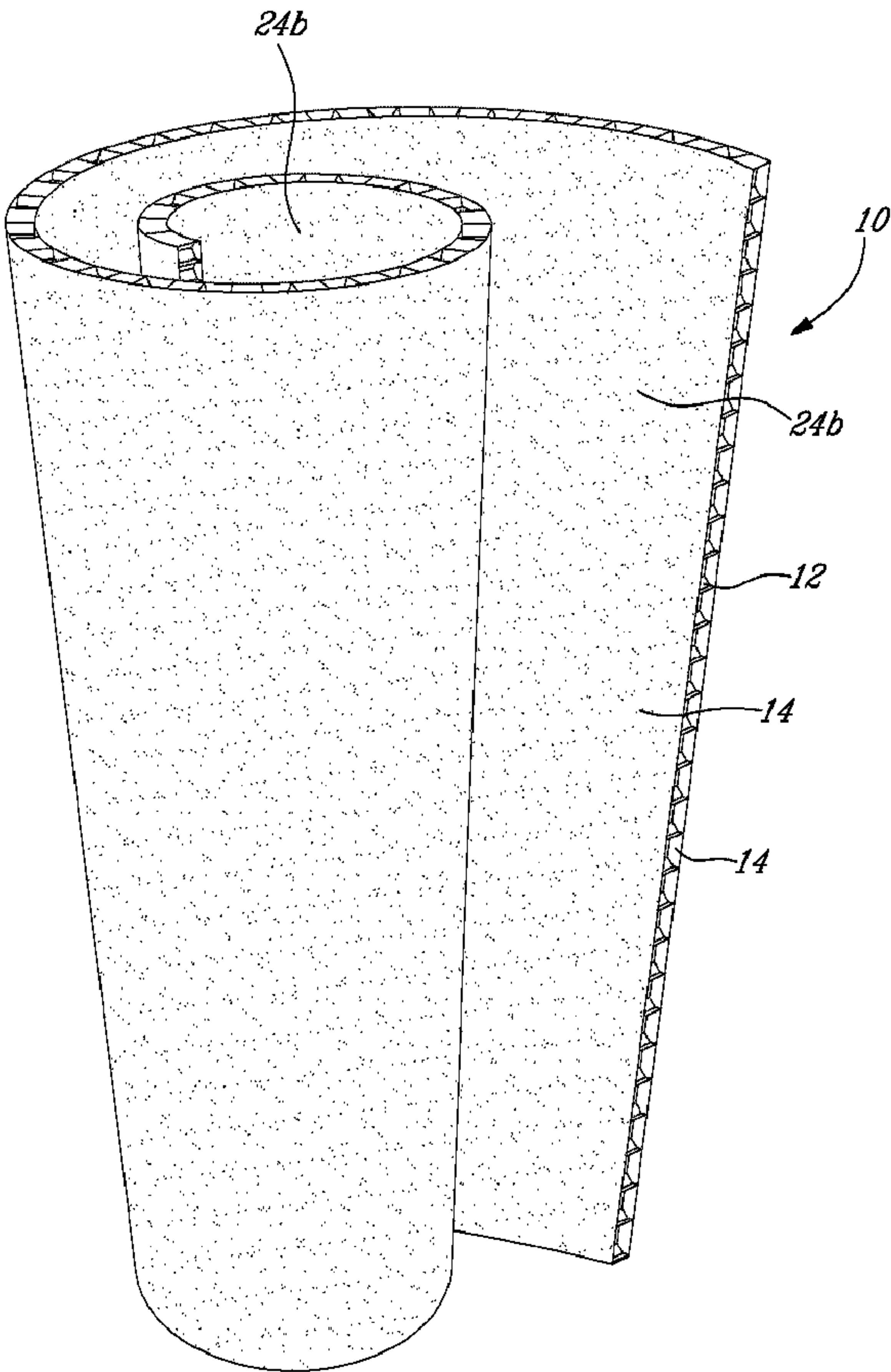




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(54) **Titre : MATERIAU FLEXIBLE EN NID D'ABEILLE A BASE DE FIBRES CELLULOSIQUES**
(54) **Title: FLEXIBLE CELLULOSIC FIBER-BASED HONEYCOMB MATERIAL**



(57) **Abrégé/Abstract:**
A flexible cellulose fiber-based material including: a core portion having a geometrically patterned structure defining two spaced-apart substantially planar faces and providing air space therebetween, the core portion including cellulose fiber-based walls having

(57) **Abrégé(suite)/Abstract(continued):**

a core grammage; and at least one cellulosic fiber-based liner bonded to a respective one of the planar faces of the core portion and having a liner grammage lower than the core grammage, the material being flexible along a plane defined by the at least one liner.

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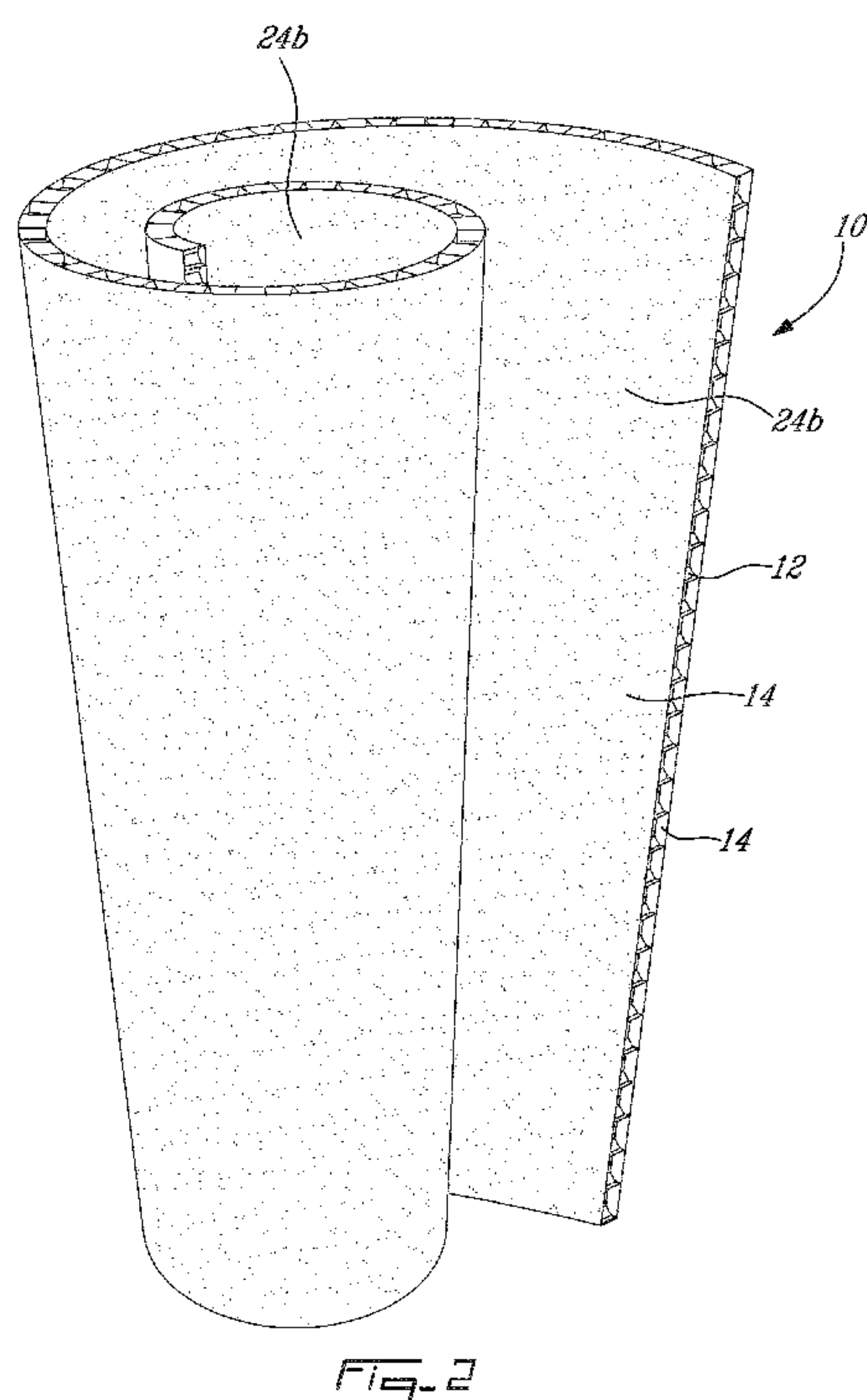
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[Continued on next page]

(54) Title: FLEXIBLE CELLULOSIC FIBER-BASED HONEYCOMB MATERIAL



(57) Abstract: A flexible cellulosic fiber-based material including: a core portion having a geometrically patterned structure defining two spaced-apart substantially planar faces and providing air space therebetween, the core portion including cellulose fiber-based walls having a core grammage; and at least one cellulose fiber-based liner bonded to a respective one of the planar faces of the core portion and having a liner grammage lower than the core grammage, the material being flexible along a plane defined by the at least one liner.

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FLEXIBLE CELLULOSIC FIBER-BASED HONEYCOMB MATERIAL

Technical Field of the Invention

[0002] The present invention relates to a flexible material for packaging, structural, and void space filling applications, for instance, and, more particularly, to a flexible cellulosic fiber-based material including a three-dimensional geometrically patterned structure such as a honeycomb structure.

Background

[0003] Bubble wrap® and similar products are pliable plastic material commonly used for packing fragile items and filling void spaces. They include regularly spaced, protruding air-filled hemispheres ("bubbles") which provide cushioning for packaged items.

[0004] Packaging and void space filling materials should be relatively lightweight, flexible to adapt to almost any shapes and sizes, easy to use, and relatively reliable.

[0005] However, Bubble wrap® and similar products are made of plastics, which are usually not environmentally friendly since most of them are not recyclable or biodegradable.

[0006] Furthermore, the structural properties of Bubble wrap® and similar products are limited.

[0007] There is thus a need for new materials which are more environmentally friendly that can be used for packaging, structural, and void space filling applications, for instance.

BRIEF SUMMARY OF THE INVENTION

[0008] It is therefore an aim of the present invention to address the above mentioned issues.

[0009] According to an aspect, there is provided a cellulosic fiber-based packaging material comprising: a core portion having a geometrically patterned structure defining two spaced-apart substantially planar faces and providing air space therebetween, the core portion including a cellulosic fiber-based material having a core grammage; and at least one liner bonded to a respective one of the planar faces of the core portion and including a cellulosic fiber-based material having a liner grammage lower than the core grammage, the packaging material being flexible along a plane defined by the at least one liner.

[0010] According to another aspect, there is provided a flexible paper honeycomb structure comprising: a core portion having a paper-based honeycomb structure defining two spaced-apart substantially planar faces and providing air space therebetween and including paper-based walls having a grammage between 60 and 200 grams per square meter; and two paper-based liners bonded to a respective one of the planar faces of the core portion and having a grammage below 60 grams per square meter.

[0011] According to another aspect, there is provided a flexible cellulosic fiber-based material comprising: a core portion having a geometrically patterned structure defining two spaced-apart substantially planar faces and providing air space therebetween, the core portion including cellulosic fiber-based walls having a core grammage; and at least one cellulosic fiber-based liner bonded to a respective one of the planar faces of the core portion and having a liner grammage lower than the core grammage, the material being flexible along a plane defined by the at least one liner.

[0012] In an embodiment, the geometrically patterned structure comprises a plurality of cells having a diameter and a height, and the ratio of the cell height and the cell diameter is below 1.1. In an embodiment, the core grammage ranges between 80 and 200 grams per square meter and the liner grammage is below 100 grams per

square meter. In an embodiment, the cellulosic fiber grammage of the liner is below 60 grams per square meter. In an embodiment, the geometrically patterned structure of the core portion is in one of an at least partially expanded state and a stretched state.

[0013] The material can be rollable onto itself in a spiral shape.

[0014] According to another aspect, there is provided a packaging material comprising the flexible cellulosic fiber-based material described above.

[0015] According to still another aspect, there is provided a roll of the flexible cellulosic fiber-based material as described above, wherein the flexible cellulosic fiber-based material is rolled onto itself into a spiral shape.

[0016] According to a further aspect, there is provided a method for packing an article comprising: applying the flexible cellulosic fiber-based material described above over the article to at least partially cover the article ; and folding the flexible cellulosic fiber-based material over at least one non-planar element of the article.

[0017] According to still another aspect, there is provided a flexible cellulosic fiber-based material comprising: a core portion having a three dimensional geometrically patterned structure with cellulosic fiber-based walls having a grammage between 80 and 200 grams per square meter, the three dimensional geometrically patterned structure defining two spaced-apart substantially planar faces and providing air space therebetween; and at least one cellulosic fiber-based liner bonded to a respective one of the planar faces of the core portion and having a grammage below 100 grams per square meter.

[0018] According to another aspect, there is provided a method for manufacturing a flexible cellulosic fiber-based material, comprising: providing a core portion having a geometrically patterned structure defining two spaced-apart substantially planar faces and a plurality of cells having a diameter and a height and providing air space therebetween, the core portion including a cellulosic fiber-based material having a core grammage and having a cell height and diameter ratio below 1.1; and bonding at least one liner to a respective one of the planar faces of the core portion, the at least one liner including a cellulosic fiber-based material having a liner grammage,

the core grammage and the liner grammage being selected to obtain a lower liner grammage than the core grammage, the packaging material being flexible along a plane defined by the at least one liner.

[0019] Although the higher weights are normally denoted as paperboard or linerboard, the term 'paper' includes paper of all types, paperboard, linerboard, coated paper, printed paper, tissue paper, air-laid tissue paper, and the like having a grammage ranging between 10 to 500 grams per square meter.

[0020] According to a further aspect, there is provided a flexible packaging material comprising: a core portion having a geometrically patterned structure, such as a honeycomb structure, defining two spaced-apart substantially planar faces and providing air space therebetween; and at least a first liner and a second liner, the first liner and the second liner being bonded to a respective one of the planar faces of the core portion, the first liner having a first liner grammage and the second liner having a second liner grammage different than the first liner grammage, at least one of the first liner and the second liner comprising a cellulosic fiber-based liner, the material being bendable and/or intrinsically manually curvable along at least two non-parallel axes. In an embodiment, the core portion extends continuously between the first and the second liners. In an embodiment, the flexible packaging material is curvable, bendable or foldable simultaneously along at least two non-parallel axes and/or without prior crushing of the core. In an embodiment, the core cellulosic fiber-based portion includes a stack of bonded cellulosic fiber-based sheets bonded together at spaced-apart intervals in a staggered configuration and the honeycomb structure comprises a plurality of cells having a cell diameter and a cell height, and a ratio of the cell height and the cell diameter is below 1.1.

[0021] In an embodiment, the first liner grammage is lower than the second liner grammage and the first liner comprising the cellulosic fiber-based liner. In an embodiment, the geometrically patterned structure comprises a plurality of cells having a cell diameter and a cell height, and the ratio of the cell height and the cell diameter is below 1.1. In an embodiment, the core portion comprises cellulosic fiber-based walls or sheets having a core grammage ranging between 60 and 200 grams

per square meter. In an embodiment, the core portion comprises cellulosic fiber-based walls or sheets having a core grammage, at least one of the first liner grammage and the second liner grammage being lower than the core grammage. The first liner grammage and the second liner grammage can be lower than the core grammage. In an embodiment, at least one of the first liner grammage and the second liner grammage is below 100 grams per square meter. In an embodiment, the material is flexible along a plane defined by at least one of the first liner and the second liner. In an embodiment, the first liner and the second liner comprise cellulosic fiber-based liners. In an embodiment, at least one of the first liner and the second liner comprises an air-laid paper. The other one of the first liner and the second liner can comprise a kraft paper, such as extendable kraft paper. In an embodiment, the geometrically patterned structure of the core portion is in an at least partially expanded state. In an embodiment, the geometrically patterned structure is in a stretched state. In an embodiment, the flexible packaging material has an overall thickness ranging between 0.6 and 2.5 cm. In an embodiment, the geometrically patterned structure comprises a honeycomb material with a grid of hexagonal cells. In an embodiment, the geometrically patterned structure comprises cells having a diameter ranging between 0.6 cm and 3.8 cm. In an embodiment, the core portion comprises walls and the walls or sheets of the core portion and at least one of the one of the first liner and the second liner comprises wood fiber based materials. In an embodiment, the material is bendable/curvable around a corner area of an object. In an embodiment, the material has a material grammage below about 500 grams per square meter.

[0022] According to another aspect, there is provided a flexible packaging material comprising: a core cellulosic fiber-based portion having a honeycomb structure, the core cellulosic fiber-based portion defining two spaced-apart substantially planar faces and providing air space therebetween, the core cellulosic fiber-based portion including a stack of bonded cellulosic fiber-based sheets bonded together at spaced-apart intervals in a staggered configuration, the cellulosic fiber-based sheets having a core grammage ranging between 60 and 200 grams per square meter; and at least a first liner and a second liner, the first liner and the second liner being bonded to a

respective one of the planar faces of the core portion, the first liner having a first liner grammage and the second liner having a second liner grammage different than the first liner grammage, at least one of the first and second liner grammages being lower than the core grammage and at least one of the first liner grammage and the second liner grammage is below 100 grams per square meter, at least one of the first liner and the second liner comprising a cellulosic fiber-based liner, the core cellulosic fiber-based portion extending continuously between the first and the second liners, the material being intrinsically manually curvable along at least two non-parallel axes.

[0023] According to still another aspect, there is provided a method for packing an article comprising: applying the flexible packaging material as described above over the article to at least partially cover the article; and curving the flexible packaging material over at least one non-planar element of the article. The method can comprise directly superposing one of the first liner and the second liner to the article being packed. According to another aspect, there is provided an article at least partially protected by the flexible packaging material as described above. The material can be bended over at least one non-planar element, such as a corner

[0024] According to still another aspect, there is provided a flexible packaging material comprising: a core portion having a three dimensional geometrically patterned structure, such as a honeycomb structure, with cellulosic fiber-based walls defining two spaced-apart substantially planar faces and providing air space therebetween; a first liner bonded to a first one of the planar faces of the core portion and comprising an air-laid fiber material having a first liner grammage; and a second liner bonded to a second one of the planar faces of the core portion and comprising a kraft paper having a second liner grammage different than the first liner grammage; the flexible packaging material being bendable or curvable and/or intrinsically manually curvable along at least two non-parallel axes. In an embodiment, the core portion extends continuously between the first and the second liners. In an embodiment, the flexible packaging material is curvable, bendable or foldable simultaneously along at least two non-parallel axes and/or without prior crushing of the core. In an embodiment, the core cellulosic fiber-based portion includes a stack

of bonded cellulosic fiber-based sheets bonded together at spaced-apart intervals in a staggered configuration and the honeycomb structure comprises a plurality of cells having a cell diameter and a cell height, and a ratio of the cell height and the cell diameter is below 1.1. In an embodiment, the kraft paper comprises extendable kraft paper. In an embodiment, the air-laid fiber material comprises air-laid paper. In an embodiment, the geometrically patterned structure comprises a plurality of cells having a cell diameter and a cell height, and the ratio of the cell height and the cell diameter is below 1.1. In an embodiment, the geometrically patterned structure is in a stretched state. In an embodiment, the cellulosic fiber-based walls or sheets have a core grammage between 60 and 200 grams per square meter. In an embodiment, the cellulosic fiber-based walls or sheets have a core grammage and the first liner grammage and the second liner grammage are lower than the core grammage. In an embodiment, the flexible packaging material has an overall thickness ranging between 0.6 and 2.5 cm. In an embodiment, the geometrically patterned structure comprises a honeycomb material with a grid of hexagonal cells. In an embodiment, the geometrically patterned structure comprises cells having a diameter ranging between 0.6 cm and 3.8 cm. In an embodiment, the walls of the core portion (or the cellulosic fiber-based sheets of the core portion) and the first liner and the second liner comprise wood fiber based materials. In an embodiment, the material is flexible along a plane defined by at least one of the first liner and the second liner. In an embodiment, the material is bendable around a corner area of an object.

[0025] According to still another aspect, there is provided a method for manufacturing a flexible packaging material, comprising: providing a core portion having a geometrically patterned structure, such as a honeycomb structure, defining two spaced-apart substantially planar faces and a plurality of cells having a diameter and a height and providing air space therebetween; bonding a first liner to a first one of the planar faces of the core portion, the first liner having a first liner grammage; and bonding a second liner to a second one of the planar faces of the core portion, the second liner having a second liner grammage different than the first liner grammage; the flexible packaging material being bendable and/or intrinsically

manually curvable along at least two non-parallel axes. In an embodiment, the core portion extends continuously between the first and the second liners.

[0026] According to still another aspect, there is provided a flexible packaging material comprising: a core having two spaced-apart core surfaces and including a plurality of cellulosic fiber-based walls extending between the two core surfaces, the plurality of cellulosic fiber-based walls defining a plurality of empty cells having a cell diameter and a cell height, and a ratio of the cell height and the cell diameter is below 1.1; a first liner having a first liner grammage, the first liner extending along a first one of the two core surfaces, substantially normal to the cellulosic fiber-based walls, and secured to the cellulosic fiber-based walls; and a second liner having a second liner grammage, lower than the first liner grammage, the second liner extending along a second one of the two core surfaces, substantially normal to the cellulosic fiber-based walls, and secured to the cellulosic fiber-based walls; wherein the flexible packaging material is curvable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Fig. 1 is a perspective view, partly sectioned, of a flexible paper honeycomb material in accordance with an embodiment;

[0028] Fig. 2 is a perspective view of the material shown in Fig. 1 rolled into a spiral-like shape;

[0029] Fig. 3 is a perspective and schematic view of the material shown in Fig. 1 applied over an upper portion of an object and folded along several axes; and

[0030] Fig. 4 is a perspective view of the material shown in Fig. 1, partially twisted.

[0031] It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION

[0032] Referring now to the drawings and, more particularly referring to Fig. 1, it will be seen a flexible and protective cellulosic fiber based material 10 including a three-dimensional geometrically patterned structure in accordance with an embodiment. More particularly, in the embodiment shown, the three-dimensional geometrical pattern is a honeycomb structure.

[0033] The material 10 includes a core portion 12 and two face members, or liners, 14. The core portion 12 has walls 16 defining the three-dimensional geometrically patterned structure which provides air spaces therein and strengthens the resulting material 10. In the embodiment shown, the geometrically patterned structure is a honeycomb type structure with hexagonal open-ended core cells. The walls 16 of the core portion 12 define two opposite substantially planar surfaces 20, spaced-apart from one another.

[0034] In the embodiment shown, the honeycomb type material is a grid of hexagonal cells. As it will be easily understood by one skilled in the art, any other lattice structure and/or geometrically patterned structure, which provides enhanced strength for supporting and protecting loads, creating an air space as a result of that structure, can be used.

[0035] The walls 16 of the core portion 12 can be made of any cellulosic fiber-based materials such as, without being limitative, wood fibers, agricultural residues, and recycled fibers, or any combination thereof. For instance and without being limitative, the walls 16 of the core portion 12 can be made of virgin kraft paper or recycled paper (or medium). The wall material can be unbleached (brown) or bleached and is adapted for packaging applications.

[0036] In an embodiment, the wall material has a grammage ranging between 60 and 200 grams per square meter. In an alternative embodiment, the wall material has a grammage ranging between about 65 and about 130 grams per square meter and, in still another embodiment, the wall material has a grammage ranging between about 80 and about 110 grams per square meter.

[0037] The core portion 12 may be manufactured by applying spaced apart, parallel glue strips across each of a plurality of sheets of cellulosic fiber-based material. The glue strips on alternate sheets being off-set with respect to the glue strips on the intermediate sheets, superimposing aligned sheets upon another to form a stack, and thereafter expanding the said edge portion to form the core.

[0038] In an embodiment, the cell dimensions range between about 0.6 cm (1/4 inch) and 3.8 cm (1 1/2 inch), i.e. each cell has a diameter of about 0.6 cm up to 3.8 cm. In an alternative embodiment, the cell diameter ranges between about 1.6 cm (5/8 inch) and 2.2 cm (7/8 inch). In another alternative embodiment, the cell diameter ranges between about 0.95 cm (3/8 inch) and 1.6 cm (5/8 inch) and, in still another alternative embodiment, the cell diameter ranges between about 0.95 cm (3/8 inch) and 2.2 cm (7/8 inch). The diameter of a cell is measured between two opposed cell walls.

[0039] In an embodiment, the core height, i.e. the wall height, ranges between about 0.6 cm (1/4 inch) and 1.9 cm (3/4 inch). In an alternative embodiment, the cell height ranges between about 0.95 cm (3/8 inch) and 1.3 cm (1/2 inch).

[0040] In an embodiment, the ratio of the cell height and the cell diameter is below about 1.1. In an alternative embodiment, the ratio is kept below or equal to about 1 for a greater flexibility of the resulting material.

[0041] In an embodiment, the honeycomb structure or any other three-dimensional geometrically patterned structure can be in a stretched state to improve the flexibility of the resulting material, i.e. the three-dimensional geometrically patterned structure is stretched. In other words, the core portion can be stretched along an axis in a manner such that the cell diameter is longer along the stretch axis and shorter along an axis substantially perpendicular to the stretch axis. The cells are thus flattened along the axis that is substantially perpendicular to the stretch axis. If the cells are stretched, the cell diameter is measured between the two most-spaced apart corners, i.e. along the stretch axis.

[0042] The walls of the core portion can be prestressed, i.e. they can be deformed along their length to a predetermined depth. The deformation can be achieved by compressing the core portion, including or not a face member, to a predetermined depth.

[0043] The face members 14, or liners, are also cellulosic fiber-based materials such as, without being limitative, wood fibers, agricultural residues, and recycled fibers, or any combination thereof. For instance and without being limitative, the liners 14 can be made of tissue paper, towel paper, extendable kraft paper, recycled paper (medium), and kraft paper. The liners can include additives, coatings, adhesives, or resins to modify its properties. For instance and without being limitative, the liners can be air-laid papers including cellulosic fibers and resins or antistatic paper-based materials. One skilled in the art will appreciate that liners including additives, coatings, adhesives, or resins have higher grammages than liners that are substantially free of additives, coatings, adhesives, and resins. As for the wall material, the liners 14 can be unbleached (brown) or bleached and are adapted for

packaging structural, and void space filling applications. The liners are substantially flat, relatively thin, and flexible members.

[0044] The face members 14 and/or the walls of the core portion 12 can be single ply or can comprise several superposed paper plies. In an embodiment, at least one of face members 14 is a tissue paper. The face members 14 can be embossed, i.e. they can include an embossed pattern. They can further have information, patterns, ornamentations, and the like printed thereon.

[0045] In an embodiment, the liners 14 have a grammage ranging below about 100 grams per square meter. The liner grammage includes the cellulosic fiber grammage and the additive, coating, adhesive, or resin grammage. In an embodiment, the liners 14 have a cellulosic fiber grammage below about 60 grams per square meter. In an alternative embodiment, the cellulosic fiber grammage ranges between about 10 and 50 grams per square meter. In still another embodiment, the liners 14 have a cellulosic fiber grammage ranging between about 20 and 30 grams per square meter. In a further embodiment, the liners 14 have a cellulosic fiber grammage ranging between about 30 and 50 grams per square meter. The grammage of the liner(s) 14 is typically lower than the grammage of the walls defining the core portion.

[0046] As mentioned above, when a liner includes an additive, a coating, an adhesive or a resin, the total grammage of the liner, i.e. the grammage of the liner including the cellulosic fiber grammage and the resin, coating, adhesive, or additive grammage, is below about 100 grams per square meter. In an alternative embodiment, the total grammage of the liner is below about 80 grams per square meter.

[0047] In an embodiment, if one of the liners includes an additive, a coating, an adhesive or a resin, the other liner is substantially free of resin, coating, adhesive, or additive such as a cohesive adhesive, a pressure sensitive adhesive, an airlaid coating, or any other coating. In an embodiment, if one of the liners includes an additive, a coating, an adhesive or a resin, the other liner has a total grammage below about 60 grams per square meter.

[0048] In an embodiment, the total grammage of both liners is below about 160 grams per square meter. In an alternative embodiment, the total grammage of both liners is below about 120 grams per square meter.

[0049] Each one of the liners 14 has two surfaces 24a, 24b. One surface 24a of each liner 14, the inner surface, is laminated (or bonded) on a respective surface 20 of the core portion 12. The other surface 24b of each face member 14 is the outer surface of the material 10. The liners 14 are bonded to the core portion 12 with the three-dimensional geometrically patterned structure in an at least partially expanded state, i.e. with open-ended cells. The liners 14 maintain the three-dimensional geometrically patterned structure in the at least partially expanded state.

[0050] One skilled in the art will appreciate that the liners 14 maintain the three-dimensional geometrically patterned structure in an open-ended state which can be a partially expanded state, a fully expanded state or a stretched state.

[0051] It is appreciated that, in an alternative embodiment (not shown), the material 10 can include only one liner 14 bonded to one surface 20 of the core portion 12. Furthermore, if the material 10 includes two liners 14, the properties, for instance, the material and/or the grammage of both liners 14 can be different.

[0052] The material 10 has an overall thickness, i.e. including the core portion 12 and the liner(s) 14, ranging between about 0.6 and 2.5 cm (about 0.25 to 1 inch). In an alternative embodiment, the overall thickness ranges between about 0.6 and 1.6 cm (about 0.25 to 5/8 inch).

[0053] In an embodiment, the grammage of the material 10 is below about 500 grams per square meters. In an alternative embodiment, the grammage of the material is below about 400 grams per square meter.

[0054] The liners 14 can be continuous or discontinuous, i.e. several liners are juxtaposed and bonded to the surfaces 20 of the core portion 12. Moreover, the liners 14 can include apertures, elongated slots, and the like defined therein.

[0055] An additional layer can be superposed to the liners 14. For instance and without being limitative, a soft material can be superposed to the at least one of the liners 14 to improve the softness of the resulting material 10.

[0056] The face members 14 strengthen the honeycomb core portion 12 by being disposed perpendicular to the latter, thereby distributing the weight over the three-dimensional geometrically patterned structure such as the honeycomb structure. Bonding of the face members 14 on the core portion 12 can be accomplished by appropriate methods such as by gluing.

[0057] One skilled in the art will appreciate that the liners 14 can be bonded directly or indirectly to the surfaces 20 of the core portion 12. If the liners 14 are mounted indirectly, another material can be interposed in between.

[0058] The resulting material 10 is flexible along a plane defined by the liners 14, i.e. it can be folded along substantially any axis parallel to the liners 14 or allows folding substantially in all planar directions as shown in Figs. 2 to 4. Thus, the material 10 can adapt and substantially conform to the shape of an object being wrapped or protected or to a void space being filled. In Fig. 3, the material 10 is applied to the upper portion of an object and, more particularly, a filing cabinet A. The material 10 is folded along several non parallel axis. The material 10 has protective and cushioning properties particularly when stresses are applied in a direction substantially perpendicular to the liners 14.

[0059] The material 10 can be either manufactured manually or continuously on any appropriate apparatus (not shown). The material 10 can be cut manually or automatically to the desired size.

[0060] The material 10 can be used for packaging and void space filling applications to replace bubble wrap or any other flexible products. The material 10 is foldable and bendable in substantially all planar directions, as needed to facilitate conforming of the material 10 to the particular object being shipped. The conformability of the material 10 as a protective packaging and void space filling product, i.e. its ability to wrap around all surfaces of an object, including corner areas of the object, provides

cushioning against shock loads imposed at any angle on the outer shipping container or directly on the material. It is thus adapted for use in packaging, specifically in multi planar, pliable packaging and void space filling applications.

[0061] The cellulosic or paper-based materials for the walls 16 or the liners 14 can be impregnated and/or coated with a resin to improve their resistance to water, grease or fire, their gas and vapor barrier properties, their non-slip properties, their low-abrasion properties, their low friction properties, and the like. They can also be treated with a water-based coating or a resin coating. For instance and without being limitative, the cellulosic or paper-based materials for the walls 16 or the liners 14 can include up to 45 % of a non-cellulosic material such as resins, polymers, and the like.

[0062] Several adhesives can be used to laminate the face members 14 to the core portion 12. For example, without being limitative, adhesives such as water-based adhesive, polyvinyl alcohol (PVOH), polyvinyl acetate (PVA), acrylic, stamp glue, dextrin, and polyurethane can be used to assemble components of the composite material together. Hot melt adhesives such as polyolefin and ethylene vinyl acetate (EVA) can also be used. In some embodiments, it might be desirable to use a degradable or a repulpable adhesive. In other embodiments, it might be desirable to use an adhesive that remains on the surfaces 20 of the geometrically patterned structure of the core portion or an adhesive that bonds very rapidly.

[0063] Pressure-sensitive and/or cohesive adhesives can be applied on an outer surface of the face members or liners 14, i.e. the surface in contact with the article to be wrapped. The pressure-sensitive adhesives can be activated by applying pressure. The material 10 can be removably bonded to the article to be wrapped during the wrapping process.

[0064] Furthermore, release adhesives or any other appropriate adhesives can be applied to the liners 14 and, more particularly to their outer surfaces 24b.

[0065] Polycoating can also be applied to the liners 14 and, more particularly to their outer surfaces 24b to modify the properties of the liners 14. For instance, a polycoating can be applied to increase the abrasion resistance of the liners 14.

[0066] One skilled in the art will appreciate that the grammage of the liners including the resins, the adhesives, the coatings, or any other products is lower than about 120 grams per square meter. In an alternative embodiment, the grammage of the liners is below about 80 grams per square meter.

[0067] In an embodiment, the material 10 can be substantially continuous. It can be substantially free of continuous or discontinuous cuts extending through the core portion 12 and/or the liners 14. In an alternative embodiment, the material 10 can include cookie cuts extending solely through at least one of the liners 14, slit cuts extending through one of the liners 14 and at least partially in the core portion 12, or other cuts that increase the flexibility of the structure 10 and facilitate its forming. The cuts, such as slits or grooves, orientate the flexibility of the material along predetermined axes.

[0068] The material 10 can be used to wrap irregularly shaped products.

[0069] The material 10 can be transported, stored, and sold as a roll wherein the material 10 is rolled onto itself in a spiral shape.

[0070] The material 10 can be folded along any axis without requiring a discontinuity, which can be continuous or not, extending through one of the liners and/or the core portion. Discontinuities include cuts defined in the material 10. The material 10 can be folded simultaneously along two axis that are not parallel to one another.

[0071] The material 10 is adequate as a flexible and protective packaging, void space filling and protective material. Moreover, it is a cost-efficient packaging and void space filling material due to its lightweight and recyclable and degradable nature.

[0072] The material 10 can also be used in structural applications such as inner filling for furniture.

[0073] Several alternative embodiments and examples have been described and illustrated herein. The embodiments of the invention described above are intended to be exemplary only. A person of ordinary skill in the art would appreciate the

features of the individual embodiments, and the possible combinations and variations of the components. A person of ordinary skill in the art would further appreciate that any of the embodiments could be provided in any combination with the other embodiments disclosed herein. It is understood that the invention may be embodied in other specific forms without departing from the central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein. Accordingly, while the specific embodiments have been illustrated and described, numerous modifications come to mind. The scope of the invention is therefore intended to be limited solely by the scope of the appended claims.

CLAIMS:

1. A flexible packaging material comprising:

a core cellulosic fiber-based portion having a honeycomb structure, the core cellulosic fiber-based portion defining two spaced-apart substantially planar faces and providing air space therebetween, the core cellulosic fiber-based portion including a stack of bonded cellulosic fiber-based sheets bonded together at spaced-apart intervals in a staggered configuration, the honeycomb structure comprises a plurality of cells having a cell diameter and a cell height, and a ratio of the cell height and the cell diameter is below 1.1; and

at least a first liner and a second liner, the first liner and the second liner being bonded to a respective one of the planar faces of the core portion, the first liner having a first liner grammage and the second liner having a second liner grammage different than the first liner grammage, at least one of the first liner and the second liner comprising a cellulosic fiber-based liner, the core cellulosic fiber-based portion extending continuously between the first and the second liners, the material being intrinsically manually curvable along at least two non-parallel axes.
2. The flexible packaging material as claimed in claim 1, wherein the cellulosic fiber-based sheets have a core grammage ranging between 60 and 200 grams per square meter.
3. The flexible packaging material as claimed in one of claims 1 and 2, wherein the cellulosic fiber-based sheets have a core grammage, at least one of the first liner grammage and the second liner grammage being lower than the core grammage.

4. The flexible packaging material as claimed in claim 3, wherein the first liner grammage and the second liner grammage are lower than the core grammage.
5. The flexible packaging material as claimed in any one of claims 1 to 4, wherein at least one of the first liner grammage and the second liner grammage is below 100 grams per square meter.
6. A flexible packaging material comprising:
 - a core cellulosic fiber-based portion having a honeycomb structure, the core cellulosic fiber-based portion defining two spaced-apart substantially planar faces and providing air space therebetween, the core cellulosic fiber-based portion including a stack of bonded cellulosic fiber-based sheets bonded together at spaced-apart intervals in a staggered configuration, the cellulosic fiber-based sheets having a core grammage ranging between 60 and 200 grams per square meter; and
 - at least a first liner and a second liner, the first liner and the second liner being bonded to a respective one of the planar faces of the core portion, the first liner having a first liner grammage and the second liner having a second liner grammage different than the first liner grammage, at least one of the first and second liner grammages being lower than the core grammage and at least one of the first liner grammage and the second liner grammage is below 100 grams per square meter, at least one of the first liner and the second liner comprising a cellulosic fiber-based liner, the core cellulosic fiber-based portion extending continuously between the first and the second liners, the material being intrinsically manually curvable along at least two non-parallel axes.
7. The flexible packaging material as claimed in claim 6, wherein the honeycomb structure comprises a plurality of cells having a cell diameter

and a cell height, and a ratio of the cell height and the cell diameter is below 1.1.

8. The flexible packaging material as claimed in one of claims 6 and 7, wherein the first liner grammage and the second liner grammage are lower than the core grammage.
9. The flexible packaging material as claimed in any one of claims 1 to 8, wherein the first liner grammage is lower than the second liner grammage and the first liner comprising the cellulosic fiber-based liner.
10. The flexible packaging material as claimed in any one of claims 1 to 9, wherein the material is flexible along a plane defined by at least one of the first liner and the second liner.
11. The flexible packaging material as claimed in any one of claims 1 to 10, wherein the flexible packaging material is curvable simultaneously along at least two non-parallel axes.
12. The flexible packaging material as claimed in any one of claims 1 to 11, wherein the flexible packaging material is curvable without prior crushing of the core.
13. The flexible packaging material as claimed in any one of claims 1 to 12, wherein the first liner and the second liner comprise cellulosic fiber-based liners.
14. The flexible packaging material as claimed in any one of claims 1 to 13, wherein at least one of the first liner and the second liner comprises an air-laid paper.
15. The flexible packaging material as claimed in claim 14, wherein the other one of the first liner and the second liner comprises a kraft paper.

16. The flexible packaging material as claimed in claim 15, wherein the kraft paper comprises extendable kraft paper.
17. The flexible packaging material as claimed in any one of claims 1 to 16, wherein the honeycomb structure of the core portion is in an at least partially expanded state.
18. The flexible packaging material as claimed in any one of claims 1 to 17, wherein the honeycomb structure is in a stretched state.
19. The flexible packaging material as claimed in any one of claims 1 to 18, having an overall thickness ranging between 0.6 and 2.5 cm.
20. The flexible packaging material as claimed in any one of claims 1 to 19, wherein the honeycomb structure comprises a honeycomb material with a grid of hexagonal cells.
21. The flexible packaging material as claimed in any one of claims 1 to 20, wherein the honeycomb structure comprises cells having a diameter ranging between 0.6 cm and 3.8 cm.
22. The flexible packaging material as claimed in any one of claims 1 to 21, wherein the cellulosic fiber-based sheets of the core portion and at least one of the one of the first liner and the second liner comprises wood fiber based materials.
23. The flexible packaging material as claimed in any one of claims 1 to 22, wherein the material is curvable around a corner area of an object.
24. The flexible packaging material as claimed in any one of claims 1 to 23, wherein the material has a material grammage below about 500 grams per square meter.
25. A method for packing an article comprising:

applying the flexible packaging material of any one of claims 1 to 24 over the article to at least partially cover the article ; and
curving the flexible packaging material over at least one non-planar element of the article.

26. The method as claimed in claim 25, comprising directly superposing one of the first liner and the second liner to the article being packed.
27. An article at least partially protected by the flexible packaging material of any one of claims 1 to 24.
28. The article as claimed in claim 27, wherein the material is curved over at least one non-planar element.
29. The article as claimed in claim 28, wherein the non-planar element comprises a corner.
30. A flexible packaging material comprising:
 - a core portion having a honeycomb structure and including a stack of cellulosic fiber-based sheets having a core grammage and bonded together at spaced-apart intervals in a staggered configuration, the core portion defining two spaced-apart substantially planar faces and providing air space therebetween, the honeycomb structure comprising a plurality of cells having a cell diameter and a cell height, and a ratio of the cell height and the cell diameter is below 1.1;
 - a first liner bonded to a first one of the planar faces of the core portion and comprising an air-laid fiber material having a first liner grammage; and
 - a second liner bonded to a second one of the planar faces of the core portion and comprising a kraft paper having a second liner grammage different than the first liner grammage, the core portion

extending continuously between the first and the second liners; the flexible packaging material being intrinsically manually curvable along at least two non-parallel axes.

31. The flexible packaging material as claimed in claim 30, wherein the cellulosic fiber-based sheets have a core grammage between 60 and 200 grams per square meter.
32. The flexible packaging material as claimed in one of claims 30 and 31, having an overall thickness ranging between 0.6 and 2.5 cm.
33. A flexible packaging material comprising:
 - a core portion having a honeycomb structure and including a stack of cellulosic fiber-based sheets bonded together at spaced-apart intervals in a staggered configuration, the core portion defining two spaced-apart substantially planar faces and providing air space therebetween, the cellulosic fiber-based sheets having a core grammage between 60 and 200 grams per square meter;
 - a first liner bonded to a first one of the planar faces of the core portion and comprising an air-laid fiber material having a first liner grammage; and
 - a second liner bonded to a second one of the planar faces of the core portion and comprising a kraft paper having a second liner grammage different than the first liner grammage, the core portion extending continuously between the first and the second liners; the flexible packaging material being intrinsically manually curvable along at least two non-parallel axes,wherein the flexible packaging material has an overall thickness ranging between 0.6 and 2.5 cm.
34. The flexible packaging material as claimed in claim 33, wherein the honeycomb structure comprises a plurality of cells having a cell diameter

and a cell height, and a ratio of the cell height and the cell diameter is below 1.1.

35. The flexible packaging material as claimed in any one of claims 30 to 34, wherein the kraft paper comprises extendable kraft paper.
36. The flexible packaging material as claimed in one of claims 30 and 35, wherein the air-laid fiber material comprises air-laid paper.
37. The flexible packaging material as claimed in any one of claims 30 to 36, wherein the honeycomb structure is in a stretched state.
38. The flexible packaging material as claimed in any one of claims 30 to 37, wherein the first liner grammage and the second liner grammage are lower than the core grammage.
39. The flexible packaging material as claimed in any one of claims 30 to 38, wherein the honeycomb structure comprises a honeycomb material with a grid of hexagonal cells.
40. The flexible packaging material as claimed in any one of claims 30 to 39, wherein the honeycomb structure comprises cells having a diameter ranging between 0.6 cm and 3.8 cm.
41. The flexible packaging material as claimed in any one of claims 30 to 40, wherein the sheets of the core portion and the first liner and the second liner comprise wood fiber based materials.
42. The flexible packaging material as claimed in any one of claims 30 to 41, wherein the material is flexible along a plane defined by at least one of the first liner and the second liner.
43. The flexible packaging material as claimed in any one of claims 30 to 42, wherein the material is curvable around a corner area of an object.

44. The flexible packaging material as claimed in any one of claims 30 to 43, wherein the flexible packaging material is curvable simultaneously along at least two non-parallel axes.
45. The flexible packaging material as claimed in any one of claims 30 to 44, wherein the flexible packaging material is curvable without prior crushing of the core.
46. A method for manufacturing a flexible packaging material, comprising:
providing a core portion having a honeycomb structure having a diameter ranging between 0.6 cm and 3.8 cm and including a stack of cellulosic fiber-based sheets having a core grammage and bonded together at spaced-apart intervals in a staggered configuration, the core portion defining two spaced-apart substantially planar faces and a plurality of cells having a diameter and a height and providing air space therebetween;
bonding a first liner to a first one of the planar faces of the core portion, the first liner having a first liner grammage; and
bonding a second liner to a second one of the planar faces of the core portion, the second liner having a second liner grammage different than the first liner grammage and the core portion extending continuously between the first and the second liners, at least one of the first and second liner grammages being lower than the core grammage;
the flexible packaging material being intrinsically manually curvable along at least two non-parallel axes.
47. A flexible packaging material comprising:
a core having two spaced-apart core surfaces and including a plurality of cellulosic fiber-based walls extending between the two core surfaces, the plurality of cellulosic fiber-based walls defining a

plurality of empty cells having a cell diameter and a cell height, and a ratio of the cell height and the cell diameter is below 1.1;

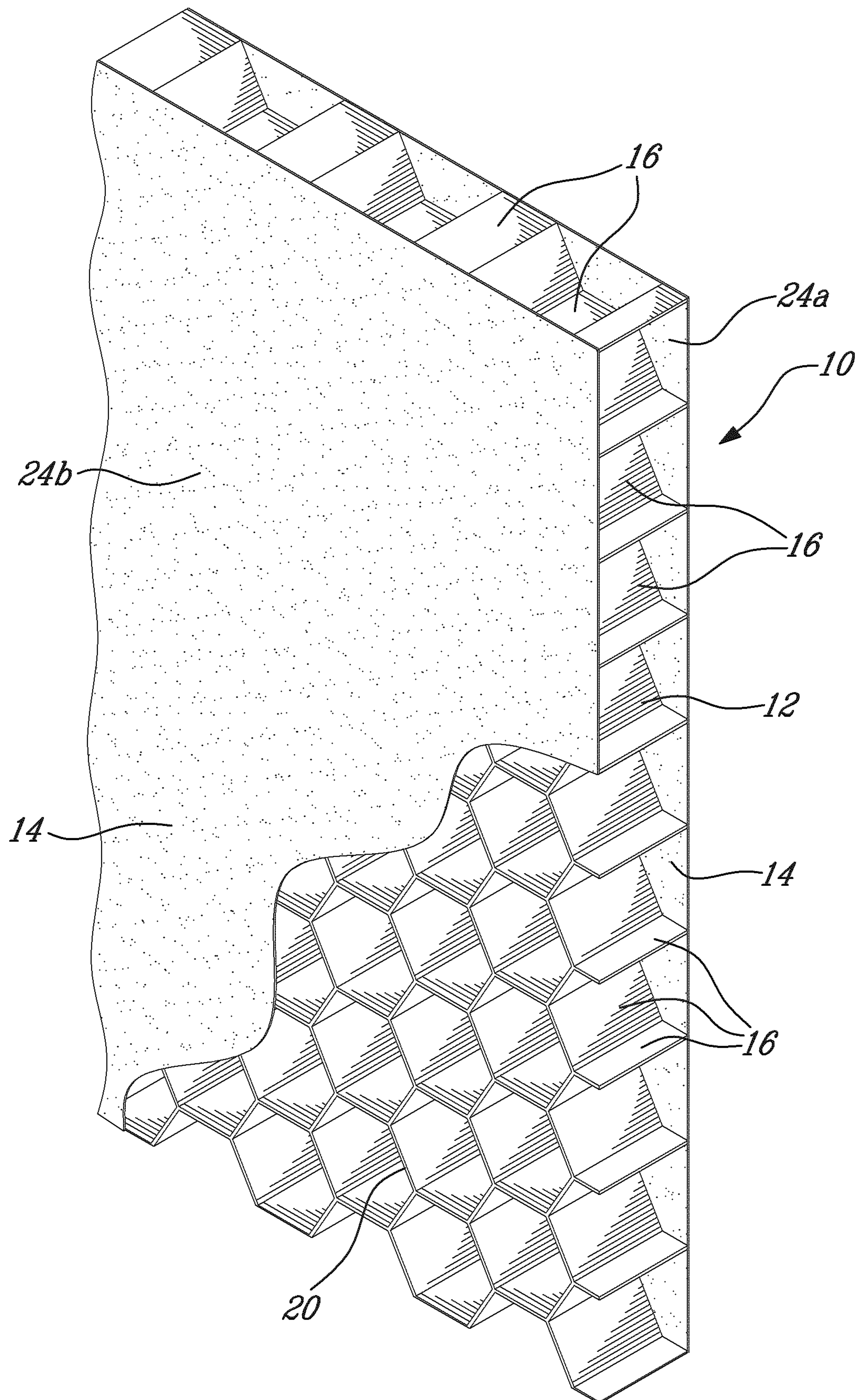
a first liner having a first liner grammage, the first liner extending along a first one of the two core surfaces, substantially normal to the cellulosic fiber-based walls, and secured to the cellulosic fiber-based walls; and

a second liner having a second liner grammage, lower than the first liner grammage, the second liner extending along a second one of the two core surfaces, substantially normal to the cellulosic fiber-based walls, and secured to the cellulosic fiber-based walls; wherein the flexible packaging material is curvable.

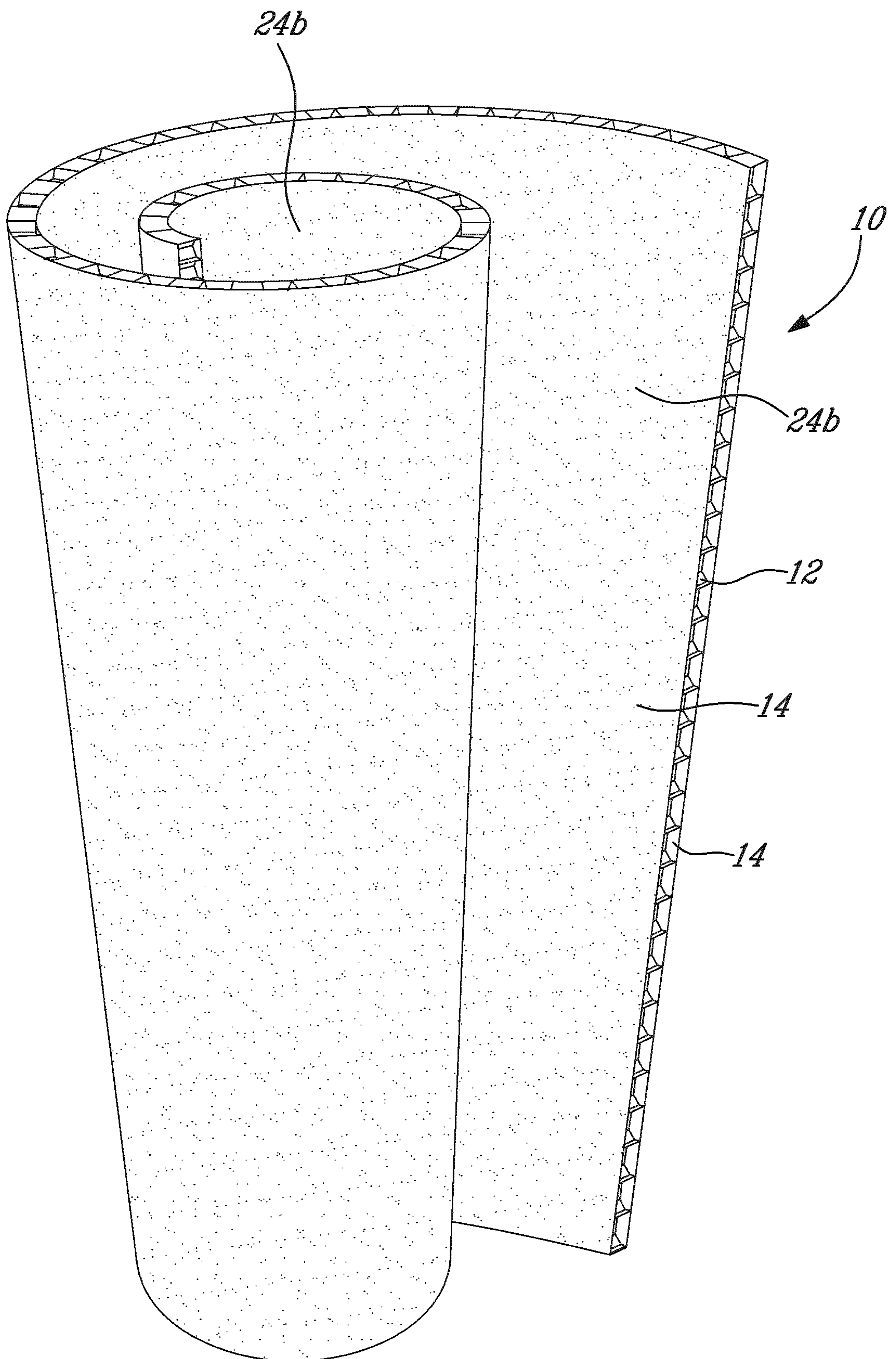
48. The flexible packaging material as claimed in claim 47, wherein the cellulosic fiber-based walls have a core grammage ranging between 60 and 200 grams per square meter and at least one of the first liner grammage and the second liner grammage being lower than the core grammage.
49. The flexible packaging material as claimed in claim 48, wherein the first liner grammage and the second liner grammage are lower than the core grammage.
50. The flexible packaging material as claimed in any one of claims 47 to 49, wherein at least one of the first liner grammage and the second liner grammage is below 100 grams per square meter.
51. The flexible packaging material as claimed in any one of claims 47 to 50, wherein at least one of the first liner grammage and the second liner grammage is below 60 grams per square meter.
52. The flexible packaging material as claimed in any one of claims 47 to 51, wherein the two core surfaces extend substantially parallel to one another.

53. The flexible packaging material as claimed in any one of claims 47 to 52, wherein the flexible material is flexible along a plane defined by at least one of the first liner and the second liner.
54. The flexible packaging material as claimed in any one of claims 47 to 53, wherein one of the first liner and the second liner comprises an air-laid paper.
55. The flexible packaging material as claimed in claim 54, wherein the other one of the first liner and the second liner comprises a kraft paper.
56. The flexible packaging material as claimed in claim 55, wherein the kraft paper comprises an extendable kraft paper.
57. The flexible packaging material as claimed in any one of claims 47 to 56, having an overall thickness ranging between 0.6 cm and 2.5 cm.
58. The flexible packaging material as claimed in any one of claims 47 to 57, wherein the plurality of empty cells has a diameter ranging between 0.6 cm and 3.8 cm.
59. The flexible packaging material as claimed in any one of claims 47 to 58, wherein the plurality of empty cells defines a grid of hexagonal empty cells.
60. The flexible packaging material as claimed in any one of claims 47 to 59, wherein the cellulosic fiber-based walls of the core and at least one of the first liner and the second liner comprise wood fiber based materials.
61. The flexible packaging material as claimed in any one of claims 47 to 60, wherein the flexible packaging material is curvable around a corner area of an object.

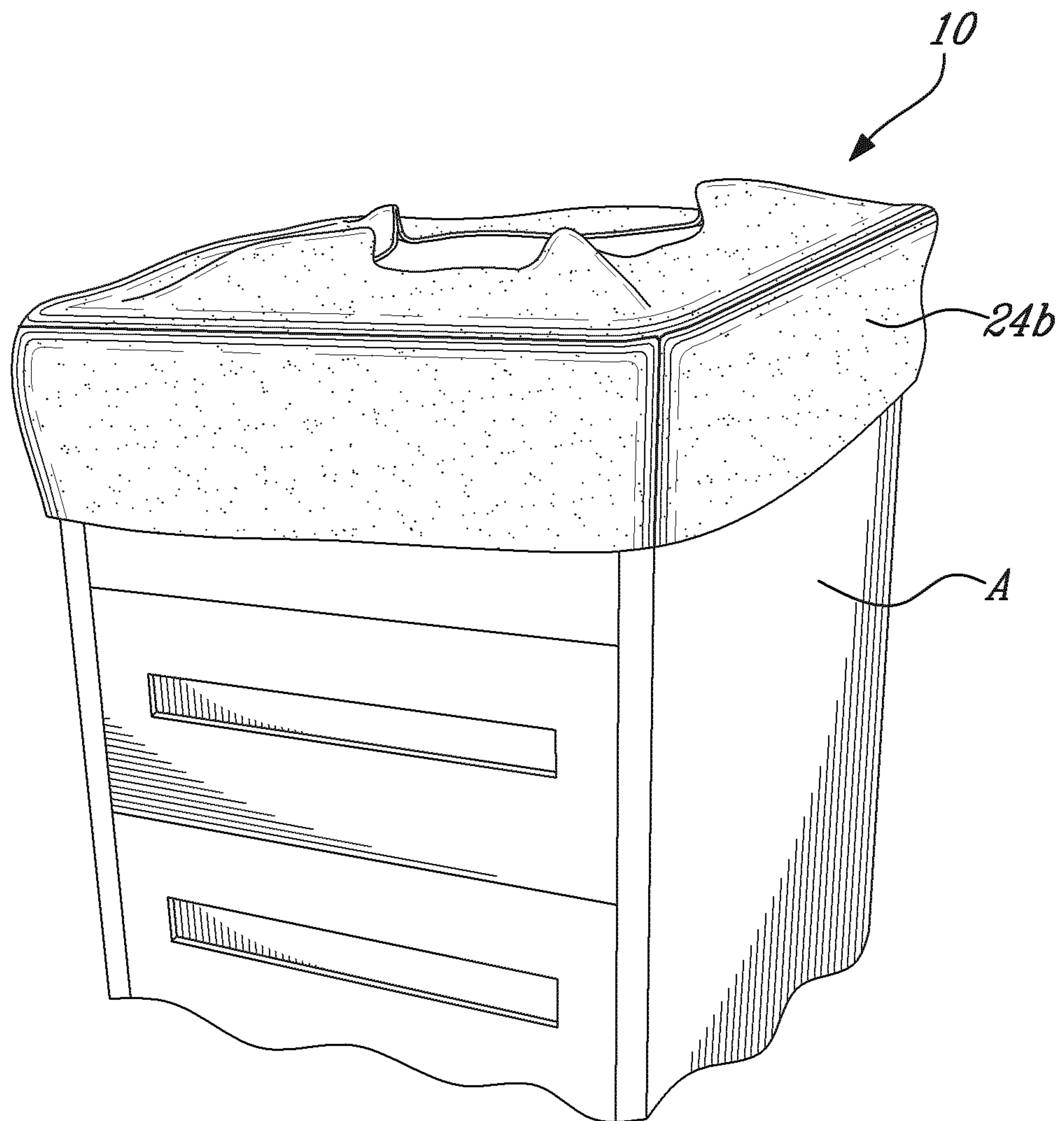
62. The flexible packaging material as claimed in any one of claims 47 to 61, wherein the flexible packaging material has a packaging material grammage below about 500 grams per square meter.
63. The flexible packaging material as claimed in any one of claims 47 to 62, wherein the flexible packaging material is curvable along several non-parallel axes.
64. The flexible packaging material as claimed in any one of claims 47 to 63, wherein the flexible packaging material is reshapable following curving.
65. The flexible packaging material as claimed in any one of claims 47 to 64, wherein the flexible packaging material is curvable simultaneously along at least two non-parallel axes.
66. An article at least partially protected by the flexible packaging material of any one of claims 47 to 65.
67. The article as claimed in claim 66, wherein the material is curved over at least one non-planar element.
68. The article as claimed in claim 67, wherein the non-planar element comprises a corner.

**Fig-1**

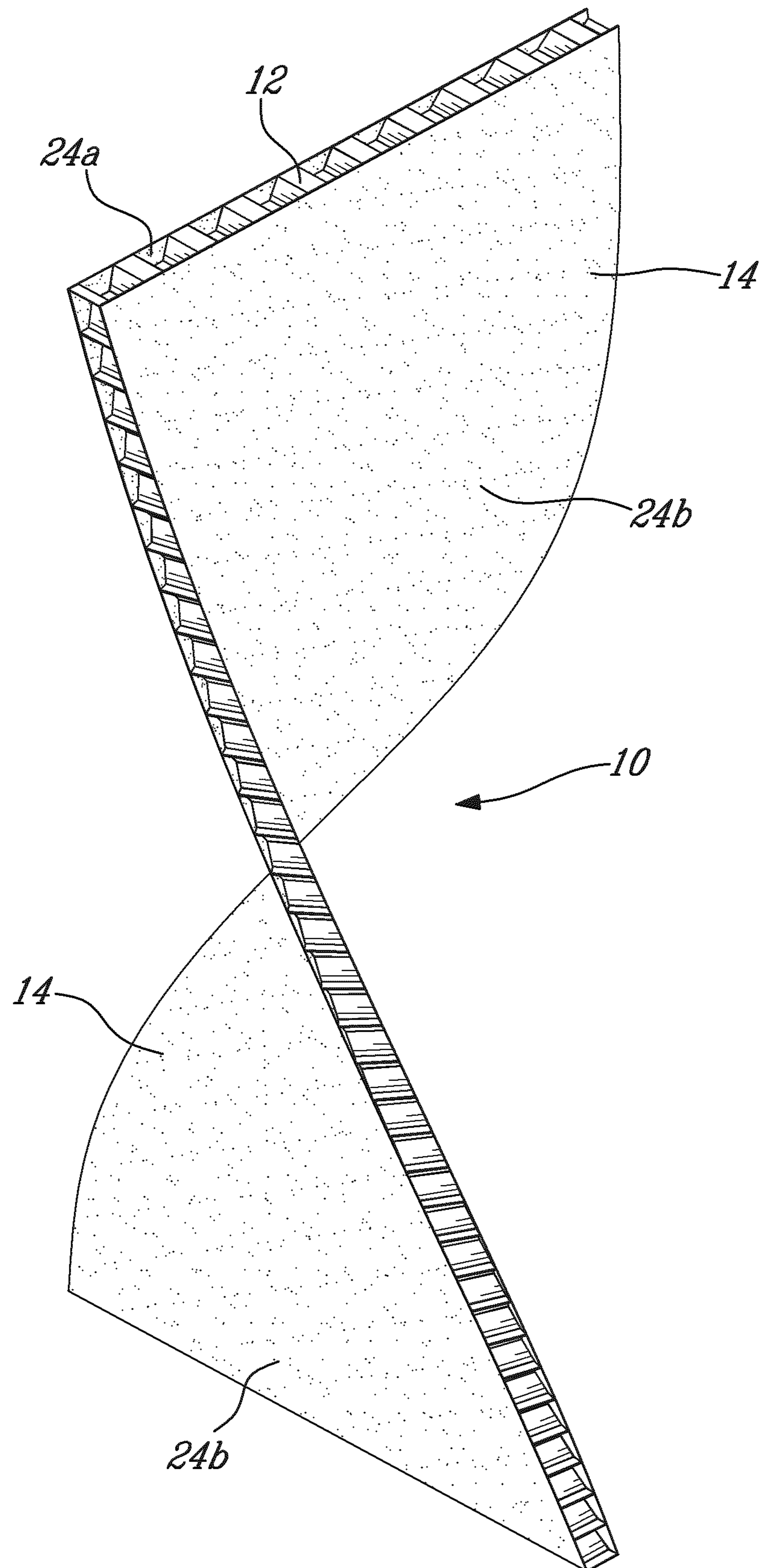
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Fig. 2

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Fig-3

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Fig-4

