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(54) Title: MANUALLY OPENABLE RECYCLABLE PACKAGE

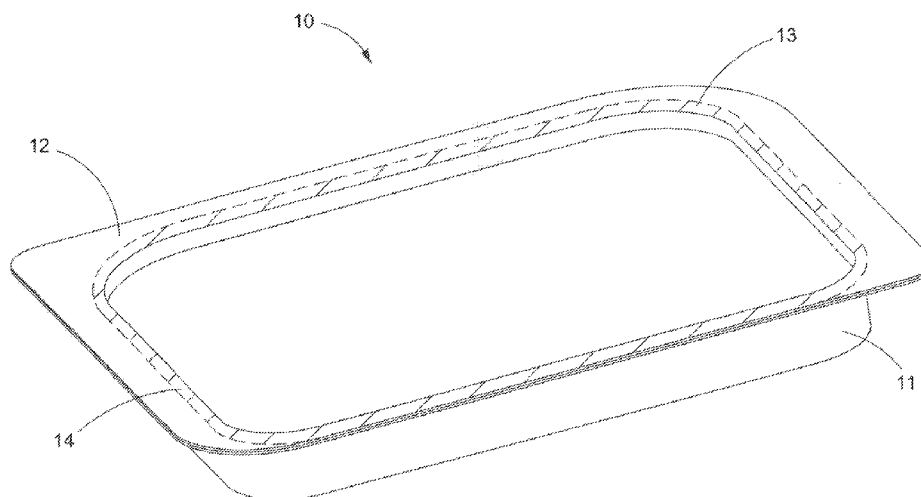


FIG. 1

(57) Abstract: A thermoplastic package comprises a tray and a lidding film, both of which are suitable for recycling into a polyethylene terephthalate (PET) recycling stream. Packages comprise predominantly recyclable polyethylene terephthalate materials relative to the total weight of the package. Packages may be especially for retail display for containing a food such as fresh produce, cheeses and meats, and/or non-food product. Also provided is a manually openable package which includes a tray sealed to a lidding film laminate by a peelable heat seal.



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MANUALLY OPENABLE RECYCLABLE PACKAGE

BACKGROUND OF THE INVENTION

- [01] The present invention relates generally to primary packaging and more particularly, to manually openable packages for containing a product. Specifically, the present invention refers to manually openable packages formed from materials which are generally considered recyclable.
- [02] Discarded packaging materials often wind up in a landfill. In some countries, particularly the U.S., there is a significant decrease in the availability of landfill space when approximately 90% of the municipal solid waste is disposed of by landfilling. Recyclable packaging materials can dramatically reduce landfill waste. Today, there are a number of plastics considered recyclable which may enter established recycling streams. These materials include low density and linear low density polyethylene, high density polyethylene, polypropylene, polyethylene terephthalate, polystyrene and a few others. Polyethylene terephthalate (PET) bottles and jars are generally considered recyclable. The PET can be recovered and recycled again and again through washing and re-melting for use in new food and non-food packaging applications, or by chemically breaking down the PET into its constituent raw materials, which are then purified and converted into new recycled PET resins. In the last few years there has been a significant increase in the use of PET trays by the packaging industry. Unfortunately, most of these trays and other PET containing packaging cannot be easily recycled because they are made up of a plurality of layers of a variety of plastic materials. Recycling of such packages can involve costly cleaning and sorting operations to separate the recyclable plastics from any non-recyclable materials. The fewer the non-recyclable materials there are and the more chemically similar the recyclable plastics present in a package, the less expensive and more efficient the recycling operations become.

SUMMARY OF THE INVENTION

- [03]** An important object of the present invention is to provide a package that includes a tray and a lidding film, both of which are suitable for recycling into a polyethylene terephthalate (PET) recycling stream. The package is preferably thermoplastic. In one preferred embodiment, the package of the present invention advantageously comprises at least 97% by weight of polyethylene terephthalate materials relative to the total weight of the package.
- [04]** Another object is to provide a package especially for retail display for containing a food such as, but not limited to, fresh produce, cheeses and meats, and/or non-food product. In one preferred embodiment, the package of the present invention is advantageously well-suited for packaging of fresh unprocessed and processed food, and especially for respiring foodstuffs, particularly carbon dioxide respiring foodstuffs. One particular application is packaging of cheese such as for example, but not limited to, Emmental, Gouda and Edam. Towards this specific end, in some preferred embodiments, the packages may have an average oxygen transmission rate of $12 \text{ cm}^3/\text{m}^2$ for 24 hours at 23°C and 50% relative humidity and an average carbon dioxide transmission rate of $54 \text{ cm}^3/\text{m}^2$ for 24 hours at 23°C and 50% relative humidity. In other preferred embodiments where protection against the ingress of oxygen is required, the packages may have an average oxygen transmission rate of less than $12 \text{ cm}^3/\text{m}^2$ for 24 hours at 23°C and 50% relative humidity. In some preferred embodiments, the package may be a vertical or horizontal form-fill-seal package.
- [05]** Still another object is to provide a manually openable package which includes a tray sealed to a lidding substrate by a peelable heat seal. A manually openable package is one in which the lidding substrate can readily peel apart by hand from the tray without uncontrolled or random tearing or rupturing of the tray and/or lidding substrate. Peel strength can be controlled over a wide temperature range. Seal strength of the seal between the tray and lidding substrate is

sufficient to ensure that the seal remains secure and unbroken during package fabrication, distribution and storage. In one preferred embodiment, the peelable heat seal between the tray and lidding substrate is hermetic and can readily peel apart by hand without uncontrolled or random tearing or rupturing of the tray and/or lidding substrate. For example, a manually peelable heat seal such as one formed with a heat seal lacquered oriented polyethylene terephthalate (OPET) lidding substrate sealed to an amorphous polyethylene terephthalate (APET) tray at a temperature of 140-170° C under a pressure of 0.5 N/mm² exhibits an initial seal opening force in the range from 1 to 2.5 N/15 mm and propagation peel force ranging from 1 to 2.5 N/15 mm when tested by a "T-peel method" at 23° C at a speed of 200 mm/min. Initial seal opening force and propagation peel force may vary depending upon the thickness of the heat seal lacquer and the sealing temperature used to seal the tray and lidding substrate together.

- [06] Provided herein is a package for containing a product having a tray with a product receiving area and a sealing flange. The package includes a lidding substrate having sealing margin. The package further includes a peelable hermetic seal between the sealing margin of the lidding substrate to the sealing flange of the tray. The tray and the lidding substrate may each be thermoplastic, or they both may be thermoplastic. The package has two basic components: one basic component comprises an oriented polyethylene terephthalate layer and a polyester copolymer heat sealing lacquer coating applied to the oriented polyethylene terephthalate layer and the other basic component comprises a mono-layer of amorphous polyethylene terephthalate, oriented polyethylene terephthalate, crystalline polyethylene terephthalate or recycled polyethylene terephthalate. Not only are the polyethylene terephthalate materials used in the package suitable for a PET recycling stream, but the polyester copolymer heat sealing lacquer coating is also compatible with PET recycling streams.

- [07]** In a first version, the package includes a tray comprising an oriented polyethylene terephthalate layer and a polyester copolymer heat sealing lacquer coating applied to the oriented polyethylene terephthalate layer. This version of the package also includes a lidding substrate comprising a mono-layer of amorphous polyethylene terephthalate, oriented polyethylene terephthalate, crystalline polyethylene terephthalate or recycled polyethylene terephthalate.
- [08]** In a second version, the package includes a lidding substrate comprising an oriented polyethylene terephthalate layer and a polyester copolymer heat sealing lacquer coating applied to the oriented crystalline polyethylene terephthalate layer. In the second version, the tray comprises a mono-layer of amorphous polyethylene terephthalate, oriented polyethylene terephthalate, crystalline polyethylene terephthalate or recycled polyethylene terephthalate.
- [09]** In some preferred embodiments, both the lidding substrate and tray are rigid or semi-rigid.
- [10]** In some preferred embodiments, the tray is rigid or semi-rigid while the lidding substrate is flexible.
- [11]** In some preferred embodiments, both the lidding substrate and tray are flexible.
- [12]** In some preferred embodiments, the polyester copolymer heat sealing lacquer coating is pattern-applied onto the oriented polyethylene terephthalate layer.
- [13]** In such embodiments, the polyester copolymer heat sealing lacquer coating is non-extensive with the oriented polyethylene terephthalate layer.
- [14]** In some preferred embodiments, the polyester copolymer heat sealing lacquer coating is co-extensive with the oriented polyethylene terephthalate layer.
- [15]** An advantageous optional feature of the present invention is that it may include an integrally formed tamper-evident feature. In one preferred embodiment, the

tamper-evident feature comprises visible whitened area of the sealing flange of the tray produced when the hermetic seal has been breached which occurs when the lidding film is peeled from the tray.

- [16] Also provided herein are methods of delivering food products. The methods comprise: obtaining any manually openable recyclable package disclosed herein containing a food product; and manually opening the peelable hermetic seal.

BRIEF DESCRIPTION OF THE DRAWINGS

- [17] Further features and advantages of the present invention will become apparent from the following detailed description, taken in combination with the appended drawings, in which:
- [18] FIG. 1 illustrates a schematic view of a package according to an embodiment.
- [19] FIG. 2 illustrates an exploded schematic view of a package according to an embodiment.
- [20] FIG. 3 illustrates a top-down view of a lacquer coating applied in-register onto oriented polyethylene terephthalate layer of the lidding substrate according to an embodiment.
- [21] FIG. 4 illustrates a cross-sectional view of a two-layer laminate suitable for use as either a lidding substrate or tray according to an embodiment.
- [22] FIG. 5 illustrates a top-down view of a lacquer coating applied in-register onto oriented polyethylene terephthalate layer of the tray according to an embodiment.

DETAILED DESCRIPTION OF THE INVENTION

- [23] Reference herein to "polyethylene terephthalate materials" means something formed from a polymer of polyethylene terephthalate. Examples include one or more of: amorphous polyethylene terephthalate, oriented polyethylene

terephthalate, crystalline polyethylene terephthalate or recycled polyethylene terephthalate. Polyethylene terephthalate materials are recyclable.

- [24]** A preferred embodiment of the package **10** includes a thermoplastic tray **11** and a multilayer thermoplastic lidding film laminate **12** as depicted in FIGS. 1 and 2. The thermoplastic tray **11** may be formed as a flexible, rigid and/or semi-rigid substrate and may also have any shape as required by the product being packaged. In one preferred embodiment, tray **11** is rigid or semi-rigid substrate. In one preferred embodiment, tray **11** is rigid or semi-rigid substrate and thermoformed, and has a product receiving area **11a** and a sealing flange **11b**. The depth of thermoforming, *i.e.*, product receiving area may vary depending upon the amount and dimensions of the product(s) being packaged. It should be understood that the package may also include a non-thermoformed tray (not shown) having a product receiving area and a sealing flange. In one preferred embodiment, tray **11** consists essentially of a mono-layer amorphous polyethylene terephthalate (APET). As depicted in FIGS. 1 and 2, the product receiving area **11a** is a thermoformed cavity displaced horizontally away from the sealing flange **11b**. This displacement may be any distance including distances of between 1 mm and 100 mm, or between 20 mm and 75 mm, or between 10 mm and 20 mm. In this particular embodiment, the sealing flange **11b** circumvents the product receiving area **11a** and is shown having a width about 10 mm. The width of the sealing flange **11b** may vary any distance and may include distances of between 2 mm and 20 mm, or 4 mm and 8 mm. It should be understood that flange **11b** may further optionally include an extended flap area **11c** located at one corner of package **10** which facilitates the peeling open of said package. In at least one preferred embodiment, tray **11** includes good optical properties such as low haze, high gloss and/or no streaks or lines which detract from the tray's appearance. In another preferred embodiment, a substantial area of the tray **11** is optical transparent in order to render the product packaged therein visibly observable by the consumer when the package is

displayed in a retail store. Tray **11** may have a thickness which varies between 50 μm and 700 μm , or 100 μm and 500 μm , or 125 μm and 250 μm .

[25] As depicted in FIGS. 1-3, one preferred embodiment of the thermoplastic lidding substrate **12** is illustrated having a substantially flat construction which is sealed to tray **11** at the tray's flange **11b** to cover the product receiving area **11a**. Lidding substrate **12** may include a flexible thermoplastic substrate, or as depicted in this particular example, a rigid or semi-rigid thermoplastic substrate. The overall thickness of lidding substrate **12** may vary depending upon the thickness of the individual layers used to construct the laminate. Typically, the overall thickness of lidding substrate **12** is between 25 μm and 500 μm , or between 50 μm and 300 μm , or between 100 μm and 250 μm . Lidding substrate **12** has a sealing margin **12a** which is peelable sealed to the tray **11**. This sealing margin **12a** encompasses a portion of the peripheral edge of the laminate and may vary in width. In some preferred embodiments, lidding substrate **12** may be slightly thermoformed such that the sealing margin **12a** is horizontally offset from the remaining portion of the laminate. In such preferred embodiments, lidding substrate may have a draw depth of between 1 mm and 10 mm, or between 3 mm and 8 mm, or between 5 mm and 7 mm. In other preferred embodiments, lidding substrate **12** may not be thermoformed at all.

[26] In its final form, package **10** further includes a hermetic seal **13** comprising a perimeter heat seal **14** circumventing the product receiving area **11a** formed by heat sealing the sealing margin **12a** of the lidding substrate **12** to the sealing flange **11b** of the tray. Package **10** may optionally include an integrally formed tamper-evident feature **15**. In one preferred embodiment, the tamper-evident feature **15** is visible whitened area of the sealing flange **11b** of the tray which is produced when the hermetic seal **13** has been breached and occurs when the lidding substrate **12** is peeled from the tray **11**, as depicted in FIG. 2.

- [27] The construction of the tray **11** and lidding substrate **12** are important aspects of the present invention which includes one or more recyclable layers. Turning to FIG. 4, item 100a is directed to an oriented polyethylene terephthalate layer **101** having a polyester copolymer heat sealing lacquer coating **102** applied directly onto the surface of layer **101**. In a first version, lidding substrate **12** is 100a, which includes a layer **101** comprising oriented polyethylene terephthalate and a polyester copolymer heat sealing lacquer coating **102** applied directly onto the surface of layer **101** as depicted in FIG. 4. Examples of suitable oriented polyethylene terephthalate include, but are not limited to those sold under the tradename ARYAPET-A100, ARYAPET-A200, and ARYAPET-A300 by JBF RAK LLC, Ras Al Khaimah, United Arab Emirates. Advantageously, such materials are optically transparent. The thickness of the oriented polyethylene terephthalate may vary between 50 μm and 300 μm , or between 100 μm and 250 μm , or between 125 μm and 250 μm . In some preferred embodiments, the heat sealing lacquer coating **102** is a polyester copolymer coating. Heat sealing lacquer coating **102** may be applied to using well-known reverse gravure, direct gravure and/or flexo-printing technologies. Optionally, the surface of oriented polyethylene terephthalate may be pre-treated by corona discharge before the heat sealing lacquer is applied thereto. After application to a substrate, lacquer coating **102** provides a heat-sealable surface which can form a peelable heat seal to tray **11** under heat and/or pressure. Examples of such commercially available heat-sealable coatings include, but are not limited to those sold under the trademark family ADCOTE™ by The Dow Chemical Company, Midland, MI, USA. In some preferred embodiments as shown in FIG. 3, heat sealing lacquer coating **102** is applied in-register onto oriented polyethylene terephthalate layer **101** such that only a portion of the surface area of layer **101** encompassing the sealing area **12a** is thereby covered. In this particular embodiment, heat sealing lacquer coating layer **102** is coated onto layer **101** to form either a transparent or semi-opaque band **101a** having a width equal to about 2.5 mm, or 5 mm, or 10

mm, or 20 mm extending from an outer edge to a pre-determined distance towards the center of lidding substrate **12**. Alternatively (not shown), heat sealing lacquer coating **102** may be coated onto oriented polyethylene terephthalate layer **101** such that it covers the entire surface area of layer **101**. The polyester copolymer heat sealing lacquer coating may have a thickness of between 0.5 μm and 10 μm (3g/m^2 to 5g/m^2). In this first version of the present invention, tray **11** is constructed from a mono-layer comprising amorphous polyethylene terephthalate (APET), oriented polyethylene terephthalate (OPET) crystalline polyethylene terephthalate (CPET) or recycled polyethylene terephthalate (RPET). Examples of commercially available amorphous polyethylene terephthalate (APET) mon-layers include, but are not limited to those sold by Coexpan Montonate S.R.L., Sumirago, Italy; Klöckner Pentaplast GmbH, Montabaur, Germany; and Sky-light A/S, Varde, Denmark.

- [28] In a second version of the present invention, lidding substrate **12** is constructed from a mono-layer comprising amorphous polyethylene terephthalate (APET), oriented polyethylene terephthalate (OPET), crystalline polyethylene terephthalate (CPET) or recycled polyethylene terephthalate (RPET) while tray **11** is 100a, which includes a layer **101** comprising oriented polyethylene terephthalate and a polyester copolymer heat sealing lacquer coating **102** applied directly onto the surface of layer **101** as described above and depicted in FIG. 4. In this second version of the present invention, heat sealing lacquer coating **102** may applied in-register such that only a portion of the surface area of layer **101** encompassing tray flange **11b** is thereby covered as depicted in FIG. 5. Alternatively, heat sealing lacquer coating **102** may be coated onto oriented polyethylene terephthalate layer **101** such that it covers the entire surface area of layer **101** and thus the entire surface of tray **11**.
- [29] It is also within the scope of the present invention to reverse-print indicia onto the tray and/or lidding substrate using conventional solvent-based inks. Suitable ink

for use with the present invention need not be water-soluble, but can be removed from the lidding substrate and/or tray using an etching and mechanical abrasion process which is generally recognized as fully approved for food grade recycling. An overprint lacquer coating may also be included to protect the printed indicia and/or each of the lidding substrate and tray. Solvent-based or water-washable inks and overprint lacquers are known in the art and may be used with the present invention.

- [30]** The above description and examples illustrate certain embodiments of the present invention and are not to be interpreted as limiting. Selection of particular embodiments, combinations thereof, modifications, and adaptations of the various embodiments, conditions and parameters normally encountered in the art will be apparent to those skilled in the art and are deemed to be within the spirit and scope of the present invention.

What is claimed:

1. A manually openable recyclable package for containing a product comprising:
a tray having a product receiving area and a sealing flange;
a lidding substrate having a sealing margin;
wherein:
one of either the tray or the lidding substrate comprises an oriented polyethylene terephthalate layer and a polyester copolymer heat sealing lacquer coating applied to the oriented polyethylene terephthalate layer, and the other of the tray or the lidding substrate comprises a mono-layer of amorphous polyethylene terephthalate, oriented polyethylene terephthalate, crystalline polyethylene terephthalate or recycled polyethylene terephthalate; and
a peelable hermetic seal between the sealing margin of the lidding substrate and the sealing flange of the tray.
2. The package according to claim 1, wherein the peelable hermetic seal comprises a perimeter heat seal circumventing the product receiving area formed by heat sealing.
3. The package according to claim 1, wherein the package comprises a tamper-evident feature.
4. The package according to claim 3, wherein the tamper-evident feature comprises a visible whitened area of the sealing flange of the tray produced when the hermetic seal has been breached.
5. The package according to any one of claims 1-4, wherein the tray, the lidding, or both are rigid or semi-rigid.

6. The package according to any one of claims 1-5, wherein the tray is thermoformed.
7. The package according to any one of claims 1-5, wherein the lidding substrate is thermoformed.
8. The package according to claim 7, wherein the lidding substrate has a draw depth of between 1 mm and 20 mm.
9. The package according to any one of claims 1-8, wherein the hermetic seal has a seal strength in the range of 1 N/15 mm and 6 N/15 mm at 23° C.
10. The package according to any one of claims 1-9, wherein the oriented polyethylene terephthalate layer has a thickness of between 100 μm and 250 μm .
11. The package according to any one of claims 1-10, wherein the polyester copolymer heat sealing lacquer coating has a thickness of between 0.5 μm and 10 μm .
12. The package according to any one of claims 1-11, wherein the lidding substrate and/or the tray further comprises a layer of water-washable ink.
13. The package according to claim 12, wherein the lidding substrate and/or the tray further comprises layer positioned on the surface of the ink which comprises a water-washable overlacquer.

14. The package according to any one of claims 1-13, wherein the polyester copolymer heat sealing lacquer coating is pattern-applied onto the oriented polyethylene terephthalate layer.
15. The package according to any one of claims 1-14, wherein the polyester copolymer heat sealing lacquer coating is non-extensive with the oriented polyethylene terephthalate layer.
16. The package according to any one of claims 1-15, wherein the package comprises at least 97% by weight polyethylene terephthalate materials relative to the total weight of the package.
17. The package according to any one of claims 1-16, wherein the tray comprises between 1% and 20% by weight of recycled polyethylene terephthalate relative to the total weight of the tray.
18. The package according to any one of claims 1-17, wherein the package is a horizontal form-fill-seal package.
19. The package according to any one of claims 1-18, wherein the package has an average oxygen transmission rate of at least $12 \text{ cm}^3/\text{m}^2$ for 24 hours at 23°C and 50% relative humidity.
20. The package according to any one of claims 1-19, wherein the package has an average oxygen transmission rate of less than $12 \text{ cm}^3/\text{m}^2$ for 24 hours at 23°C and 50% relative humidity.

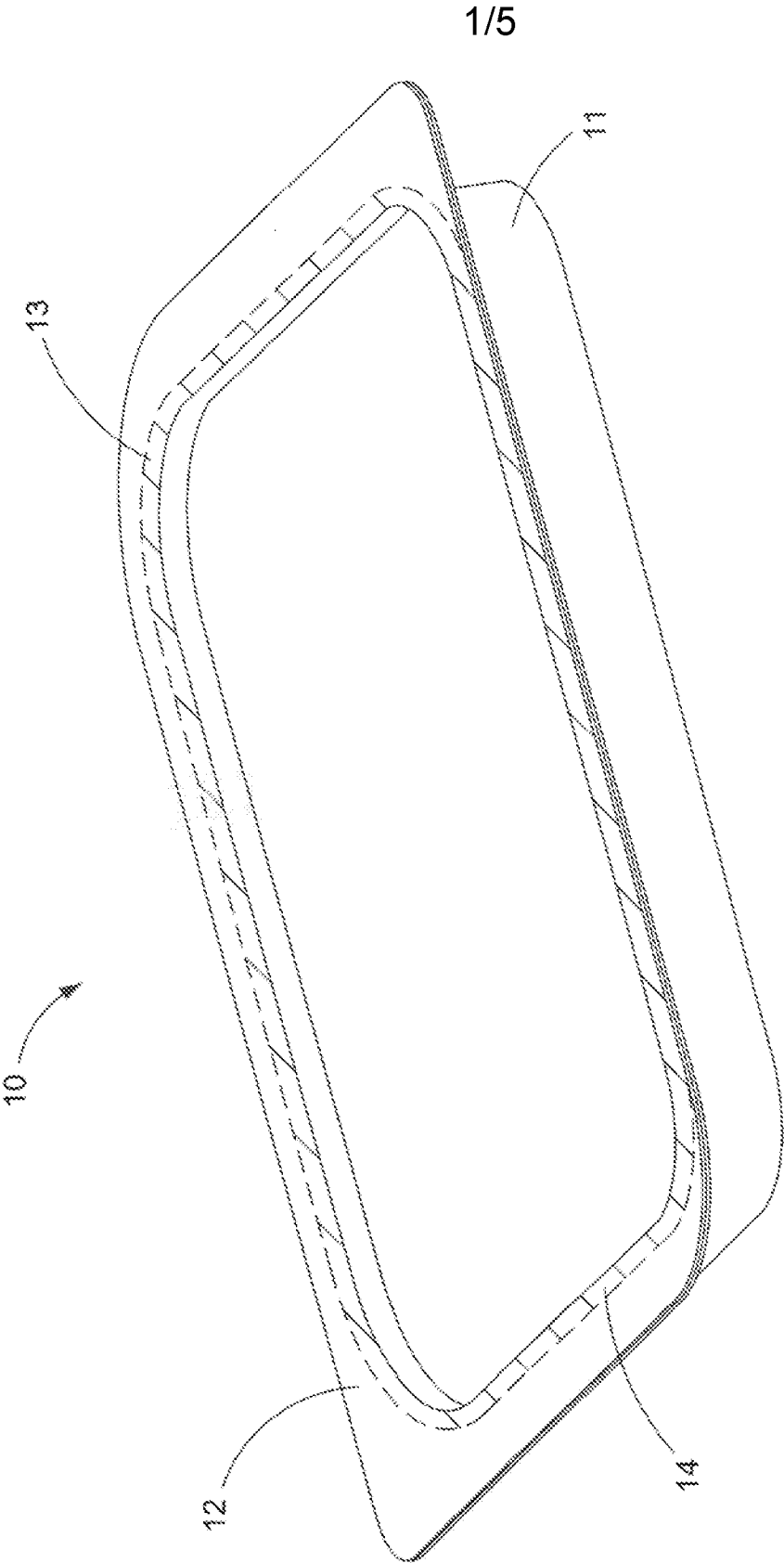


FIG. 1

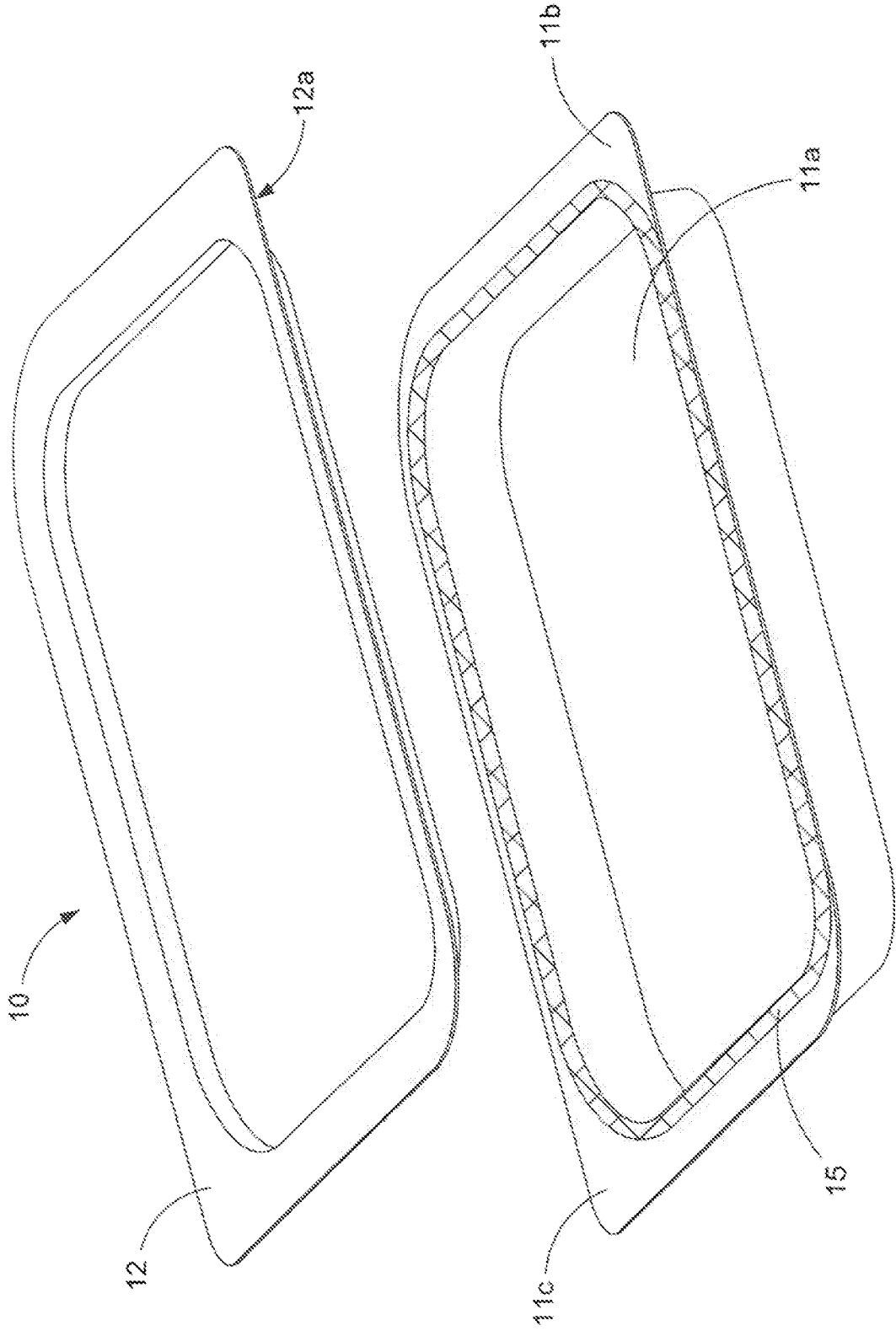


FIG. 2

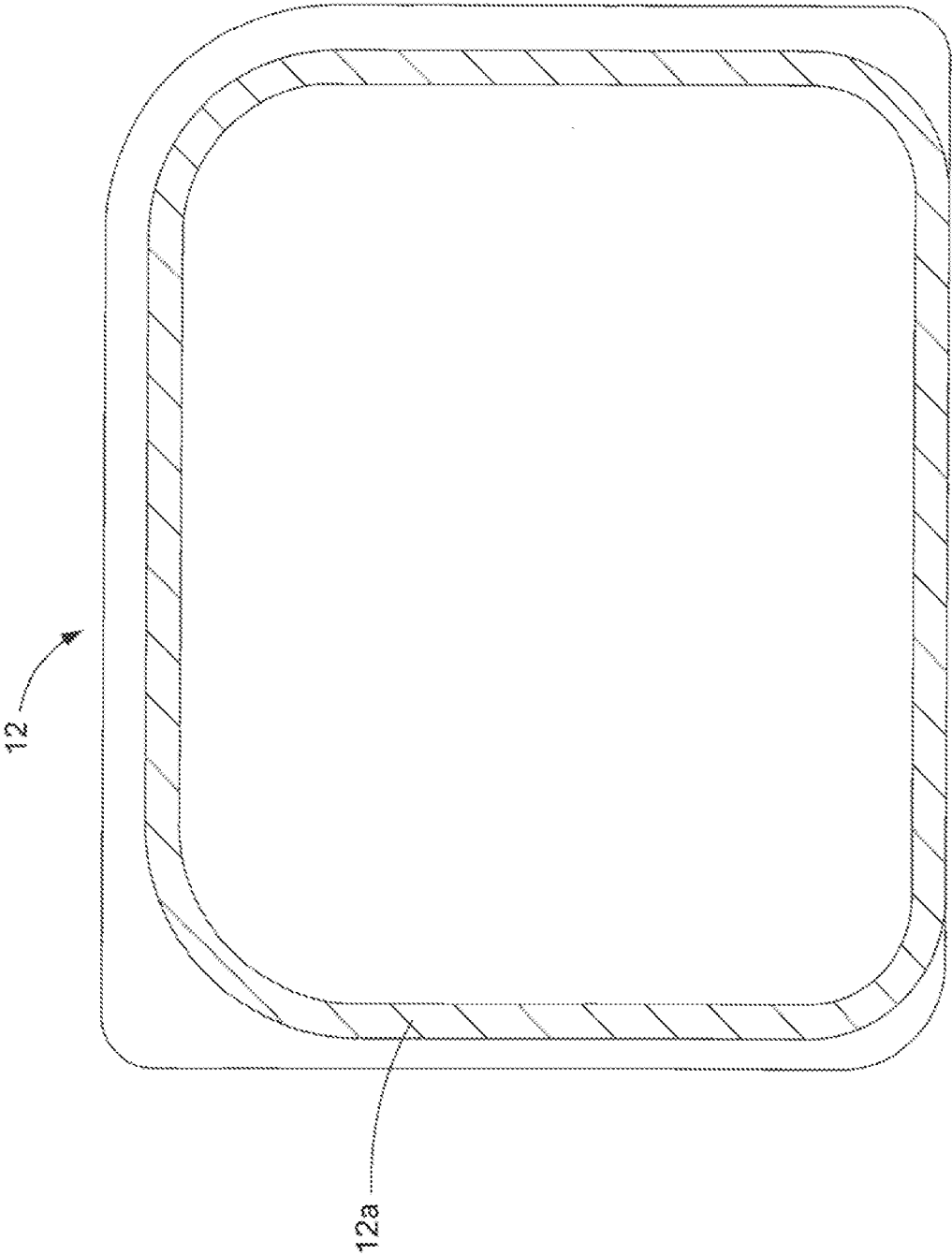


FIG. 3

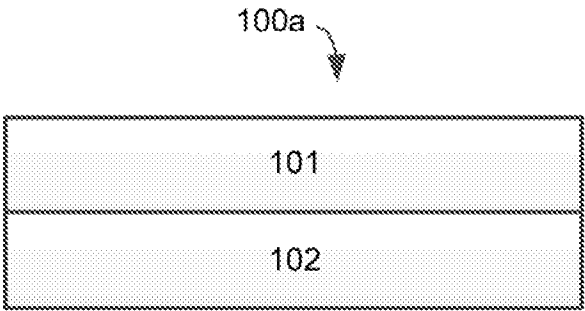


FIG. 4

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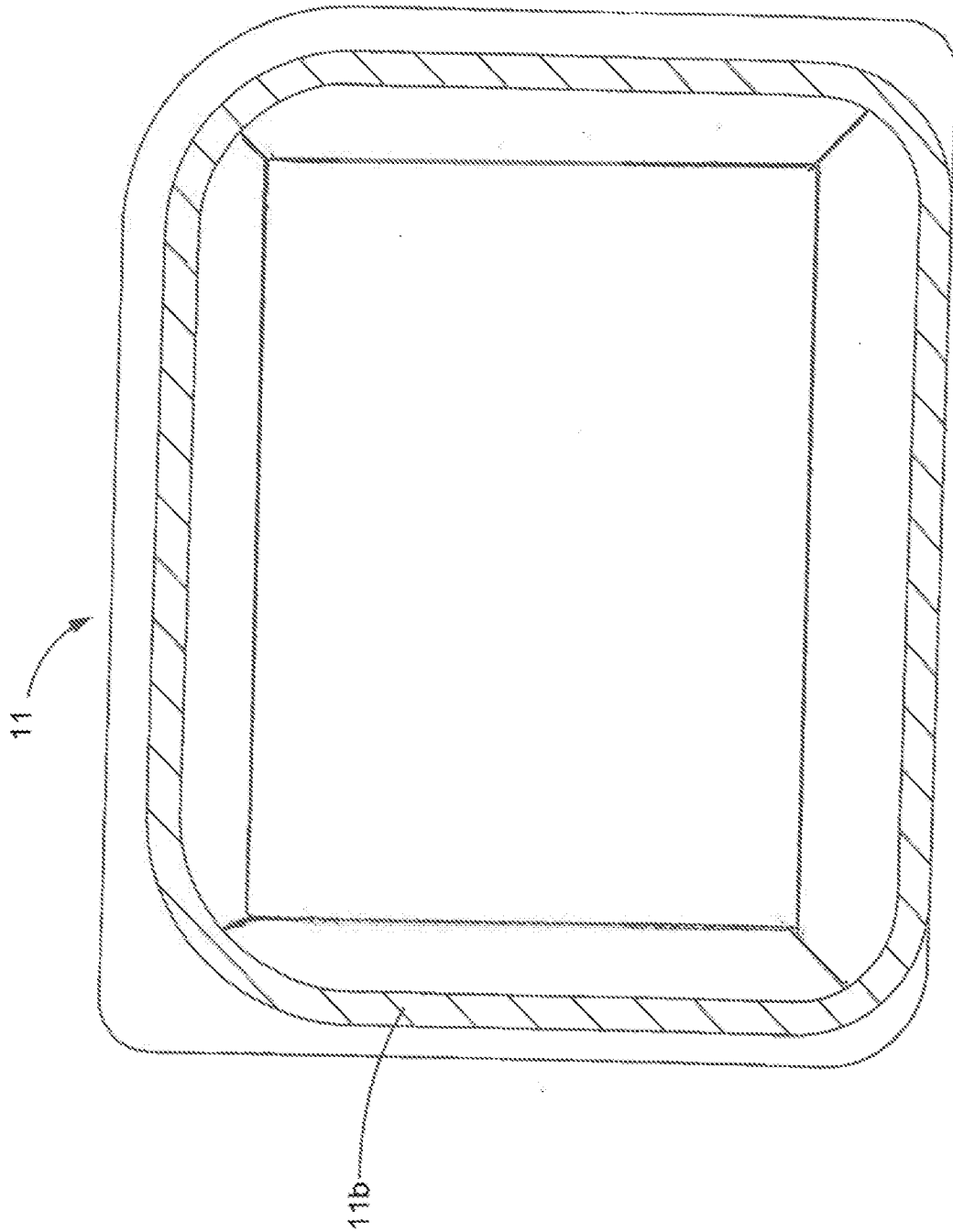


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/39991

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B32B 3/02 (2016.01)

CPC - F16J 15/104 F16J 15/102 F16J 15/3284

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)
CPC - F16J 15/104 F16J 15/102 F16J 15/3284Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - F16J 15/104 F16J 15/102 F16J 15/3284; IPC(8) - B32B 3/02 (2016.01); USPC - 428/66.4, 349, 428/521, 428/34.8Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); PatBase; Google Scholar. Search Terms: recyclable packaging tray oriented crystalline polyethylene terephthalate PET peelable seal layer coating lid cover remove peel open polyester copolymer tamper evident white

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2005/0100729 A1 (Peiffer et al.) 12 May 2005 (12.05.2005), abstract; FIG. 1; paras [0003]-[0004], [0020], [0041], [0160]	1-2, 5/(1-2) ----- 3-4, 5/(3-4)
Y	US 5,882,749 A (Jones et al.) 16 March 1999 (16.03.1999), abstract; col 5, ln 66	3-4, 5/(3-4)

☐

Further documents are listed in the continuation of Box C.

☐

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

12 August 2016

Date of mailing of the international search report

23 SEP 2016

Name and mailing address of the ISA/US

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Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/39991

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 6-20
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.