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(54) **REFRIGERATOR APPLIANCE**

(57) A cabinet (110) for a refrigerator appliance comprises an inner casing (114) wherein a cavity (111, 112) configured to receive food items to be stored is formed and an outer casing (115) having a top wall (117), a bottom wall (118), a rear wall (119) and side walls (116a, 116b). The outer casing (115) is joined to a front wall of said inner casing (114) and the top wall (117), the bottom wall (118), the rear wall (119) and the side walls (116a, 116b) of the outer casing (115) are spaced apart from the inner casing (114) so as to define with it a cavity to be filled with a thermally insulating material. All the walls (116a, 116b, 117, 118, 119) forming the outer casing (115) are made of a metal material and strips (140) made of a material softer than said metal material are applied at the interfaces between neighboring metal walls.

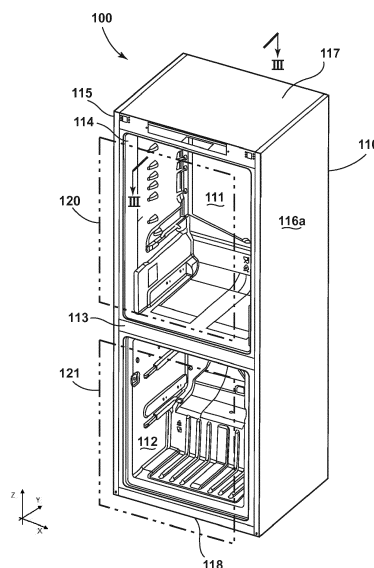


FIG. 1

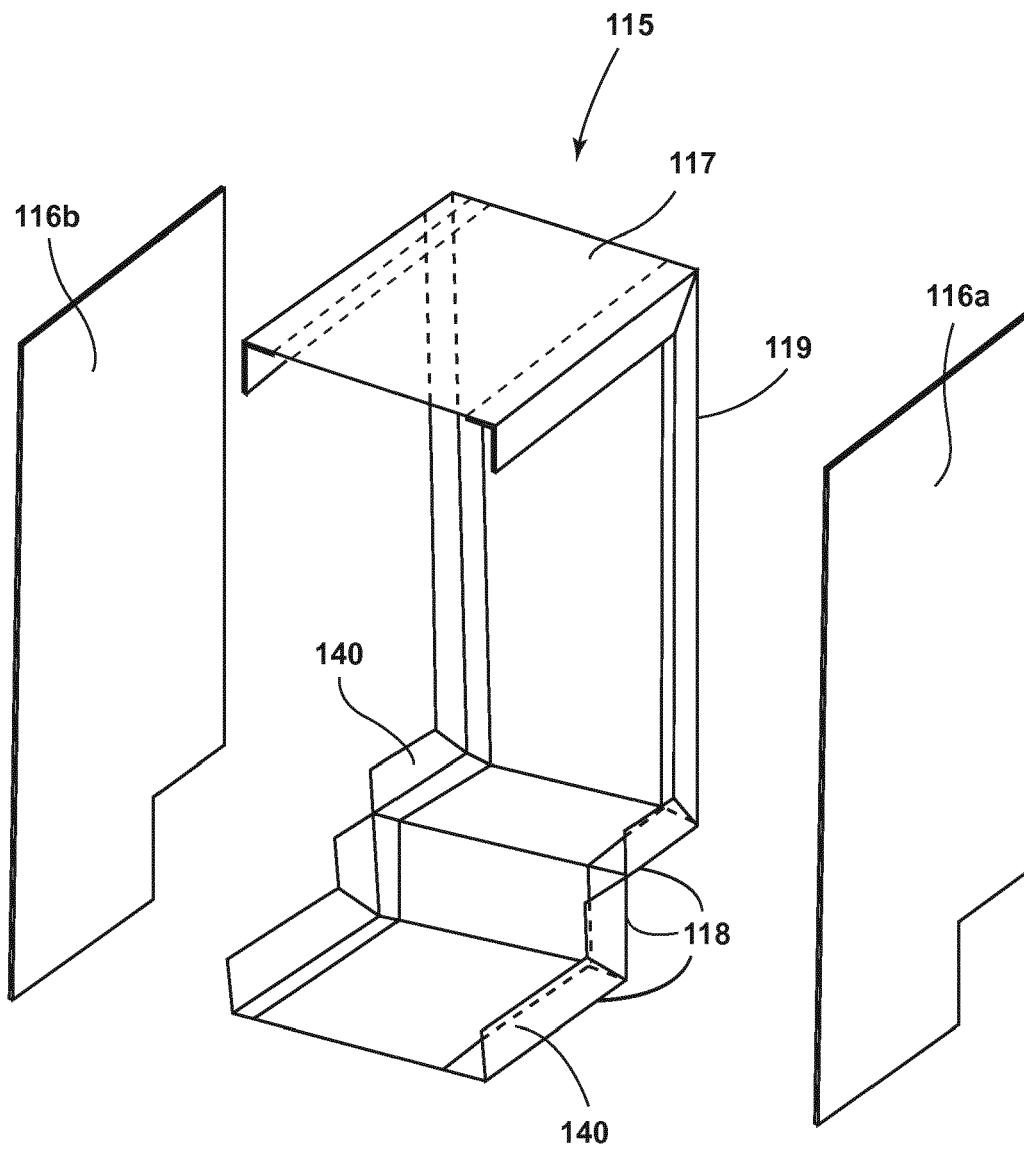


FIG. 4

Description

Technical field of the invention

[0001] The present invention generally relates to refrigerator appliances and more particularly to a cabinet for a refrigerator appliance having an outer casing made up of metal walls.

Background

[0002] Refrigerator appliances generally include thermally insulated cabinets that define a chilled chamber configured to receive food items to be stored. For example, a cabinet can have a fresh food chamber and/or a freezer chamber. The fresh food chamber can be maintained at a temperature higher than the freezing point of water. Conversely, the freezer chamber can be maintained at a temperature equal to or lower than the freezing point of water.

[0003] The cabinet of a refrigerator appliance comprises an inner casing, also typically called liner, where a fresh food chamber and/or a freezer chamber are formed. The cabinet also includes an outer casing that encloses left, right and rear walls, as well as a top wall and a bottom wall of the liner and defines with it a closed cavity to be filled with a thermally insulating material, such as e.g. a PU foam material. The liner is typically made of a polymeric material, such as e.g. acrylonitrile-butadiene styrene (ABS) or high impact polystyrene (HIPS) and manufactured as a single piece e.g. by thermoforming, while the outer casing is made up of a number of sheet metal panels. Depending on the refrigerator model, different configurations are known for the outer casing. For instance, all walls of the outer casing can be manufactured as independent members and assembled to each other by way of screws, fasteners and the like. Alternatively, side walls and a top wall of the outer casing can be manufactured in a single piece by bending a single sheet metal plate cut from a coil, while a rear or back wall and a bottom wall can be made as independent components. Further configurations are also possible.

[0004] In order to carry out foaming, the liner, previously equipped with all the necessary evaporator devices and components, and the outer casing are assembled to each other, arranged into a foaming jig and subsequently processed in a foaming apparatus, wherein a thermally insulating material is injected into the closed cavity of the cabinet so obtained, made to expand and cure.

[0005] Assembly between the outer casing and the liner is typically obtained by way of shape couplings, e.g. by fitting suitably shaped edges of the metal panels with correspondingly suitably shaped profiles formed along the peripheral edges of the plastic liner. These couplings are generally effective against leakages of foam material.

[0006] Couplings among the components forming the outer casing are instead achieved by way of fasteners such as e.g. screws, rivets and the like, which may cause

leakages of foam material at the coupling interface. This is due to planarity issues of sheet metal components, as well as to the mechanical rigidity of the metal parts arranged in contact with each other.

[0007] Alternatively to metal-made components, panels made of a polymeric material, such as e.g. polypropylene, or of aluminized cardboard have been employed to manufacture parts of the outer casing such as the back wall. This solution allows to minimize foam leakages thanks to the deformability of the polymeric material, which acts as a gasket at the interface with the neighboring metal parts of the outer casing. However, recent safety standards in the field of refrigeration appliances, more particularly the standard IEC 60335-2-24, have banned manufacturers from employing polymeric panels due to the flammability of the materials traditionally employed for their production. Hence, only sheet metal steel panels can be used, even though the possibility to employ fire-resistant polymeric materials has been foreseen. However, panels made of fire-resistant polymeric materials are more expensive than sheet metal panels.

Summary of the invention

[0008] The technical problem underlying and solved by the present invention is therefore to provide an improved full metal casing for a refrigerator appliance allowing to minimize foam leakages, as well as a related manufacturing method.

[0009] This problem is solved by a cabinet for a refrigeration appliance according to the independent claim 1, as well as by a manufacturing method according to the independent claim 9. Preferred features of the present invention are set forth in the dependent claims.

[0010] According to the invention, a cabinet for a refrigerator appliance comprises an inner casing wherein a cavity configured to receive food items to be stored is formed and an outer casing having a top wall, a bottom wall, a rear wall and side walls. The outer casing is joined to a front wall of the inner casing and the top wall, the bottom wall, the rear wall and the side walls of the outer casing are spaced apart from the inner casing so as to define with it a cavity to be filled with a thermally insulating material. All the walls forming the outer casing are made of a metal material and strips made of a material softer than said metal material are applied at the interfaces between neighboring metal walls.

[0011] Thanks to this configuration, no foam leakages can occur during injection of the thermally insulating material, because the strips seal the interfaces between neighboring metal walls acting as gaskets.

[0012] Suitable materials for the manufacturing of the strips are e.g. polymeric materials such as e.g. polypropylene, or aluminized cardboard.

[0013] The strips can be applied on the peripheral edges of any one of a pair of neighboring walls. Glue or adhesive tape can be used to assemble the strips to the peripheral edges of the walls.

[0014] Assembly of the strips along the peripheral edges can advantageously be carried out automatically in a manufacturing line e.g. upon cutting of the panels from sheet-metal coils. Manufacturing costs and times can thus be remarkably reduced compared to prior art assembly solutions.

[0015] Further advantages, features and operation modes of the present invention will become clear from the following detailed description of embodiments thereof, which are given for illustrative and non-limiting purposes.

Brief description of the drawings

[0016] Reference will be made to the figures of the accompanying drawings, in which:

- figure 1 is a front, perspective view schematically showing a refrigerator appliance according to the present invention;
- figure 2 is a rear, perspective view of the refrigerator appliance of figure 1;
- figure 3 schematically shows a longitudinal section of the refrigerator appliance according to the invention, taken along a plane passing through line III-III of figure 1;
- figure 4 is a perspective, exploded view of an outer casing of the refrigerator appliance according to an embodiment of the invention;
- figure 5 is a perspective view of a sheet-metal panel intended to form a portion of the outer casing of the refrigerator appliance according to an embodiment of the invention.

Detailed description of preferred embodiments

[0017] With reference to figures 1 to 3, a refrigerator appliance according to the invention is generally indicated by reference number 100.

[0018] In the figures, the refrigerator appliance 100 is shown with reference to a three-dimensional coordinate system. A first axis X and a second axis Y that are mutually perpendicular define a horizontal plane, while a third axis Z, perpendicular to said horizontal plane, defines a vertical axis along which the force of gravity acts.

[0019] The refrigerator appliance 100, hereinafter also referred to as refrigerator only, comprises a cabinet 110 having a cavity configured to store food items. The appliance shown in the drawings is e.g. a "bottom mount" refrigerator, whose cavity comprises a refrigerator compartment 111 formed above a freezer compartment 112 in a vertical direction. The refrigerator compartment 111 and the freezer compartment are separated from each other by a mullion 113. An evaporator (not shown in the

drawings) is typically provided to cool the refrigerator compartment 111 and the freezer compartment 112 at cooling temperatures generally comprised between 1°C and 10°C and between -18°C and -28°C, respectively.

[0020] It will be appreciated that neither the type of refrigerator, nor the configuration of the evaporator are limiting features of the invention.

[0021] The cabinet 110 comprises an inner casing or liner 114 e.g. made of a polymeric material, such as e.g. acrylonitrile-butadiene styrene (ABS) or high impact polystyrene (HIPS), wherein the refrigerator compartment 111 and the freezer compartment 112 are formed, and an outer casing 115.

[0022] The outer casing 115 comprises a pair of spaced apart side walls 116a, 116b, a top wall 117, a bottom wall 118 and a back wall 119 intended to be associated with a condenser (not shown in the drawings).

[0023] The outer casing 115 is joined to a front wall of the liner 114, and the top wall 117, the bottom wall 118, the rear wall 119 and the side walls 116a, 116b of the outer casing 115 are spaced apart from the liner 114 so as to define with it a cavity to be filled with a thermally insulating material, such as e.g. a PU foaming material.

[0024] The refrigerator compartment 111 and the freezer compartment 112 are selectively accessible through respective doors 120, 121.

[0025] The refrigerator 100 further typically comprises a machine compartment 130 where a compressor and a drip pan (not shown in the drawings) are arranged.

[0026] According to the invention, all the walls forming the outer casing 115 are made of a metal material, e.g. sheet-metal from steel, and strips 140 made of a material softer than said metal material are applied at the interfaces between neighboring metal walls. The strips may be made of e.g. a polymeric material such as polypropylene. Aluminized cardboard can alternatively be used.

[0027] With specific reference to figure 4, according to an embodiment of the invention the top wall 117, the bottom wall 118 and the back wall 119 of the outer casing 115 may e.g. be manufactured as a single metal piece obtained by bending a sheet metal steel panel cut from a coil. The bottom wall 118 features a stepped profile needed to accommodate devices such as e.g. a compressor and a drip pan (not shown in the drawings) to be housed in the machine compartment 130 of the refrigerator appliance 100.

[0028] The side metal walls 116a, 116b of the outer casing 115 are instead manufactured as independent members from respective sheet metal panels to be assembled thereto, as it will be explained in greater detail in the following.

[0029] According to this embodiment of the invention, the strips 140 made of a polymeric material are e.g. applied along the side edges of the top wall 117, bottom wall 118 and back wall 119 manufactured as a single sheet metal piece and partially protrude from them.

[0030] During assembly the side metal walls 116a,

116b, are arranged in a foaming jig aside such single piece so as to surround and enclose the liner 114. The strips 140 protruding from the edges of the top wall 117, bottom wall 118 and back wall 119 close the gaps between the neighboring edges of the side metal walls 116a, 116b.

[0031] Thanks to this arrangement, the strips 140 act as seals preventing foam leakages during foaming of the cabinet 110. Differently from bent edges that may be formed on sheet-metal components to allow assembly by way of fasteners according to the prior art, the provision of strips made of a polymeric material such as e.g. polypropylene or of aluminized cardboard, or more generally a material softer than the sheet metal material used to manufacture the walls of the outer casing 115, allows to achieve suitable sealing thanks to the deformability of these materials compared to sheet metal.

[0032] It will be appreciated that, alternatively to the single sheet metal piece made up of the top wall 117, the bottom wall 118 and the rear wall 119, the strips 140 might as well be applied along the side edges of the side walls 116a, 116b. More generally, the strips 140 can be applied on the peripheral edges of any one of the walls intended to form neighboring walls of the outer casing 115.

[0033] The strips 140 can be assembled to the edges of the sheet-metal components by gluing or adhesive tape.

[0034] As shown in figure 4, in order to ease assembly the strips 140 may advantageously be bent 90 degrees before assembling the metal walls of the outer casing 115 into a foaming jig. This manufacturing step facilitates positioning of the cabinet components inside the foaming jig and allows to improve the sealing action of the strips 140 against foam leakages.

[0035] It will be appreciated that assembly of the strips 140 along the edges of the sheet-metal panels intended to form walls of the outer casing 115 can be carried out automatically in a manufacturing line e.g. upon cutting of the panels from sheet-metal coils. This allows to optimize costs and reduce manufacturing time. To this aim the strips 140 may advantageously be applied in form of continuous bands along the edges and cut at a length corresponding to the length of the panels.

[0036] It will also be appreciated that the application of strips along the edges of the sheet-metal panels takes less time and is cheaper than prior art bending operations to form bent edges for assembly purposes.

[0037] Figure 5 schematically shows the result of a manufacturing step whereby the strips 140 are applied along opposite edges of a sheet-metal panel e.g. cut from a coil and intended to form the top, rear and bottom walls 117, 119 and 118 of the outer casing 115 by bending. The dashed lines schematically show the lines or portions at which the panel has to be bent so as to form these walls.

[0038] Reliefs 141 may advantageously be formed in the strips 140 at corner portions of the walls forming the outer casing 115. This allows to prevent formation of wrinkles

and to achieve good seals against possible foam leakages during the foaming process.

[0039] The provision of reliefs in the strips 140 is particularly advantageous when a number of walls of the outer casing 115 are formed as a single piece by bending a sheet-metal panel.

[0040] In the embodiment shown in the drawings, the reliefs 141 formed in the strips 140 are obtained e.g. by making dovetail notches in the strips 140.

[0041] According to a further aspect of the invention, strips made of a material softer than a metal material forming the walls of the outer casing 115 can also be advantageously employed for the manufacturing of the outer casing of cabinets for refrigerator appliances having skin condensers, such as e.g. the refrigerator appliance disclosed in the international patent application WO 2018/080473 A1, or the refrigerator appliance disclosed in the European patent application 19182735.1, both in the Applicant's name.

[0042] The edges of skin condensers, which are made up of metal panels applied on serpentine tubes, can in fact be effectively sealed by way of strips made of a polymeric material, such as e.g. polypropylene, or of aluminized cardboard, instead of resorting to prior art bent edges directly formed on the metal panels of the skin condenser.

[0043] The present invention has hereto been disclosed with reference to preferred embodiments thereof. It will be appreciated that there may be other embodiments relating to the same inventive idea, all of which are included in the scope of protection defined by the claims set out below.

Claims

1. A cabinet (110) for a refrigerator appliance, said cabinet (110) comprising:

- a. an inner casing (114) wherein a cavity (111, 112) configured to receive food items to be stored is formed,
- b. an outer casing (115) having a top wall (117), a bottom wall (118), a rear wall (119) and side walls (116a, 116b),

wherein said outer casing (115) is joined to a front wall of said inner casing (114) and the top wall (117), the bottom wall (118), the rear wall (119) and the side walls (116a, 116b) of the outer casing (115) are spaced apart from the inner casing (114) so as to define with it a cavity to be filled with a thermally insulating material,

characterized in that all the walls (116a, 116b, 117, 118, 119) forming the outer casing (115) are made of a metal material and **in that** strips (140) made of a material softer than said metal material are applied at the interfaces between neighboring metal walls.

2. The cabinet (110) appliance of claim 1, wherein the strips (140) are made of a polymeric material or of aluminized cardboard.
3. The cabinet (110) appliance of claim 1 or 2, wherein the strips (140) are applied along peripheral edges of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115).
4. The cabinet (110) appliance of any one of claims 1 to 3, wherein reliefs (141) are formed in the strips (140) at corner portions of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115).
5. The cabinet (110) appliance of any one of claims 1 to 4, wherein the strips (140) are assembled to the edges of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115) by gluing or adhesive tape.
6. The cabinet (110) appliance of any one of claims 1 to 5, wherein the top wall (117), the bottom wall (118) and the rear wall (119) of the outer casing (115) are manufactured as a single piece obtained by bending a sheet metal steel panel, and wherein the side walls (116a, 116b) are manufactured as independent members of the outer casing (115).
7. The cabinet (110) appliance of claim 6, wherein the strips (140) are applied along side edges of the top wall (117), bottom wall (118) and rear wall (119) manufactured as a single piece and partially protrude from them.
8. A refrigerator appliance (100) comprising a cabinet (110) according to any one of claims 1 to 7.
9. A method for the manufacturing of a cabinet for a refrigerator appliance, said method comprising the following steps:
 - a. Providing an inner casing (114) made of a polymeric material,
 - b. Providing an outer casing (115) comprising a pair of spaced apart side walls (116a, 116b), a top wall (117), a bottom wall (118) and a rear wall (119),
 - c. Joining the outer casing (115) to a front wall of the inner casing (114) such that the top wall (117), the bottom wall (118), the rear wall (119) and the side walls (116a, 116b) of the outer casing (115) surround and are spaced apart from the inner casing (114) so as to define with it a cavity to be filled with a thermally insulating material,
 - d. Injecting a thermally-insulating material into said cavity,
10. The method of claim 9, wherein the strips (140) are made of a polymeric material or of aluminized cardboard.
11. The method of claim 9 or 10, wherein the strips (140) are applied along peripheral edges of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115).
12. The method of any one of claims 9 to 11, wherein the strips (140) are applied in form of continuous bands along the peripheral edges of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115).
13. The method of claim 12, wherein reliefs (141) are formed in the strips (140) at corner portions of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115).
14. The method of any one of claims 9 to 13, wherein the strips (140) are applied to the peripheral edges of the walls (116a, 116b, 117, 118, 119) forming the outer casing (115) by gluing or adhesive tape.
15. The method of claim 14, wherein the strips (140) applied to the peripheral edges of the walls (116a, 116b, 117, 118, 119) of the outer casing (115) are bent 90 degrees before assembling them to form the outer casing (115).

characterized in that all the walls (116a, 116b, 117,

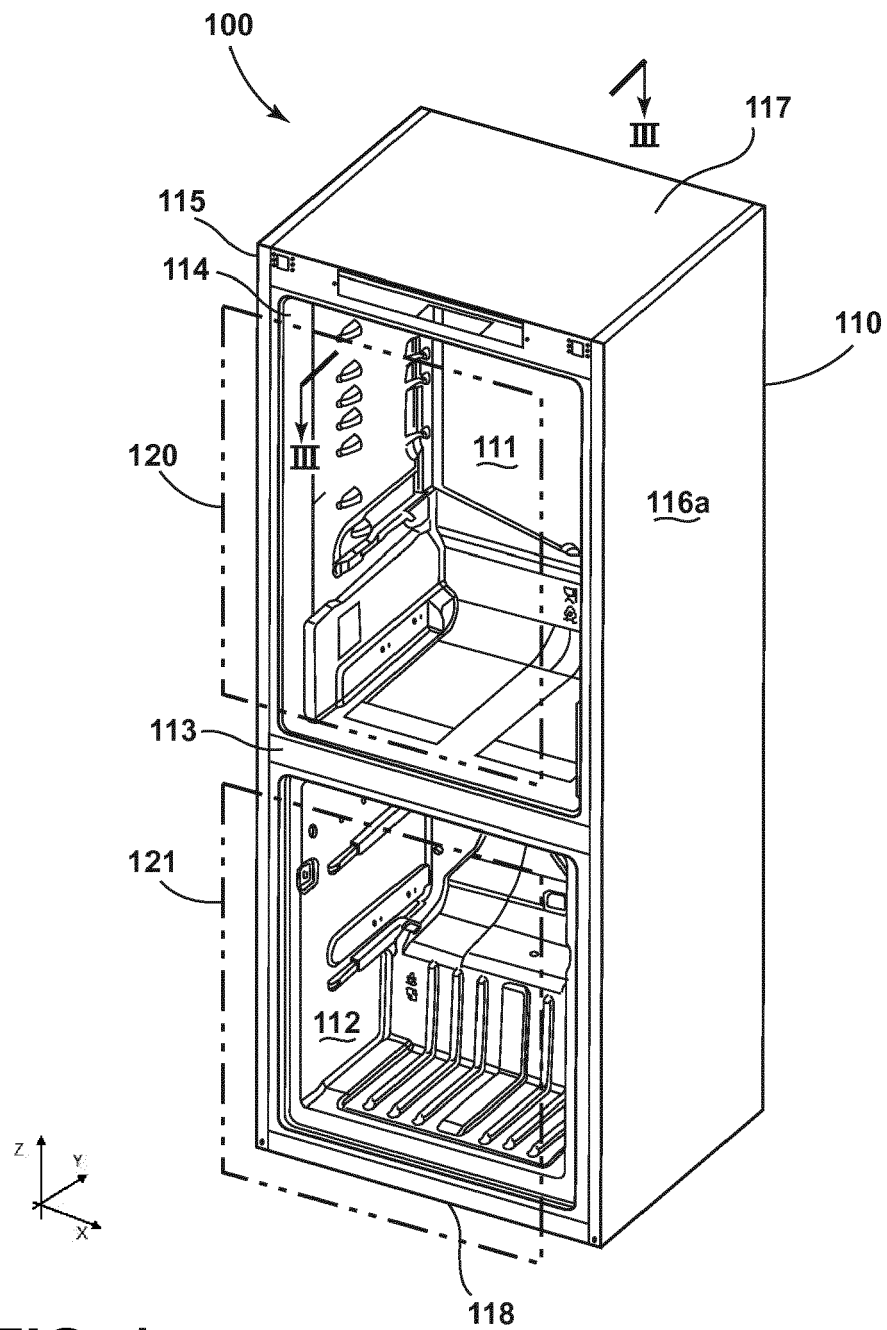


FIG. 1

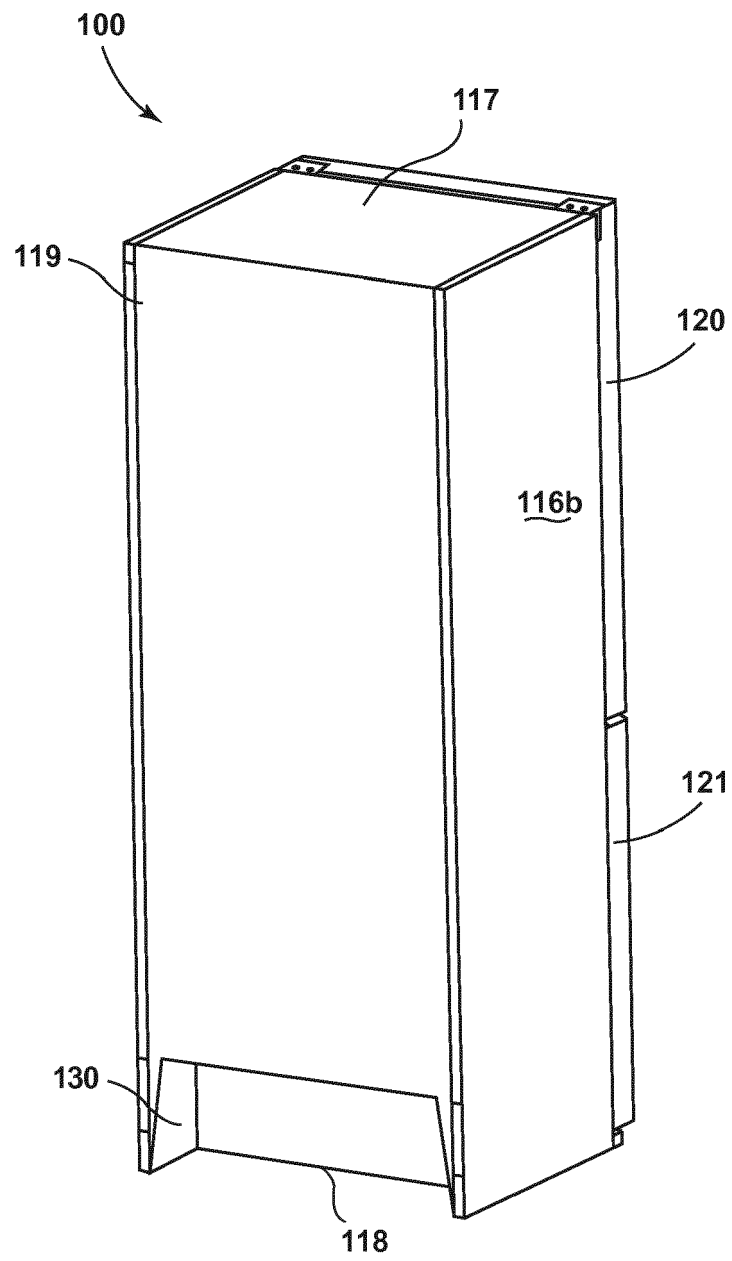


FIG. 2

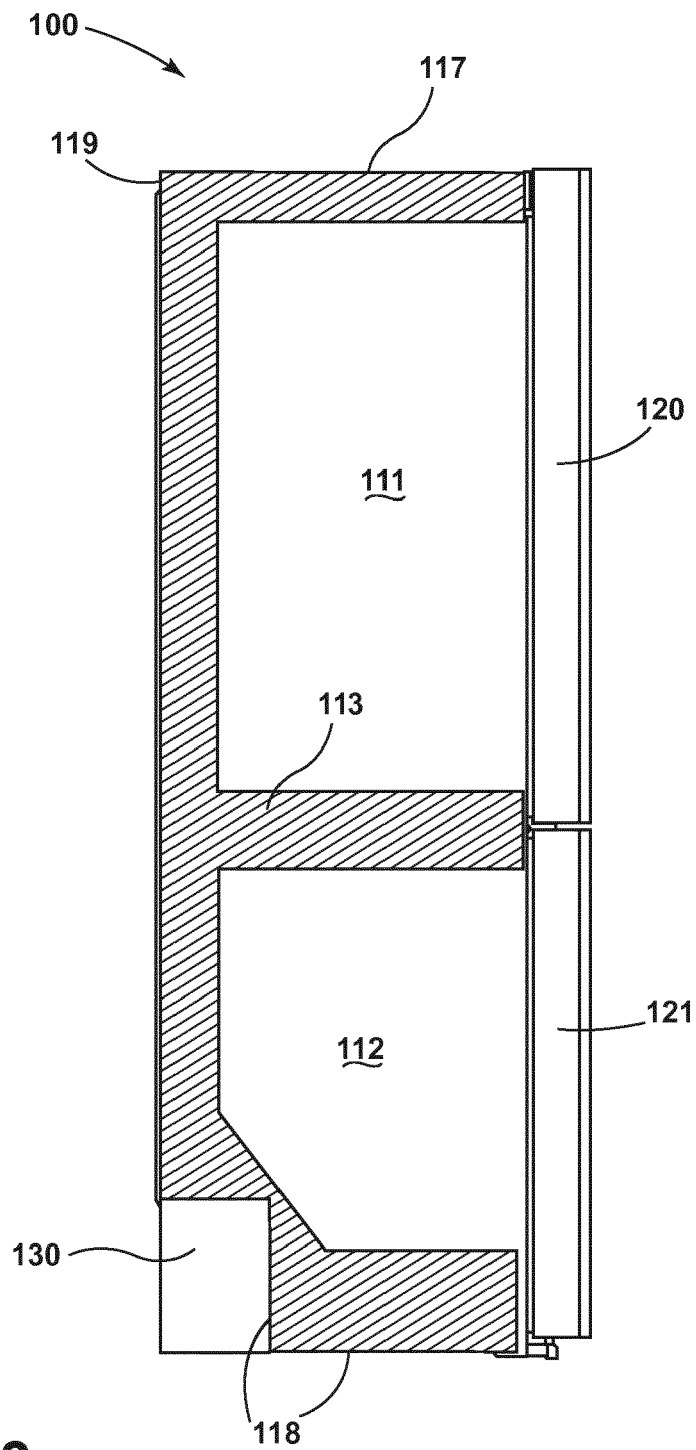


FIG. 3

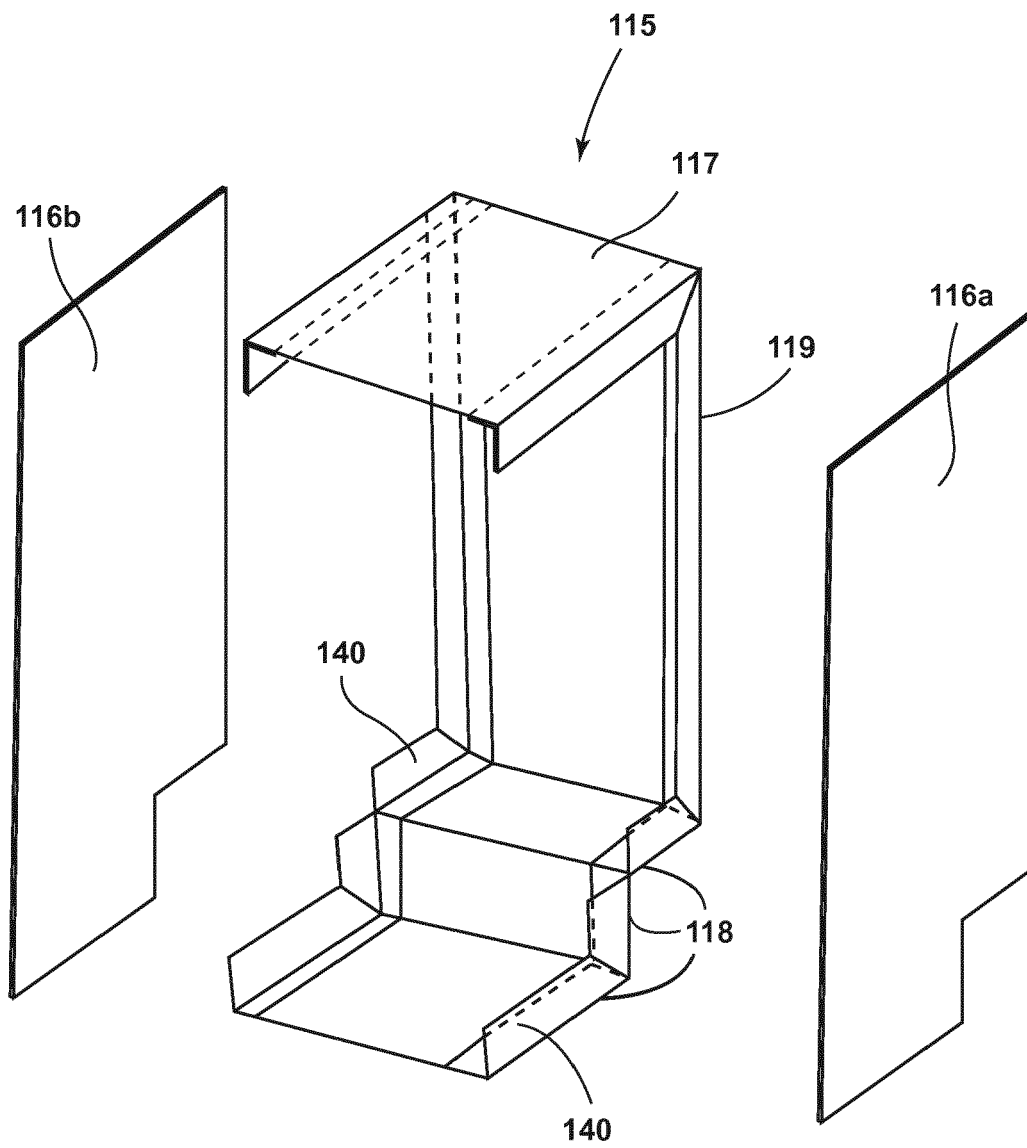


FIG. 4

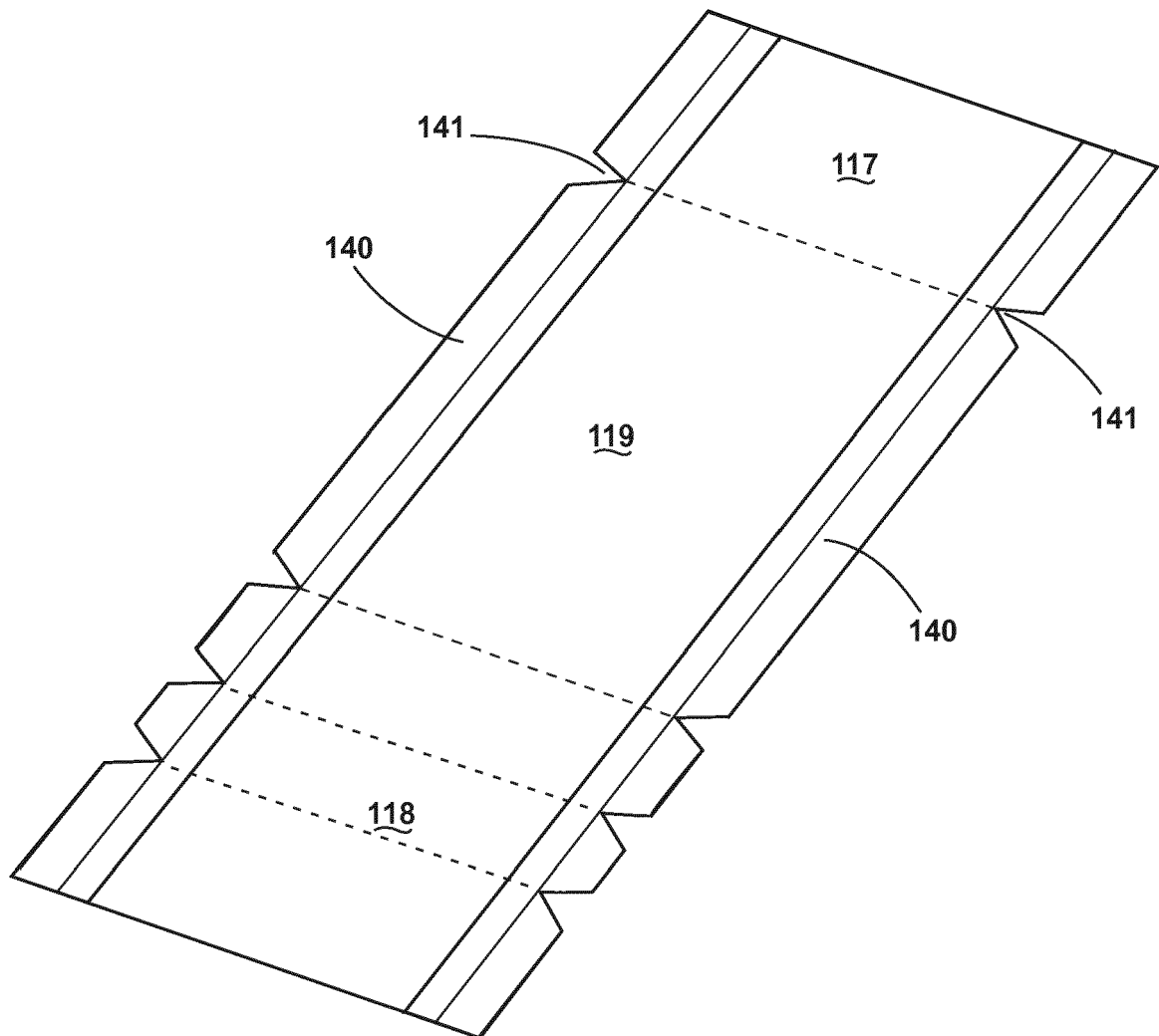


FIG. 5



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Application Number
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Place of search The Hague		Date of completion of the search 20 April 2020	Examiner Vigilante, Marco
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