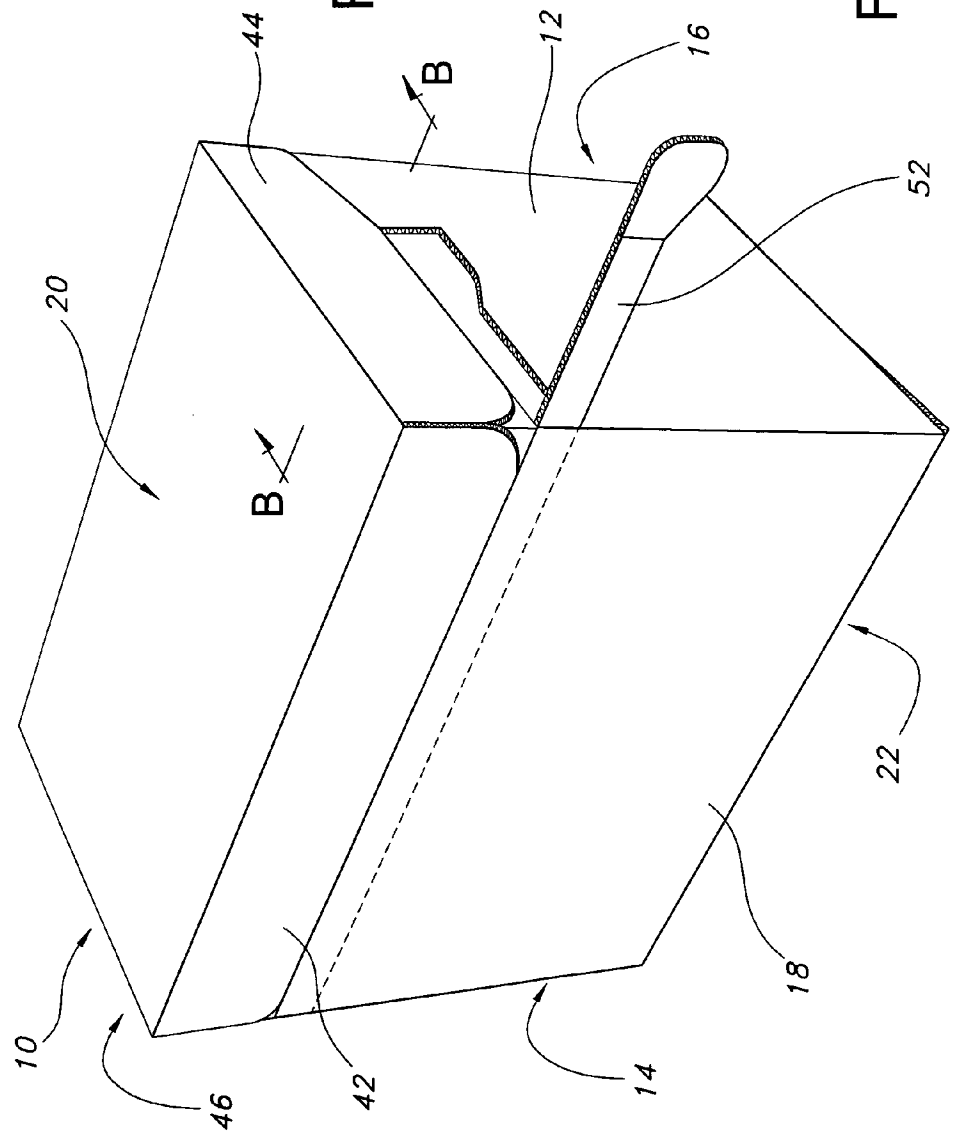


FIG. 1

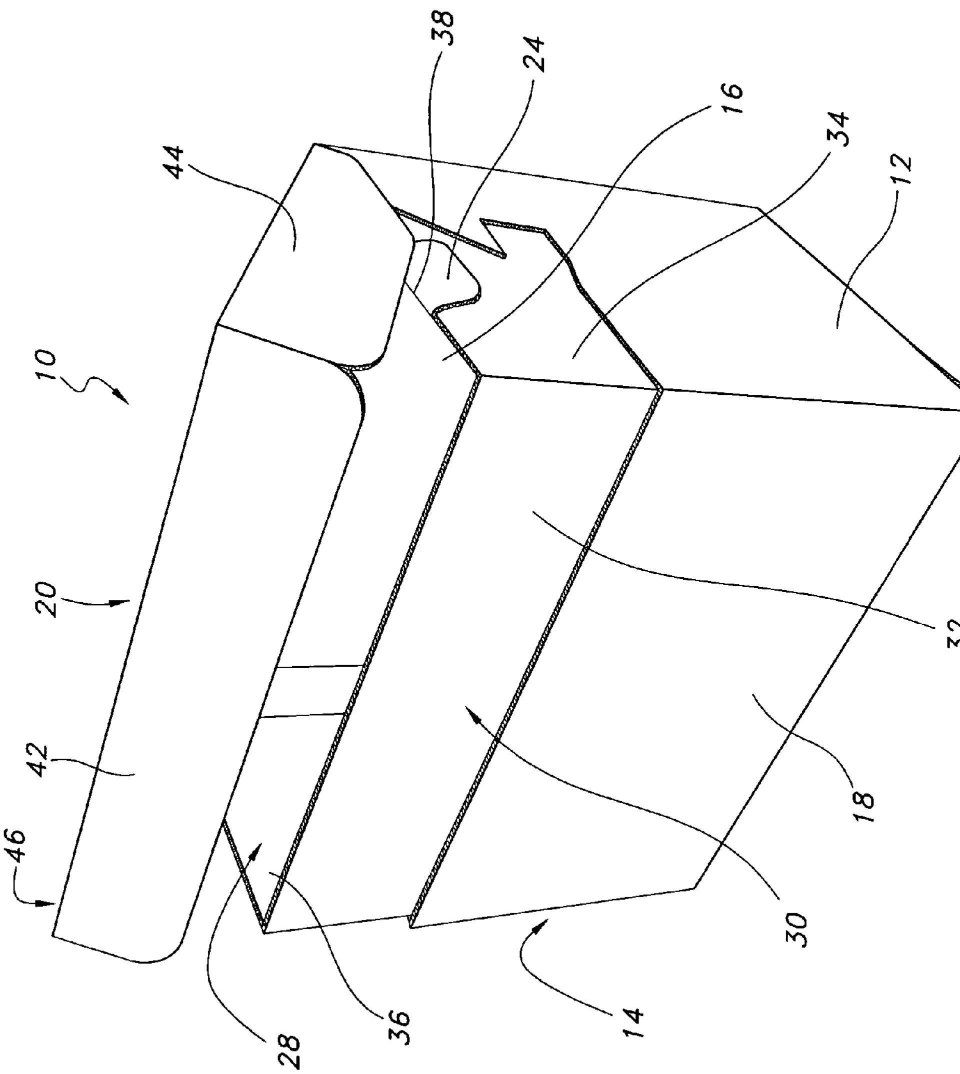


FIG. 2

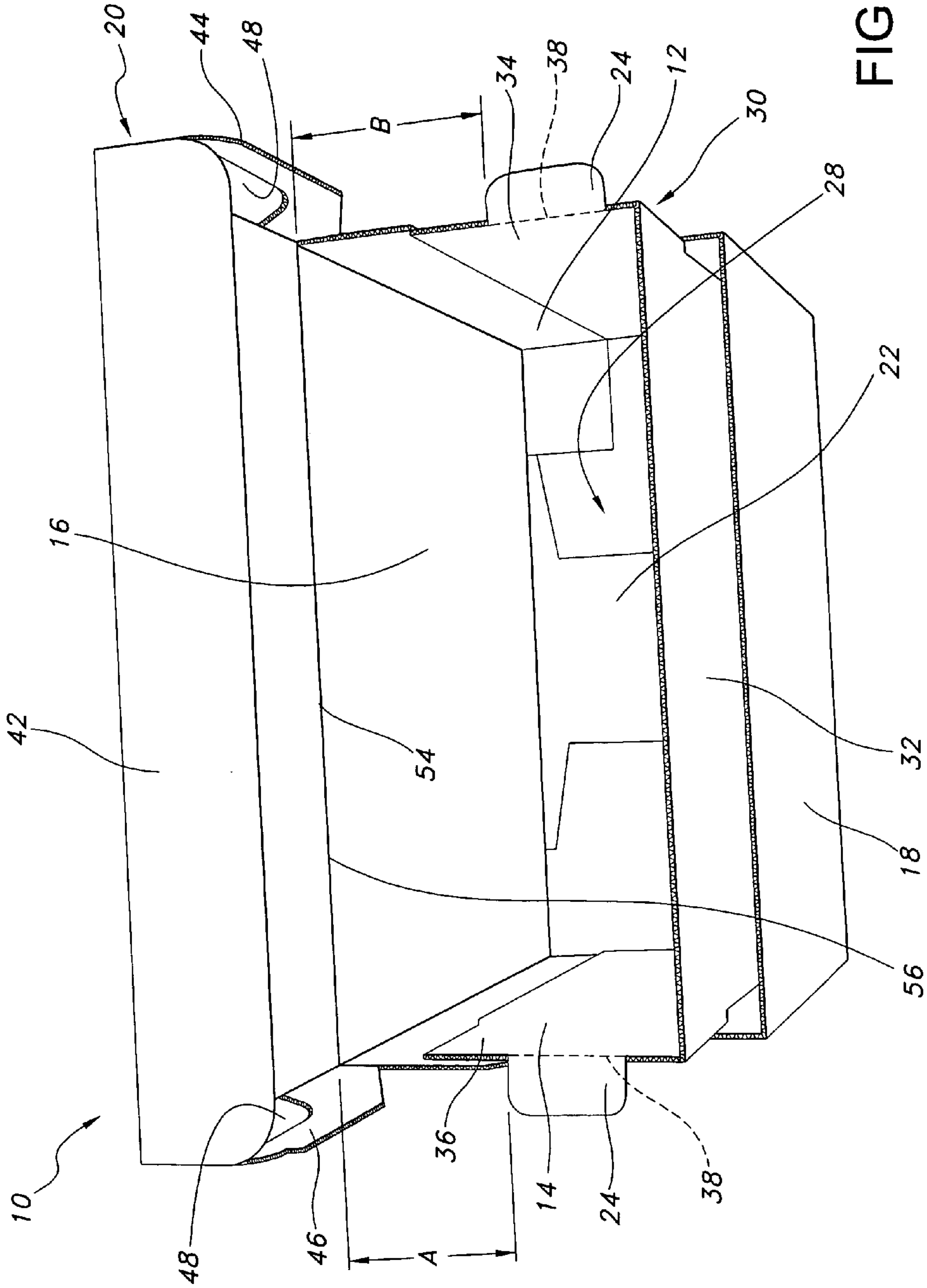


FIG. 3

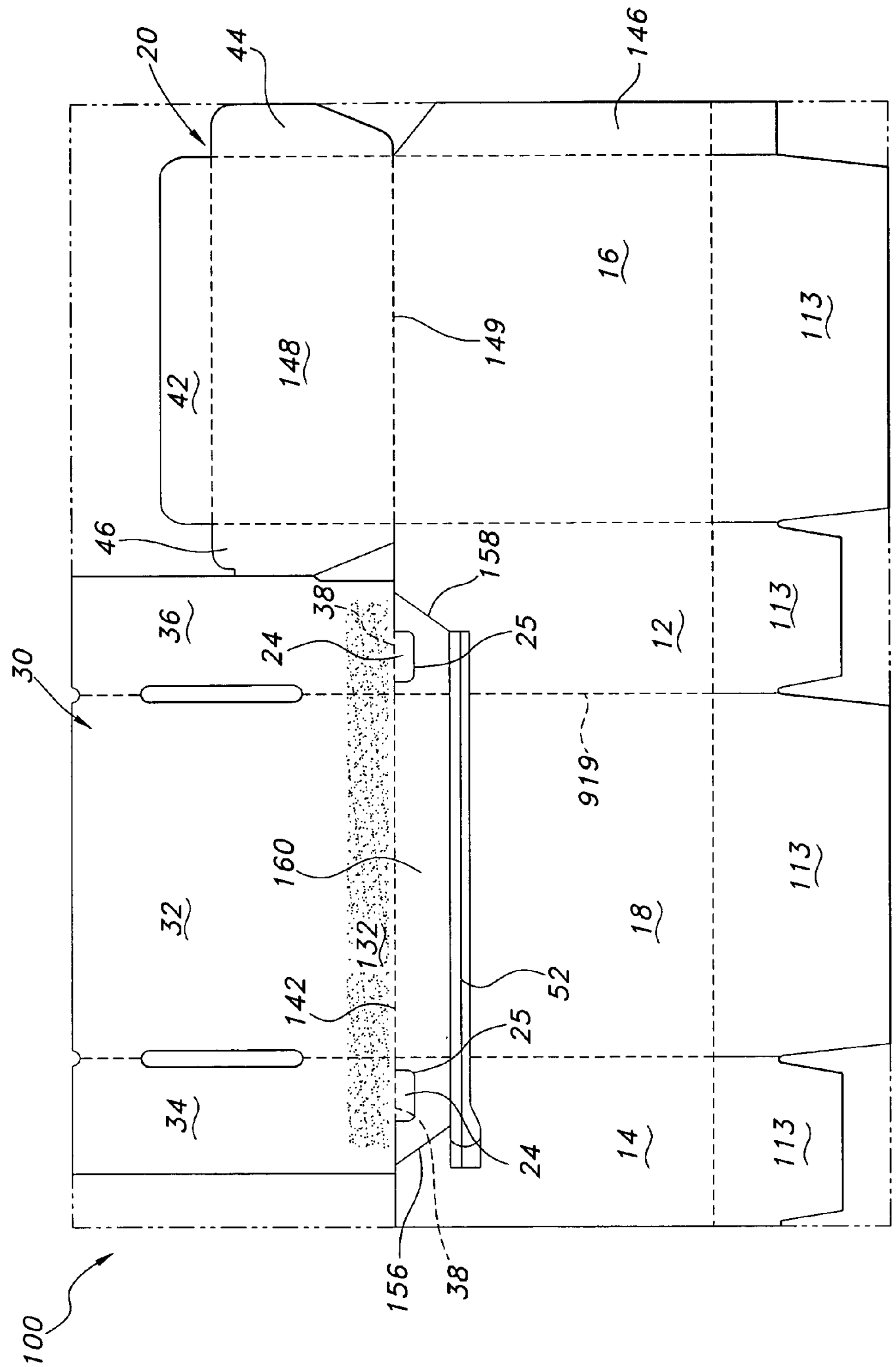

20
44
146
16
113
148
149
42
46
158
36
38
24
25
12
30
919
160
32
18
132
142
52
34
14
156
100

FIG. 5

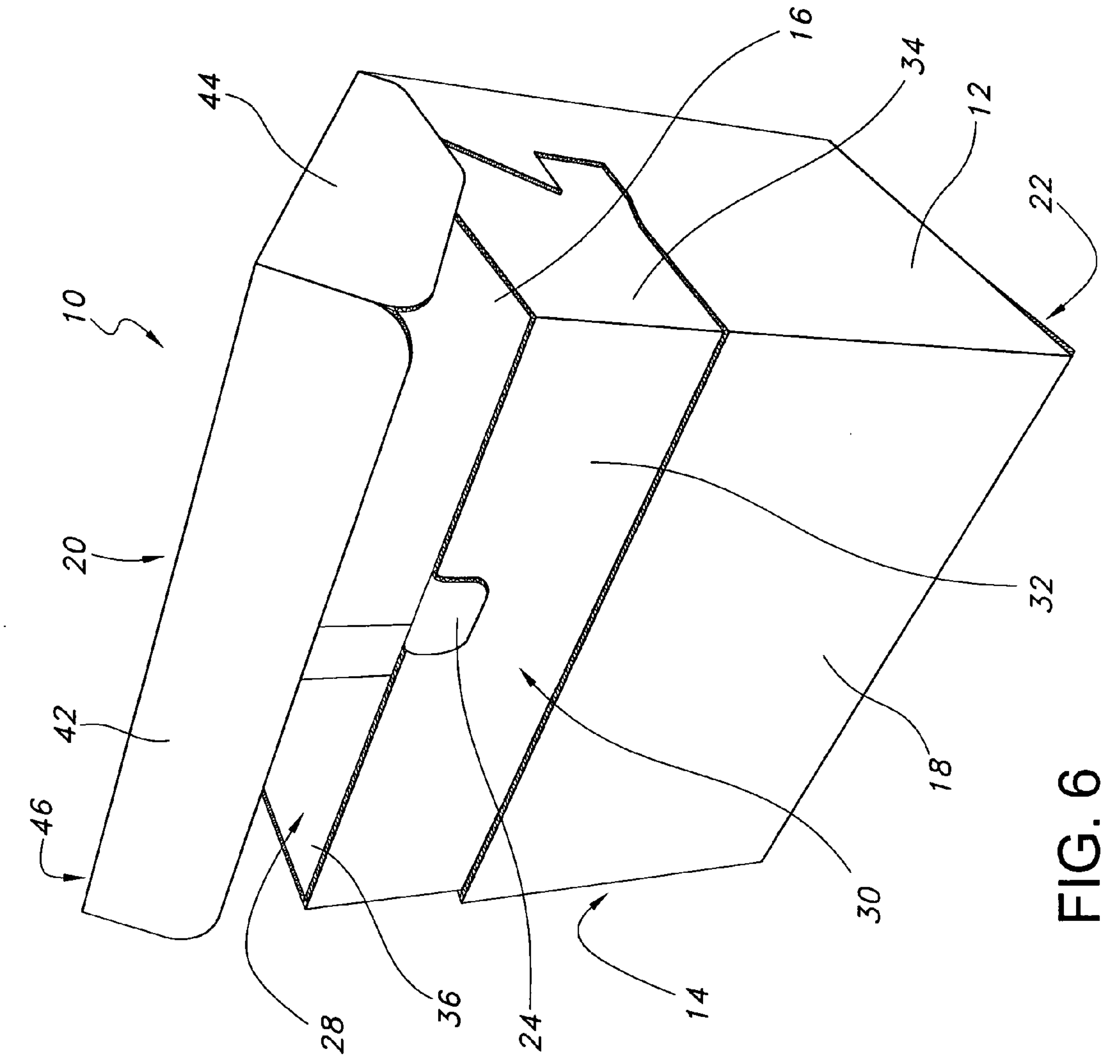


FIG. 6

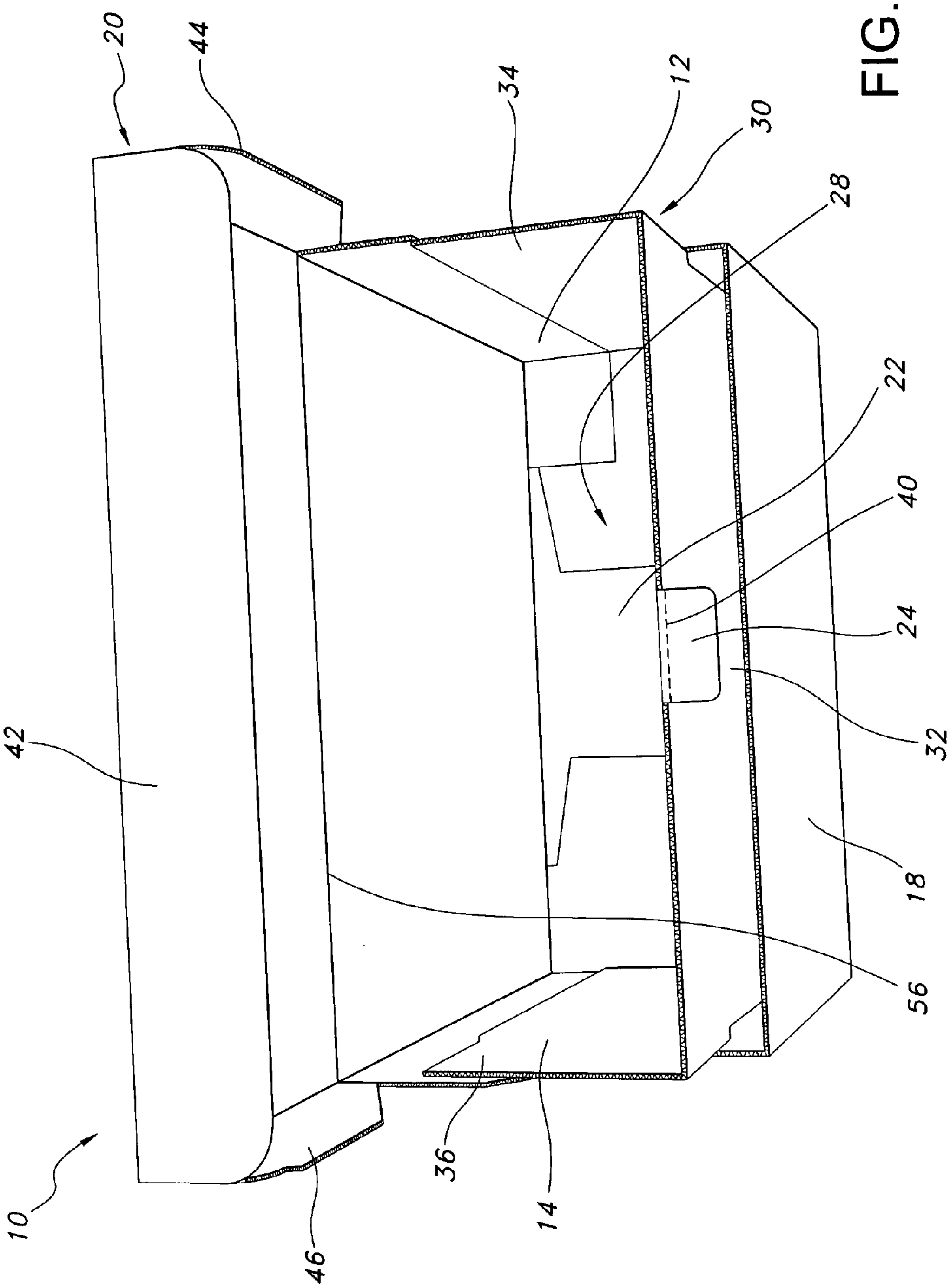
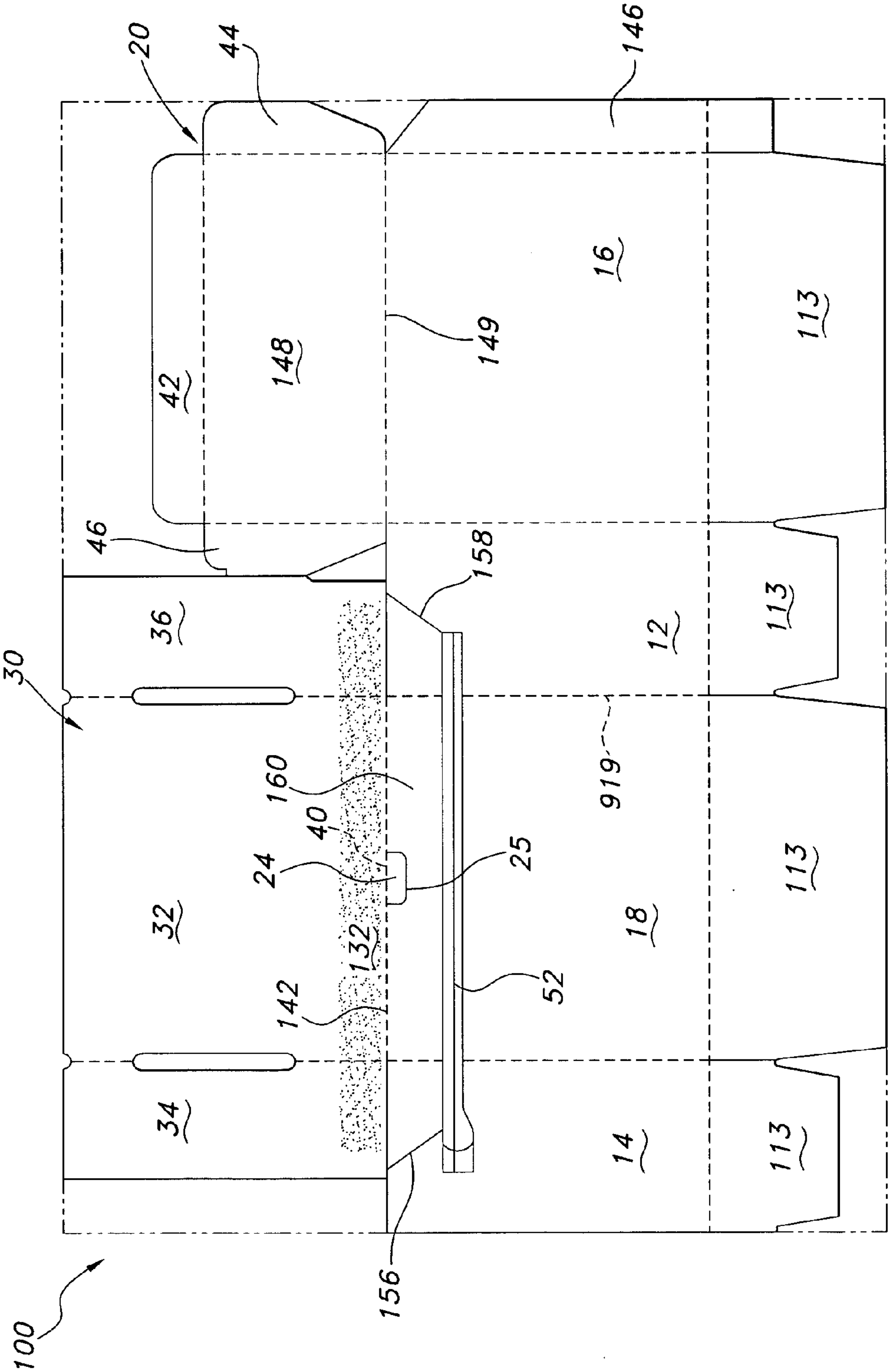


FIG. 7



20
44
146
16
113
148
149
42
46
158
36
30
12
919
160
40
24
25
32
18
132
142
52
34
14
156
100

FIG. 8

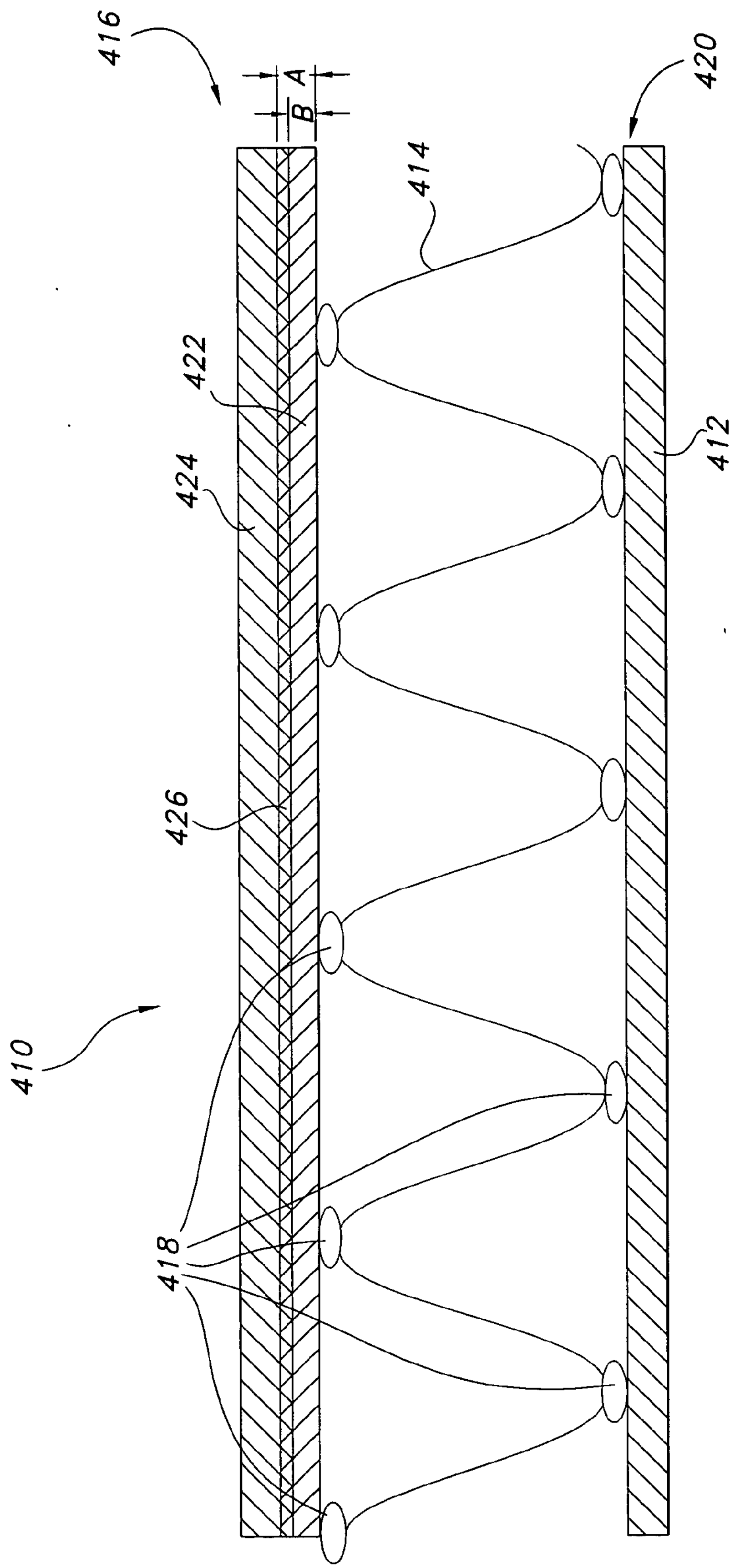


FIG. 9

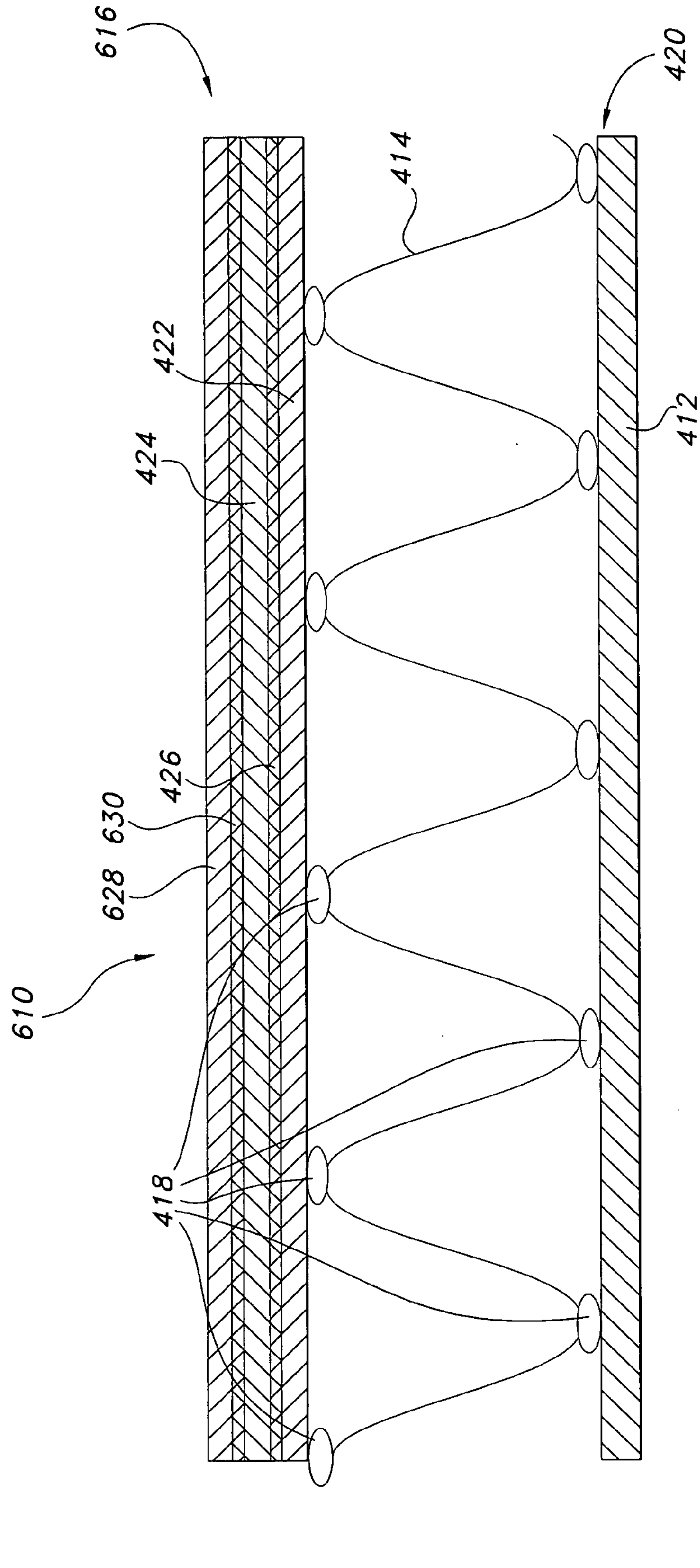


FIG. 10

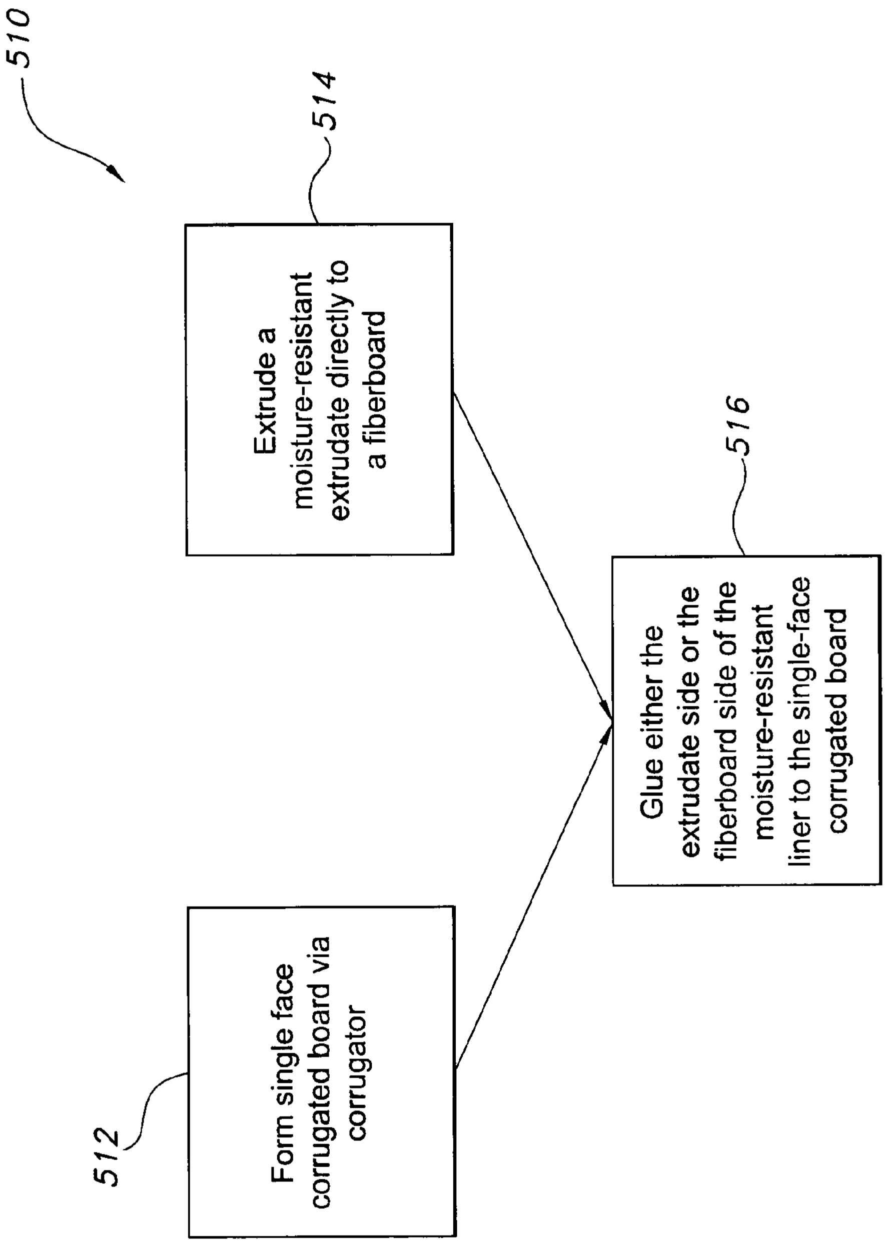

510
514
Extrude a moisture-resistant extrudate directly to a fiberboard
516
Glue either the extrudate side or the fiberboard side of the moisture-resistant liner to the single-face corrugated board
512
Form single face corrugated board via corrugator

FIG. 11

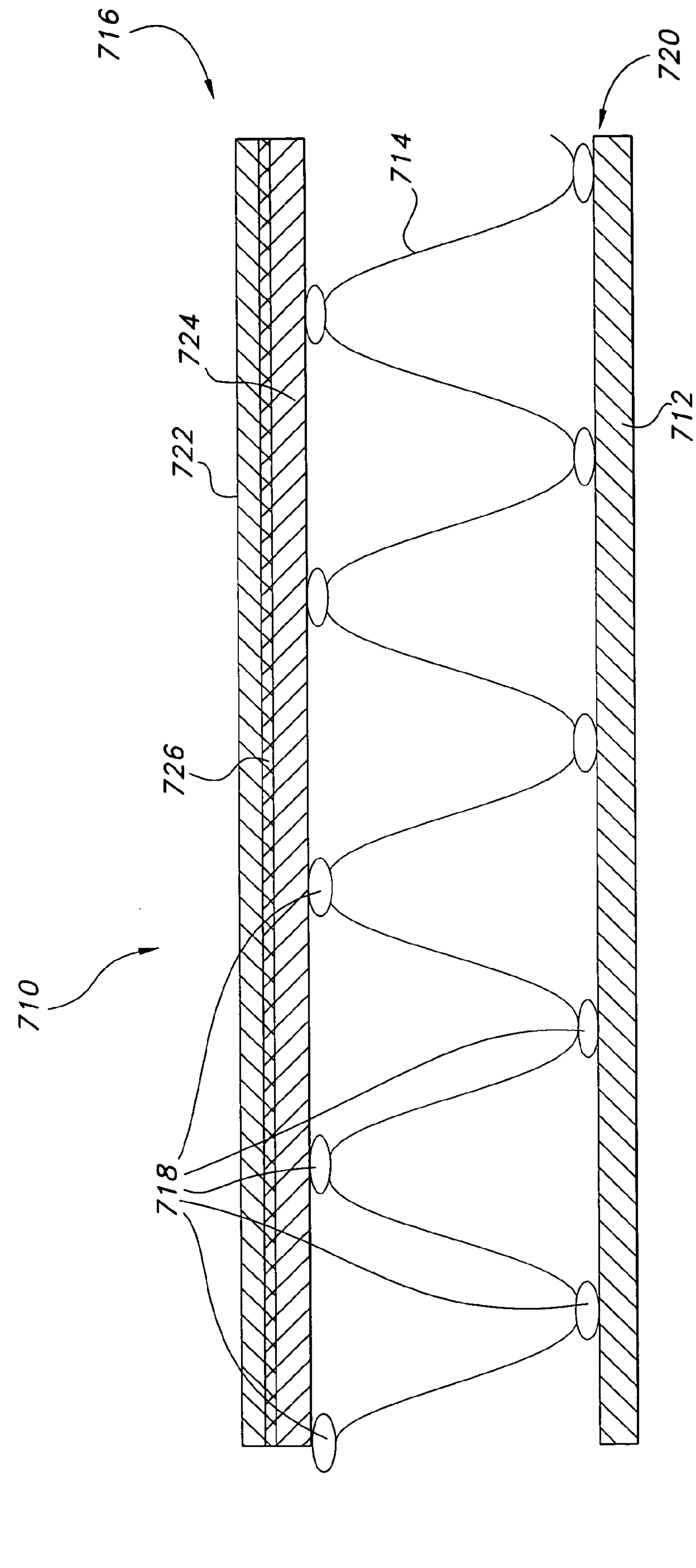


FIG. 12

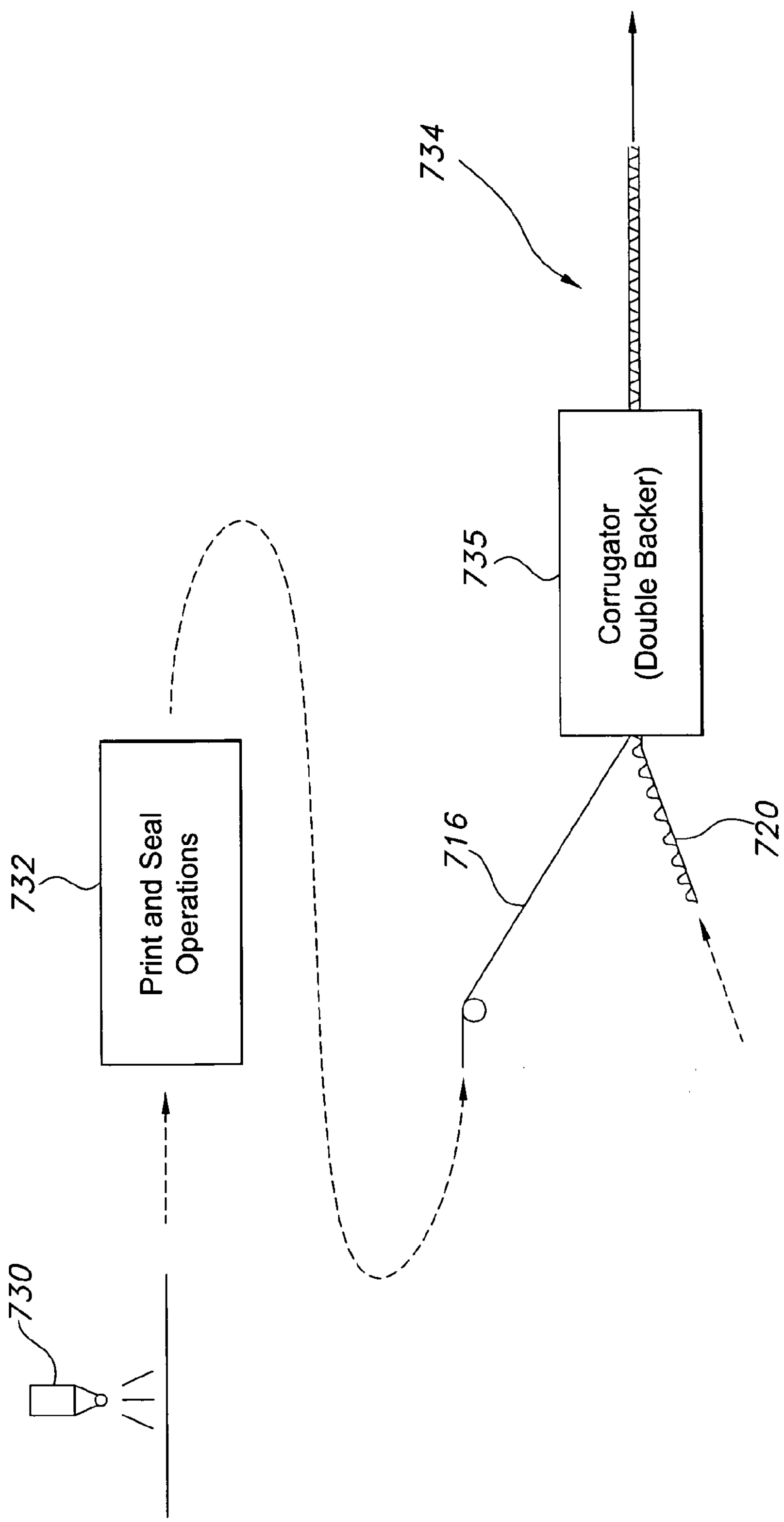

734
735
Corrugator
(Double Backer)
732
Print and Seal
Operations
716
720
730

FIG. 13

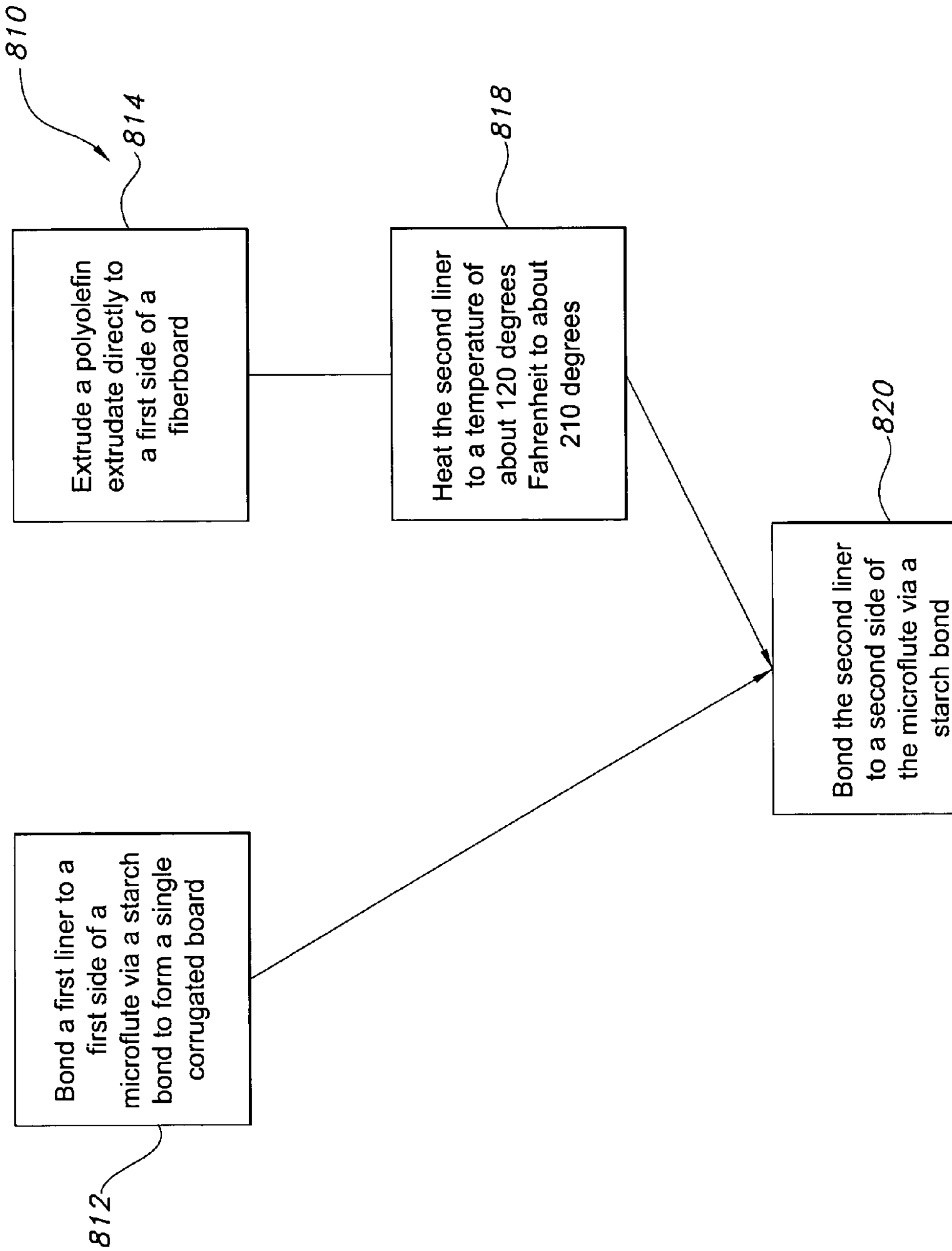

810
814
Extrude a polyolefin extrudate directly to a first side of a fiberboard
818
Heat the second liner to a temperature of about 120 degrees Fahrenheit to about 210 degrees
820
Bond the second liner to a second side of the microflute via a starch bond
Bond a first liner to a first side of a microflute via a starch bond to form a single corrugated board
812

FIG. 14

CARTON AND CORRUGATED BOARD WITH VAPOR LINER

TECHNICAL FIELD

[0001] This invention relates generally to a carton made from corrugated board with a vapor liner. More particularly, the invention relates to a re-closable click-lock carton and low moisture vapor transmission rate corrugated boards for forming such cartons. It also relates to low moisture vapor transmission rate corrugated boards for other uses, and to methods for forming such cartons.

BACKGROUND

[0002] Different types of cartons exist for a variety of different products and purposes. Cartons having low moisture vapor transmission rates are known for storing moisture-sensitive products, such as food items and dry products such as powder. Conventional containers for moisture-sensitive items are made from an outer fiberboard carton that includes a vapor barrier, and a separate fiberboard liner that fits within the outer carton. Often, the outer fiberboard carton is made from solid fiberboard that includes a vapor barrier, such as oriented polypropylene laminated to it, or a barrier coating applied by a rotogravure press. The separate inner liner is made from corrugated fiberboard.

[0003] U.S. Pat. No. 5,515,996 issued to Stone discloses a reclosable container that includes an outer carton **10** and a liner **24** snugly fit within the outer carton. The liner and carton of Stone '996 are formed from separate blanks, which are adhered to one another and assembled to form the container. Conventional containers such as these are expensive due, in large part, to the use of separate boards as well as to the assembly costs of manufacturing and combining the two boards. In addition, material losses occur with the manufacture of these containers from independent blanks, because stamping each blank from a fiberboard sheet results in discarded sheet material. Such losses are compounded with the use of multiple blanks from multiple sheets.

[0004] Conventional containers also exist that are formed from an outer carton and a liner, which are combined in a single unitary blank. U.S. Pat. No. 5,314,114, which is also issued to Stone, discloses such a container. As shown in **FIGS. 2 and 3** of Stone '114, a single blank **30** includes liner panels **38**, **40** and **42** connected to and aligned with carton panels **32**, **34**, **36** and **38**. The carton panels are folded to form the carton sidewalls and the liner panels are folded inside the carton panels. Since the liner panels are aligned with the carton panels in a unitary blank, the blank is relatively long and is therefore difficult to nest within a fiberboard sheet. In addition, the configuration of the unitary blank causes a large amount of excess fiberboard material to be wasted.

[0005] Conventional cartons for moisture-sensitive items include re-closable cartons, such as laundry detergent cartons. Conventional re-closable moisture-protected cartons either lack locking mechanisms entirely for securing the cover in a closed position, or lack locking mechanisms that securely and easily re-close cartons. As such, the moisture vapor protection afforded from such conventional cartons is compromised when the cartons are not securely re-closed.

[0006] Low moisture vapor transmission rate (MVTR) corrugated fiberboard is used to make moisture-protected cartons, as well as for other uses. For example, U.S. Pat. No. 5,772,819 to Olvey discloses a composite of paperboard and plastic film that is formed by extruding a molten polymer between a paper web and a film. As shown in **FIG. 1** of Olvey, a primer is applied to paper material at primer application station **12***a* prior to applying an extruded polymer to the paper using extruder **15**. Plastic film from material roll **16** is combined with the paper via extrusion lamination. The composite paper sheet is eventually bonded to the flutes of a single face corrugated board via a corrugator. As also shown in **FIG. 1** of Olvey, such an operation includes heating the paper sheet and a single face corrugated board, and then bonding them together in a hot plate section **29** of the corrugator.

[0007] Such a three layer composite adds expense and complexity to the process, and therefore to the fiberboard produced. For instance, the cost of the film, which acts as the moisture vapor barrier, can be high. Further, expenses incurred from the additional processing and equipment required to form the three layer composite structure add cost to the finished product.

[0008] As discussed above, the paper sheet that includes the plastic film as the moisture vapor barrier passes through a corrugator for bonding the paper sheet to the flutes of a microflute material. The paper sheet is typically printed prior to being processed through the corrugator. The process temperatures in the corrugator increase the temperature of the paper sheet as it passes through the corrugator causing the temperature to exceed the melting point of most plastic films. As a result, the film softens during processing. This causes scuffing or marring of the printed surface during processing, which increases the reject rate and reduces the overall quality of the corrugated fiberboard.

[0009] Accordingly, a need exists for an improved low moisture vapor transmission rate carton. In addition, a need exists for a high-strength low moisture vapor transmission rate board for forming such cartons and for other uses.

SUMMARY

[0010] In order to overcome the above-described deficiencies and other shortcomings that will become apparent when reading this specification, aspects of the present invention provide a low MVTR carton and a low MVTR corrugated board. A low MVTR corrugated board according to one embodiment includes a first board, a microflute board attached to a first side of the first board and a second board attached to the microflute board second side. The second board includes a moisture-resistant extrudate that is comprised of a polyolefin, preferably a polyolefin that includes a substantial percentage of high density polyethylene (HDPE) partially absorbed into a first side of the fiberboard substrate. Alternatively, both the first board and the second board may include a moisture-resistant extrudate that is preferably comprised of a substantial percentage of HDPE partially absorbed into one side of the fiberboard substrate. Where polyethylene is used, the board incorporating the moisture vapor barrier is preferably bonded to the microflute board via a cold set adhesive and the microflute and board are bonded using a cold lamination process. Where a moisture resistant extrudate having a higher melt temperature, such as PET, is used, the board may be bonded to the microflute board via a standard starch bond, and the microflute and board are bonded in a standard corrugator. Aspects of the invention further include methods for forming a low MVTR corrugated board. According to an embodiment of the invention, a low MVTR carton is formed from a low MVTR corrugated board.

[0011] Aspects of the invention also include a click-lock re-closable carton that may be simply and securely re-closed. According to one embodiment, the click-lock re-closable carton includes a pair of opposing side panels, a back panel joined to the side panels, a cover pivotally attached to the back panel having a pair of opposing side flanges, and a pair of locking tabs. A first one of the locking tabs is foldably attached to a first one of the side panels, and a second one of the locking tabs is foldably attached to a second one of the side panels. According to one aspect of the invention, the first locking tab extends a first distance from the back panel and the second locking tab extends a second distance from the back panel, which is greater than the first distance. As such, the locking tabs are offset from one another with respect to the back panel. Other features and advantages of various aspects of the invention will become apparent with reference to the following detailed description and figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The invention will be described in detail in the following description of preferred embodiments with reference to the following figures in which like reference numbers refer to like parts and wherein:

[0013] **FIG. 1** is a perspective view of a click-lock carton according to an embodiment of the invention shown in an unopened configuration but with the tear strip partially removed;

[0014] **FIG. 2** is perspective view of the carton of **FIG. 1** shown in a partially opened configuration;

[0015] **FIG. 3** is a top view, partially in perspective, of the carton of **FIG. 1** shown in a fully opened configuration;

[0016] **FIG. 4A** is a cross-sectional view of a portion of the carton taken along line B-B of **FIG. 1** through a locking tab of the carton;

[0017] **FIG. 4B** is a cross-sectional view similar to the view in **FIG. 4A** of a portion of another embodiment of the carton;

[0018] **FIG. 5** is a plan view of a carton blank for the carton of **FIG. 1**;

[0019] **FIG. 6** is a perspective view of another embodiment of the carton shown in an opened configuration;

[0020] **FIG. 7** is a top view, partially in perspective, of the carton of **FIG. 6** shown in an opened configuration;

[0021] **FIG. 8** is a plan view of a carton blank for the carton of **FIG. 6**;

[0022] **FIG. 9** is a cross-sectional view of a low MVTR board according to an embodiment of the invention;

[0023] **FIG. 10** is a cross-sectional view of a low MVTR board according to yet another embodiment of the invention;

[0024] **FIG. 11** is a flow chart illustrating a method for forming the low MVTR board of **FIG. 9**;

[0025] **FIG. 12** is a cross-sectional view of a low MVTR board according to still another embodiment of the invention;

[0026] **FIG. 13** is a schematic drawing showing a portion of a process for forming the low MVTR board of **FIG. 12**; and

[0027] **FIG. 14** is a flow chart illustrating a method for forming the low MVTR board of **FIG. 13**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] The various aspects of the invention may be embodied in various forms. The following description shows by way of illustration various embodiments in which aspects of the invention may be practiced. It is to be understood that other embodiments may be utilized and structural and functional modifications may be made without departing from the scope of the present invention. Referring now to **FIGS. 1-4, 6** and **7**, a click-lock re-closable carton **10** according to an embodiment of the invention is shown. As shown, carton **10** generally includes a pair of opposing side panels **12** and **14**, a back panel **16**, a front panel **18**, a cover **20**, a bottom **22**, and locking tabs **24**. The panels **12, 14, 16** and **18** together with cover **20** and bottom **22** form a generally cubic hollow cavity **28**.

[0029] Adhered to the inside of front panel **18** and side panels **12** and **14** is an inner liner or sleeve **30**. Sleeve **30** includes a front pane **32** and side panes **34** and **36** respectively attached to opposing ones of panels **18, 12** and **14**. Sleeve **30** generally seals the carton in a closed configuration by reducing air and moisture flow through the gap between cover **20** and panels **12, 14** and **18**. As shown in **FIGS. 1, 4, 6** and **7**, cover **20** includes a front flange **42** and a pair of opposing side flanges **44** and **46**. The inside of flanges **42, 44** and **46** respectively oppose and overlie outside upper portions of panes **32, 34** and **36** in the closed configuration.

[0030] This overlapping fit of flanges **42, 44** and **46** with panes **32, 34** and **36** retain cover **20** in a closed position. The overlapping fit alone, however, often does not securely retain cover **20** in a fully closed configuration. In addition, overlapping alone does not prevent cover **20** from popping up, such as when the carton is inadvertently bumped upward. Further, if a user closes a cover on a carton that merely relies on overlapping to retain the cover, the user does not receive any indication that the cover is fully closed. For example, the user does not feel or hear any indication that he or she fully closed the cover.

[0031] To more fully retain cover **20** in a closed configuration, locking tabs **24** may be used. Locking tabs **24** are each respectively attached to either one of side panes **34** and **36** of sleeve **30** by a fold line **38** or to front pane **32** by a fold line **40**. Locking tabs **24** located on the sides of carton **10** retain cover **20** by engaging flanges **44** and **46** while locking tab **24** located on the front of carton **10** retains cover **20** by engaging flange **42**. As shown in **FIG. 4A**, flanges **42, 44** and **46** each preferably include a locking recess **48** to respectively mate with locking tabs **24** when cover **20** is fully closed. Locking recesses **48** preferably are generally inverse replicas of locking tabs **24**. For instance, locking recesses **48** may be generally u-shaped recesses that match the u-shaped outline of locking tabs **24**. When locking recesses **48** engage locking tabs **24**, they retain cover **20** from moving in the upward direction. Because of their matching u-shape, locking recesses **48** engage locking tabs **24** along their mating bottom and side edges, which firmly retains cover **20** in the closed configuration. Other configurations are contemplated, such as a lip (not shown) along the inside of flanges **42**, **44** and **46** to engage the lower edge of locking tabs **24** in a closed configuration, as well as other shapes, such as generally v-shaped locking tabs. Flanges **42**, **44** and **46** preferably include a double board thickness to define locking recesses **48** while providing an uninterrupted outer surface. In an alternate embodiment, shown in **FIG. 4B**, locking tabs **24** may retain cover **20** via a force fit from outwardly biased locking tabs **24** frictionally engaging flanges **42**, **44** and/or **46**.

[**0032**] Click-lock carton **10** may be opened by removing a tear strip **52** disposed within side panels **12** and **14** and across front panel **18**. This permits cover **20** to pivot from back panel **16** for opening and closing. In the preferred embodiment, when initially opened, locking tabs **24** tear apart from locking recesses **48** along the perforation line disposed therebetween (see cut lines **25** of **FIGS. 5 and 8**, which are discussed below). When re-closed, locking tabs **24** engage respective locking recesses **48** to retain cover **20** in a closed position. As mentioned above, the u-shaped design of locking recesses **48** provides sturdy retention of cover **20** by retaining it in three directions. There is sufficient flex in the carton so that cover **20** can be easily opened by simply pulling upward on cover **20**.

[**0033**] To further improve retention of cover **20** in a closed configuration, locking tabs **24** located on side panels **12** and **14** are preferably offset from one another. For example, as shown in **FIG. 3**, locking tab **24** on side panel **14** is disposed a distance A from back panel **16**, and locking tab **24** on opposite side panel **12** is disposed a longer distance B from the back panel **16**. Thus, locking tab **24** on one side of carbon **10** is disposed a greater distance from the pivot axis **56** of cover **20** along fold line **54** where it mates with back panel **16** than the other locking tab **24** on the other side. As such, locking tabs **24** each retain cover **20** at different rotation-arm distances along cover **20**, which can help to ensure that cover **20** is securely retained in the closed configuration.

[**0034**] For example, when a user closes cover **20** by rotating it from a generally vertical position to a generally horizontal position, each of the locking tabs **24** engages cover **20** at different times. For instance, locking tab **24** on side panel **14** is disposed closer to fold line **56** and will engage respective locking recess **48** on flange **46** prior to locking tab **24** on side panel **12** engaging its respective locking recess **48** on flange **44**. Thus, if the user does not completely close cover **20**, locking tab **24** on side panel **14**, which is disposed closer to fold line **54** may still engage cover **20** to keep it generally closed. Because locking tabs **24** are foldably attached to sleeve panes **34** and **36** and are generally biased outward, they engage locking recesses **48** with a clicking action. When they click into place, they may provide a clicking sound and the user may feel the clicking action. Thus, the user may easily recognize when cover **20** is in a closed configuration. With locking tabs **24** offset from one another, the user may further easily recognize two distinct clicks as one tab is engaged prior to the other.

[**0035**] Carton **10** may be formed from a unitary carton blank, such as unitary blank **100** shown in **FIGS. 5 and 8**, which is discussed further below. Unitary blank **100** generally includes a unitary corrugated paperboard blank that is suitably cut, scored, perforated, etc. to be folded into carton **10**. It is understood that other suitable materials, such as corrugated plastic, may also be used for these blanks. As discussed further below with respect to **FIG. 5**, to form carton **10**, sleeve **30** and cover **20** are folded 180 degrees about fold lines **142** and **149** respectively. Next, unitary blank **100** is folded 180 degrees about fold line **919** so an attachment tab **146** is adjacent to and may be attached to side panel **14** via suitable means, such as an adhesive or metal stitches (not shown). In this configuration, a flattened carton (not shown) may be formed. The flattened carton (not shown) occupies minimal space and is particularly suited for shipping bundles of cartons. Carton **10** may be formed by unfolding the flattened carton (not shown) to form a hollow rectangular body and then forming cover **20** and bottom **22**.

[**0036**] Referring now to **FIGS. 5 and 8**, a unitary blank **100** is shown according to further embodiments of the invention. Unitary blank **100** is a uniform sheet of solid fiberboard or paperboard, corrugated fiberboard, solid or corrugated plastic board, or the like. Unitary blank **100** may be folded and assembled to a form a click-lock carton, such as click-lock carton **10**. As shown, unitary blank **100** includes a front panel **18**, a back panel **16**, a left panel **14**, a right panel **12**, lower flaps **113** attached to the panels, a sleeve **30** and cover **20**. The panels, flaps, sleeve and cover are formed from a sheet of substrate material, such as double-faced corrugated board, and connected as a single unit to form a carton. The preferred substrate material will be described hereinafter. The four panels **14**, **18**, **12** and **16** are serially connected to each other along their side portions. Each panel includes a lower flap **113** foldably connected at a lower portion, which forms the bottom **22** of the carton when assembled.

[**0037**] Sleeve **30** is foldably attached to upper portions of front panel **18** and side panels **12** and **14** of unitary blank **100**. Sleeve **30** includes three panes **34**, **32** and **36** serially connected to each other along fold lines. Along the fold line **142** between sleeve **30** and panels **18**, **12** and **14**, locking tabs **24** are foldably attached to side panes **34** and **36** of liner **30**, as shown in **FIG. 5**. The locking tabs **24** are each formed in an upper portion of a respective side panel **12** and **14** of the carton body. In an alternative embodiment shown in **FIG. 8**, locking tab **24** is foldably attached to front pane **32** and is formed in an upper portion of front panel **18** of the carton body. Locking tabs **24** are respectively defined via cut lines **25**, which may be complete cutouts or a perforated cut. Cut lines **25** also define locking recesses **48** in the assembled carton that engage locking tabs **24**. Cut lines **25** are generally u-shaped, and thereby define locking tabs **24**, as well as their respective locking recesses **48**, as being generally u-shaped. U-shaped cut lines **25** extend from fold line **142** away from sleeve **30**, and curve back to fold line **142** in a general u-shape. As such, locking tabs **24** are respectively connected to panes **32**, **34** and **36** of sleeve **30** by fold lines **38**. The remainder of the locking tabs **24** may be connected to panels **12**, **14** and **18** along cut lines **25**.

[**0038**] Unitary blank **100** provides a cost-effective blank for forming a click-lock carton. For example, unitary blank **100** is a compact design that has very little waste material. As shown in **FIGS. 5 and 8**, the blank material for forming sleeve **30** is disposed alongside the blank material for forming cover **20**. Both of the liner **30** and cover **20** are connected to panels **12**, **14**, **16** and **18**. As such, a generally rectangular blank is formed with very little unused blank material as evidenced by the minimal empty space located within the broken line surrounding unitary blank **100** in **FIGS. 5 and 8**, which represents the area of the starting material for forming blank **100**. Reducing the amount of blank material used to form unitary blank **100** reduces the amount of substrate used, thereby reducing manufacturing costs.

[**0039**] In addition, the use of a unitary blank to form a carton reduces manufacturing costs associated with producing multiple blanks for each carton, and with assembling multiple blanks to form each carton. For example, cost savings are realized by reducing the number of components maintained, shipped, tracked and otherwise planned for in order to produce such cartons. Further, manufacturing is simplified by permitting an operator to assemble the carton from a single unitary blank without having to mate independent components.

[**0040**] Click-lock carton **10** is assembled by folding and adhering portions of blank **100** to other portions of the blank. To form the carton, liner **30** is folded 180 degrees along fold line **142** to place it in contact with a first side of the blank. Sleeve **30** is attached to opposing surfaces of panels **14**, **18** and **12** via an adhesive, except in region **132** of sleeve **30** and the area of panels **14**, **18** and **12** disposed between tear strip **52** and fold line **142**. Generally cubic-shaped carton **10** is formed by attaching a securing flap **146** to side panel **14**. Bottom flaps **113** are then folded and secured to form bottom **22** of carton **10** as shown in **FIG. 1**. Top flap **148** is folded along fold line **149** adjacent to back panel **16** to form cover **20**.

[**0041**] Foldably attached along the periphery of top flap **148** are side flanges **42**, **44** and **46**, which are folded about ninety degrees to respectively form side flanges **42**, **44** and **46** of carton **10**. The inside surfaces of side flanges **42**, **44** and **46** are glued to the outside of panels **14**, **18** and **12** in the region **160** bounded by fold line **142**, cut lines **25**, tear strip **52**, and cut lines **156** and **158**. Region **160**, along with side flanges **42**, **44** and **46** of top flap **148**, form the double-wall side flanges **42**, **44** and **46** of carton **10**. The double-wall thickness of these flanges permit locking recesses **48** to be formed while maintaining an uninterrupted outer surface, which seals moisture out of the carton in the closed configuration and provides a better appearance.

[**0042**] Unitary blank **100** preferably is made from a sheet of corrugated substrate material that includes a polymer moisture barrier extruded onto one or more layers of corrugated board material, such as fiberboard. The polymer moisture barrier may include a variety of polyolefins, such as polyester, polyethylene, PET or polypropylene. Different moisture barrier materials may provide different advantages. For instance, as discussed in connection with the embodiments described below, polyethylene can provide a good quality moisture barrier. On the other hand, PET provides a moisture barrier that can withstand the high temperatures used in corrugators better than other moisture barriers due to PET's high melting point. It is contemplated that a variety of substrate materials may be used to form unitary blank **100**.

[**0043**] Preferably the polymer moisture barrier is high density polyethylene or a blend of high density polyethylene and low density polyethylene. It has been found that a blend of about 70% of a high density polyethylene, such as a polyethylene having a density of about 0.962 grams per cubic centimeter, and about 30% of a low density polyethylene, such as a polyethylene having a density of about 0.921 grams per cubic centimeter, extruded at a thickness of about 1.25 mils on a suitable substrate provides a particularly useful unitary blank with a low MVTR. Such a thickness provides the functionally equivalent moisture vapor barrier properties of at least about a 1 mil thick film of polymer adhered to the substrate. The MVTR achieved with this invention is about 0.63 grams per meter squared in 24 hours as measured by a Mocon Permatran using ASTM standard E-389. Such a low MVTR is achieved without the need for other polymeric films adhered to the polyethylene blend or the use of other oriented films or polymers adhered to the substrate with an adhesive. Indeed, with the present invention, the functionality of prior art low MVTR barriers is achieved at lower expense and with fewer processing steps.

[**0044**] Referring now to **FIGS. 9 and 11**, a low MVTR corrugated board **410** is shown according to an embodiment of the invention. Corrugated board **410** may be used with blank **100** to form click-lock carton **10** as well as for a variety of other uses. Corrugated board **410** generally includes a first panel **412** bonded to microflute corrugate **414** at a first side and a second panel **416** attached to an opposite side of microflute corrugate **414**. Such bond locations are denoted by reference number **418**. Depending upon the material used for first panel **412** and second panel **416**, either a starch bond or a cold set adhesive may be used to bond first panel **412** and second panel **416** to microflute corrugate **414**. If desired, a starch bond can be used at one side and a cold set adhesive can be used at another side. A starch bond provides adequate adhesion at low cost and is typically used to bond the elements of a corrugated carton together in a standard corrugator, which typically operates at temperatures in the range of 200 degrees Fahrenheit up to about 380 degrees Fahrenheit. A cold set adhesive provides adhesion without the need for the heat of a typical corrugator, but is more expensive than the use of a starch bond. Where polyethylene is the moisture barrier, a cold set adhesive should be used because of the relatively low melting point of the polyethylene as compared to the heat of a standard corrugator. On the other hand, where PET is the moisture barrier, a standard starch bond may be used in a standard corrugator because PET has a higher melt point than the temperatures at which standard corrugators operate.

[**0045**] First panel **412** and microflute **414** are preferably formed as a single face corrugated board **420**, which is manufactured using a corrugator as is known in the art. Where polyethylene is used for the moisture barrier, the second panel **416**, which includes polyethylene **422** extruded onto the surface of fiberboard liner **424**, is preferably cold laminated to the flute tips of single face corrugated board **420**. As shown in **FIG. 9**, an impregnated zone **426** of second panel **416** includes a mechanical combination of polymer **422** and fiberboard liner **424**. A generally homogenous polymer layer **422** exists that further resists the transmission of moisture vapor and has a total thickness A of about 1.25 mils. The thickness B of polymer extending from the surface of fiberboard liner **424** is about 1.10 mils. This configuration provides the functionally equivalent moisture vapor barrier properties of at least about a 1 mil thick film of polymer adhered to the substrate.

[0046] Low MVTR corrugated board **410** provides a corrugated board having good moisture barrier properties with relatively high compression strength. For instance, a laundry detergent carton according to the embodiment of carton **10** shown in **FIG. 1** that uses corrugated board **410** has good strength properties and moisture-resistance properties without the use of a separate structural liner insert. The use of a single board saves material costs and manufacturing costs, and reduces carton mass in comparison with a similar design using a structural liner insert that lines four walls of the carton.

[0047] Polymer **422** is directly extruded to fiberboard liner **424** without the use of a binding agent. Directly extruding polymer **422** to fiberboard liner **424** permits polymer **422** to at least partially penetrate fiberboard liner **424**. As such, a relatively strong mechanical bond is formed between polymer **422** and fiberboard liner **424** without the use of binding agents. This reduces material costs and manufacturing costs related to forming corrugated board **410**. As shown in **FIG. 9**, polymer **422** is preferably set against microflute layer **414**, but could be on the exterior if desired. See **FIG. 12**.

[0048] The process of forming second panel **416** may include flame treating fiberboard liner **424** to improve its ability to absorb molten polymer, and coating fiberboard liner **424** with extruded molten polymer. The extrusion process may include heating, melting, and extruding the polymer using, for example, a screw-driven extruder, to coat fiberboard liner **424**. The production rate, temperature of the molten polymer, and other parameters are preferably controlled to permit a desired amount of polymer to impregnate fiberboard **424**.

[0049] Second panel **416** may be printed independently of the process for assembling the double face corrugated board **410**. Printing the non-coated side of fiberboard liner **424** after the extrusion process reduces the possibility of adversely affecting the quality of the printed surface; although, fiberboard liner **424** may be printed prior to extrusion. Preferably, where a high quality printable fiberboard liner **424**, such as 12 point solid bleach sulfate, is used printing can be applied to the exterior surface of fiberboard liner **424** in the embodiment of corrugate board **410** of **FIG. 9**. Cold lamination of the second panel **416** to single-face corrugated board **420** using a cold set adhesive further reduces the possibility of affecting the quality of the printed surface. If printing is desired on the moisture barrier side of the fiberboard liner, printing can occur after the application of polymer, which avoids the use of primers while providing a printed surface on the polymer side. See **FIGS. 10 and 12**. Both of these methods allows for good penetration of the extrudate into the fiberboard liner without a primer affecting such penetration.

[0050] **FIG. 11** is a flowchart **510** that illustrates a method for forming corrugated board **410** according to an embodiment of the invention. As shown, the method includes step **512** of forming a single face corrugated board **420** via a corrugator, and step **514** of extruding a moisture-resistant extrudate **422** directly to a fiberboard **424** for forming a moisture-resistant liner **416**. As an example, about 12 pounds to about 22 pounds of polyethylene resin may be applied to about every 1,000 to 3,000 square feet of fiberboard **424**. Preferably about 14.4 pounds per thousand square feet are used. Steps **512** and **514** can be performed in any order. Subsequent to steps **512** and **514**, the method includes step **516** of gluing either the extrudate side or the fiberboard side of the moisture-resistant liner **416** to the single-faced corrugated board **420**.

[0051] Referring now to **FIG. 10**, a low MVTR corrugated board **610** is shown according to another embodiment of the invention. Corrugated board **610** may be used with blank **100** and to form click-lock carton **10**, as well as for a variety of other uses. Corrugated board **610** generally includes the same aspects and preferences as corrugated board **410**, except that second panel **616** includes a second layer of polymer extrudate **628** on the opposite side from the first layer of polymer extrudate **422**. The second layer of polymer extrudate **628** generally includes the same aspects and preferences as the first layer discussed with corrugated board **410**, and is generally extruded directly onto the surface of fiberboard liner **424**. A second impregnated zone **630** of second panel **616** includes a mechanical combination of polymer extrudate **628** and fiberboard liner **424**.

[0052] Applying second layer of polymer extrudate **628** provides additional moisture barrier performance and may increase the appearance and gloss values due to printing on the polymer extrudate **628**. For example, for use with extremely moisture sensitive products or in extremely humid environments, it may desirable to have a moisture barrier on the exterior face of the corrugated board **610**, and a reinforcing moisture barrier integral to the corrugated board disposed adjacent to the microflute. This can provide robust moisture protection to the microflute material **414**, which preserves its structural strength, as well as to the contents of any carton formed from corrugated board **610**. In addition, the second moisture-resistant extrudate may have different properties from the first extrudate as desired. For instance, the non-visible extrudate disposed within the finished corrugated board may have higher moisture-resistance properties than the second extrudate, and the second extrudate may have higher gloss or other appearance related properties than the first extrudate.

[0053] Referring now to **FIGS. 12-14**, a low MVTR corrugated board **710** is shown according to another embodiment of the invention. In this embodiment, corrugated board **710** generally has the same aspects and preferences as boards **510** and **610**, except that the extrudate **722** is located on the outside of the fiberboard liner **724** with an impregnated zone **726**. In this embodiment, polyester may be used to form the extrudate, although other polyolefins such as polyethylene and polypropylene may be used, and both liners are bonded to the microflute. As discussed above in connection with the embodiment of **FIG. 9**, depending on the melting point of the polymer used as the moisture barrier, either a starch bond or a cold set adhesive may be used to bond the microflute **714** to the fiberboard liners **712** and **716**. Corrugated board **710** may be used with blank **100** to form click-lock carton **10** as well as for various other uses. Corrugated board **710** generally includes a first panel **712** and a second panel **716** bonded to opposite sides of microflute corrugate **734**. Microflute **714** and panels **712** and **716** are preferably formed as a double faced corrugated board **720** manufactured using a corrugator **812**. Second panel **716** generally includes a polyolefin moisture barrier **722** thermally bonded at **718** to a fiberboard liner **724** via an extrusion lamination process.

[**0054**] **FIGS. 13 and 14** generally illustrate a method **810** for forming corrugated board **710** according to an embodiment of the invention. In step **812**, a single face corrugated board **716** is formed by bonding a first liner **712** to a first side of microflute **714**. In step **814**, a second liner is formed by passing a fiberboard liner **724** through an extruder **730** to extrude a polyolefin extrudate **722** such as polyester, polyethylene, PET or polypropylene, to a first side of fiberboard liner **724**. As an example, heated PET resin is extruded at a thickness of about 1 mil directly to fiberboard liner **724** without the use of a binding agent. As with boards **410** and **610**, PET resin penetrates fiberboard liner **724** to form a mechanical bond at impregnated zone **726** with the fiberboard. The bonded sheet **716** may subsequently be printed and sealed if desired via printing and sealing operations **732**. As with boards **410** and **610**, printing on top of the PET resin may avoid the use of a primer.

[**0055**] Bonded sheet **716** is subsequently passed through the double backer portion **735** of a corrugator **734** along with single face corrugated board **720** to form a double faced corrugated substrate using conventional techniques. As bonded sheet **716** is passed through corrugator **734**, in steps **818** and **820** of method **810**, it is heated to a temperature of about 120 degrees Fahrenheit up to about 210 degrees Fahrenheit, and bonded to single faced corrugated board **720** via a starch bond.

[**0056**] As noted above, corrugators generally operate in the temperature range of 200 degrees Fahrenheit up to about 380 degrees Fahrenheit. PET resins typically have melt points above this range, and for moisture-barrier applications of corrugated boards, preferably have a melt point of about 420 degrees Fahrenheit. As such, the printed layer of PET in the carton liner withstands corrugator processing better than other known barrier materials, such as polyethylene and polypropylene. Thus, scuffing and marring of the printed surface, as well as deformities in the moisture barrier layer in general, may be avoided through the use of PET resins as a moisture barrier when using corrugator processing. In addition, PET has better strength characteristics than many other barrier materials, such as polyethylene and polypropylene.

[**0057**] While the present invention has been described in connection with the illustrated embodiments, it will be appreciated and understood that modifications may be made without departing from the true spirit and scope of the invention. In particular, the invention applies to many different cartons of various shapes, designs and applications. Additionally, it is contemplated that various moisture barriers and corrugated board configurations applicable beyond the disclosed embodiments.

We claim:

1. A re-closable carton comprising:

a pair of opposing side panels;

a back panel joined along opposite sides to the side panels;

a cover pivotally attached to the back panel and having a pair of opposing side flanges, each side flange including a locking recess;

a first locking tab foldably attached to a top portion of a first one of the opposing side panels for engaging a first one of the locking recesses when the cover is in a closed configuration, the first locking tab being disposed at a first dimension from the back panel; and

a second locking tab foldably attached to a top portion of a second one of the opposing side panels for engaging a first one of the locking recesses when the cover is in a closed configuration, the second locking tab being disposed at a second dimension from the back panel, the second dimension being greater than the first dimension;

wherein the carton is formed from corrugated board having a first board, a microflute board having a first side and a second side, the microflute board attached at its first side to the first board via a starch bond; and a second board with a fiberboard substrate attached to the second side of the microflute board with a cold set adhesive, the fiberboard substrate having a first side and an opposite second side, and a moisture-resistant extrudate including high density polyethylene therein partially absorbed into the first side of the fiberboard substrate.

2. The carton blank of claim 1 wherein the moisture-resistant extrudate is comprised of a blend of high density polyethylene and low density polyethylene.

3. The carton of claim 2 wherein the moisture-resistant extrudate is comprised of a blend of about 70% high density polyethylene and about 30% low density polyethylene.

4. The carton of claim 3 wherein the moisture-resistant extrudate extends about 1.10 mils from an outer surface of first side of the fiberboard substrate.

5. A method for forming a low moisture vapor transmission rate corrugated board having only a moisture-resistant extrudate acting as the moisture vapor barrier comprising:

attaching a first fiberboard liner to a microflute at a first side of the microflute;

extruding a moisture-resistant extrudate including high density polyethylene directly to a second fiberboard liner without any intermediate composition to bind the moisture-resistant extrudate to the second fiberboard liner; and

adhering one of the extrudate and the second fiberboard liner to the microflute at a second side of the microflute with a cold set adhesive.

6. The carton blank of claim 5 wherein the moisture-resistant extrudate is

comprised of a blend of high density polyethylene and low density polyethylene.

7. The carton of claim 6 wherein the moisture-resistant extrudate is comprised of a blend of about 70% high density polyethylene and about 30% low density polyethylene.

8. The carton of claim 7 wherein the moisture-resistant extrudate extends about 1.10 mils from an outer surface of first side of the fiberboard substrate.

9. A corrugated board consisting essentially of:

a first board;

a microflute board having a first side and a second side, the microflute board attached at its first side to the first board;

a second board formed from a fiberboard substrate having a first side and an opposite second side wherein the fiberboard substrate is attached to the microflute board; and

a moisture-resistant extrudate including high density polyethylene therein partially absorbed into the first side of the fiberboard substrate.

10. The carton blank of claim 9 wherein the moisture-resistant extrudate includes a blend of high density polyethylene and low density polyethylene.

11. The carton of claim 10 wherein the moisture-resistant extrudate includes a blend of about 70% high density polyethylene and about 30% low density polyethylene.

12. The carton of claim 11 wherein the moisture-resistant extrudate extends about 1.10 mils from an outer surface of first side of the fiberboard substrate.

13. A re-closable carton comprising:

a pair of opposing side panels;

a front panel joined along opposite sides to each of the opposing side panels;

a back panel joined along opposite sides to each of the opposing side panels;

a cover pivotally attached to the back panel and having a pair of opposing side flanges and a front flange;

a locking tab foldably attached to a top portion of at least one of the opposing side panels or front panel for engaging one of the opposing side flanges or front flange when the cover is in a closed configuration; and

wherein the carton is formed from corrugated board having a first board, a microflute board having a first side and a second side, the microflute board attached at its first side to the first board; and a second board formed from a fiberboard substrate attached to the second side of the microflute board, the fiberboard substrate having a first side and an opposite second side, and a moisture-resistant extrudate partially absorbed into the first side of the fiberboard substrate.

14. The carton blank of claim 13, wherein the moisture-resistant extrudate is comprised of polyethylene terephthalate.

15. The carton blank of claim 13, wherein the moisture-resistant extrudate is comprised of high density polyethylene.

16. The carton blank of claim 13 wherein the moisture-resistant extrudate is comprised of a blend of high density polyethylene and low density polyethylene.

17. The carton of claim 16 wherein the moisture-resistant extrudate is comprised of a blend of about 70% high density polyethylene and about 30% low density polyethylene.

18. The carton of claim 17 wherein the moisture-resistant extrudate extends about 1.10 mils from an outer surface of first side of the fiberboard substrate.

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