



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.03.2021 Bulletin 2021/12

(51) Int Cl.:
D06N 7/00 (2006.01) **B32B 5/06 (2006.01)**
B32B 5/26 (2006.01) **D05C 17/02 (2006.01)**

(21) Application number: **19204778.5**

(22) Date of filing: **23.10.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **REYNOLDS, Charles Winston**
Calhoun, GA Georgia 30701 (US)
• **SETHNA, Michael Bejon**
Cohutta, GA Georgia 30710 (US)
• **CRAIG, Christopher Lee**
Calhoun, GA Georgia 30701 (US)

(30) Priority: **20.09.2019 US 201916577783**

(74) Representative: **Schacht, Benny Marcel Corneel**
Mohawk International Services, BVBA
Patent department
Ooigemstraat 3
8710 Wielsbeke (BE)

(71) Applicant: **Aladdin Manufacturing Corporation**
Calhoun, GA 30701 (US)

(54) **RECYCLABLE TUFTED CARPET PRODUCT**

(57) Recyclable tufted carpet products and methods of preparing the same are provided. In particular, the recyclable tufted carpet product includes a primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polyester nonwoven; a plurality of yarns tufted through the

primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and an adhesive that anchors the plurality of yarn loops to the second surface of the primary backing.

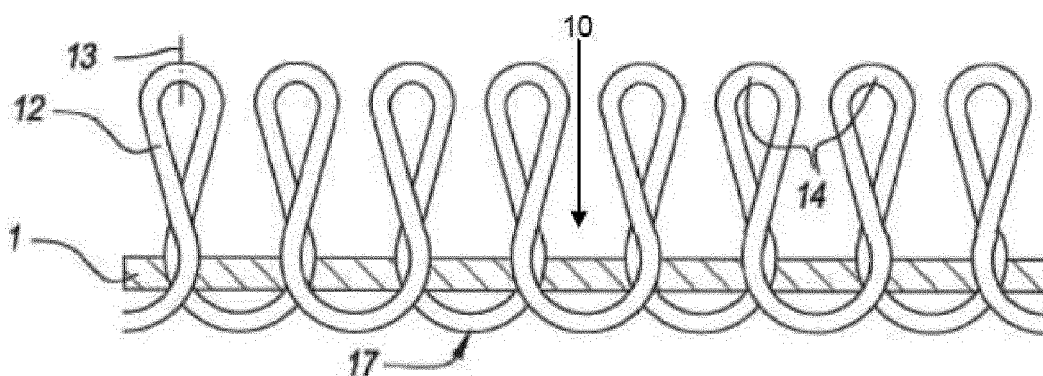


FIG. 1

Description

FIELD

[0001] The presently-disclosed invention relates generally to recyclable tufted carpet products and methods of making the same, and more particularly to recyclable tufted carpet products having a primary backing with a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength and methods of making the same.

BACKGROUND

[0002] Conventional tufted fabrics such as carpets and rugs are made up of various components and different types of material. Various components include a primary backing, secondary backing, latex adhesives and tuft material. It is common practice to produce fabrics such as carpets incorporating a primary backing of natural or synthetic plastic materials such as polypropylene in a woven fabric form. For example, broadloom carpets are normally produced by having a primary backing of woven slit film polypropylene into which there is inserted a plurality of tufts by a tufting machine. Tufts may be made from natural or synthetic fibers including wool, polyamides, polyester (e.g., polytrimethylene terephthalate), polypropylene, and acrylics. These tufts, forming the pile of the carpet, extend through the primary backing from one face to the other in the form of loops such that long loops on one side form the pile of the carpet and the short loops are located on the opposed side of the backing. Cut pile carpet is achieved by cutting the long loops on the face of the carpet. An adhesive coating, e.g., of latex, is then applied as a primary anchor coat to the side of the primary backing opposite the pile side in order to lock the tufts in the primary backing.

[0003] The necessity for an anchor coat such as latex results in a relatively heavy fabric which in some cases lacks optimum flexibility. The latex also has a water component that must be driven off during manufacture, which requires ovens that consume high amounts of energy. In addition, carpets formed with a latex backing require formation on a tenter frame to prevent the latex from shrinking during drying. In addition to the manufacturing inconvenience of using a tenter frame, the residual stress caused by the tenting process requires carpets made with a latex backing to be stretched when installed, which in turn requires additional labor and components such as tack strips to hold the stretched carpet in place.

[0004] Also, it is well-known in the industry that most carpet is disposed of in a landfill, taking up considerable space thereof. To eliminate the disposal of carpets in landfills requires the construction of carpets of recyclable materials in all parts of the carpet. One approach to recyclable carpet would be to disassemble the carpet and recycle the individual materials. Due to the plurality of materials and the latex adhesive used in this approach

to date, this has not been feasible.

[0005] Moreover, it is perceived that polyester nonwovens are unfit to serve as a primary backing due to poor tear resistance, tensile strength, and tuft bind strength during and after tufting.

[0006] Accordingly, there still exists a need for recyclable tufted carpet products made of recyclable materials without a latex adhesive and having a polyester nonwoven primary backing designed to eliminate the disadvantages noted above. Such materials are recyclable because the layers do not require mechanical or chemical separation to remove latex and because the entire tufted carpet product can be melted down due to the use of the same or similar materials.

BRIEF SUMMARY

[0007] One or more embodiments of the invention may address one or more of the aforementioned problems. Certain embodiments according to the invention provide fully recyclable tufted carpet products having polyester nonwoven primary backings with a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength after the fabric is tufted. In particular, according to a first aspect of the invention, a tufted carpet product is provided, the carper being recyclable. The tufted carpet product comprises a primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa/ 20 cm², the primary backing comprising a polymer (e.g., polyester) nonwoven; a plurality of polymer yarns tufted through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and an adhesive that anchors the plurality of yarn loops to the second surface of the primary backing.

[0008] According to some embodiments, the polymer of the nonwoven may be similar or identical to the polymer of the yarn. The polymer of the nonwoven and the polymer of the yarn may both be a polyester.

[0009] According to some embodiments, the primary backing may comprise an air permeability from about 1000 to about 4000 l/m²/sec.

[0010] According to some embodiments, the primary backing may comprise a thickness greater than 0.35 mm at 0.5 Pa / 25 cm². Unless otherwise mentioned, thicknesses are measured under a pressure applied, the pressure being 0.5 Pa over 25 cm².

[0011] According to some embodiments, the adhesive may comprise a polyester hot melt adhesive.

[0012] According to some embodiments, the adhesive may comprise a polyester nonwoven secondary backing.

[0013] According to some embodiments, the tufted yarn may comprise or even consist of polyester, such as virgin polyester, e.g. virgin PET, or recycled polyester, such as recycled PET, or any combination of such.

[0014] In a second aspect of the invention, a method of preparing a tufted carpet product is provided, the car-

pet being recyclable. The method comprises providing a primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer (e.g., polyester) nonwoven; tufting a polymer (e.g., polyester) yarn through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and anchoring the plurality of yarn loops to the second surface of the primary backing.

[0015] According to some embodiments, the polymer of the nonwoven may be similar or identical to the polymer of the yarn. The polymer of the nonwoven and the polymer of the yarn may both be a polyester.

[0016] According to some embodiments, the primary backing may comprise or have an air permeability from about 1000 to about 4000 l/m²/sec at 200 Pa / 20 cm². According to some embodiments, prior to the tufting step, the primary backing may comprise or have a thickness greater than 0.35 mm at 0.5 Pa / 25 cm².

[0017] According to some embodiments, the primary backing may comprise polyethylene terephthalate (PET) filaments and copolymer of polyethylene terephthalate (coPET) filaments. The primary backing may comprise 80-100 wt% PET and 0-20 wt% coPET. This wt% is based upon the total weight of the primary backing.

[0018] According to some embodiments, the primary backing may be at least one of hydroentangled, needled, calendered, and/or through air bonded prior to tufting.

[0019] According to some embodiments, the recyclable tufted carpet product may be free of latex.

[0020] According to some embodiments, anchoring the plurality of yarn loops to the second surface of the primary backing may make use of an adhesive by applying said adhesive to the second surface of the primary backing. Anchoring the plurality of yarn loops to the second surface of the primary backing may comprise applying a polyester hot melt adhesive to the plurality of yarn loops and the second surface of the primary backing.

[0021] According to some embodiments, anchoring the plurality of yarn loops to the second surface of the primary backing may comprise applying a nonwoven secondary backing to the plurality of yarn loops and the second surface of the primary backing. The nonwoven secondary backing may comprise PET and coPET. The nonwoven secondary backing may comprise greater than 50 wt% coPET with the remainder being PET.

[0022] The independent and dependent claims set out particular and preferred features of the invention. Features from the dependent claims may be combined with features of the independent or other dependent claims, and/or with features set out in the description above and/or hereinafter as appropriate. E.g. features of the first aspect of the invention may be combined with features of the second aspect of the invention and vice versa.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0023] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates a tufted primary backing in accordance with certain embodiments of the invention;

FIG. 2 illustrates application of an adhesive to a tufted primary backing in accordance with certain embodiments of the invention;

FIG. 3 illustrates a tufted carpet product in accordance with certain embodiments of the invention;

FIGs. 4 and 5 illustrate simplified schematic cross-sections of a nonwoven primary backing in accordance with certain embodiments of the invention;

FIGs. 6 and 7 illustrate simplified schematic cross-section of a nonwoven secondary backing in accordance with certain embodiments of the invention;

FIG. 8 illustrates the step of providing a primary backing in accordance with certain embodiments of the invention; and

FIGs. 9 and 10 are block diagrams of a method of preparing a recyclable tufted carpet product in accordance with certain embodiments of the invention.

DETAILED DESCRIPTION

[0024] The invention now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout. As used in the specification, and in the appended claims, the singular forms "a", "an", "the", include plural referents unless the context clearly dictates otherwise.

[0025] The invention includes, according to certain embodiments, tufted carpet products that are fully recyclable and utilize a polyester nonwoven primary backing having a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength after the fabric is tufted. In particular, embodiments of the invention are directed to recyclable tufted carpet products having a polymer (e.g., polyester) nonwoven primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa / 20 cm², a plurality of polymer yarns tufted through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing, and an adhesive that anchors the plurality of yarn loops to the second surface of the primary backing. As such, the recyclable tufted carpet product

includes a primary backing with an air permeability that advantageously provides improved tear strength, tensile strength, and tuft bind strength. In this regard, layers of the tufted carpet product all comprise a polyester and are joined together without a latex adhesive. These features make the tufted carpet product fully recyclable.

I. Definitions

[0026] The terms "polymer" or "polymeric", as used interchangeably herein, may comprise homopolymers, copolymers, such as, for example, block, graft, random, and alternating copolymers, terpolymers, etc., and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" or "polymeric" shall include all possible structural isomers; stereoisomers including, without limitation, geometric isomers, optical isomers or enantiomers; and/or any chiral molecular configuration of such polymer or polymeric material. These configurations include, but are not limited to, isotactic, syndiotactic, and atactic configurations of such polymer or polymeric material. The term "polymer" or "polymeric" shall also include polymers made from various catalyst systems including, without limitation, the Ziegler-Natta catalyst system and the metallocene/single-site catalyst system.

[0027] The term "air permeability", as used herein, may refer to the rate of airflow passing perpendicularly through a known area under a prescribed air pressure differential between the two surfaces of a material. In other words, permeability refers to how easily air, or water, flows through a material having a controlled size alignment of pores. Air permeability differs from porosity in that porosity is the amount of empty space in a solid and is indicative of how much water a material can hold. For the purposes of this disclosure, air permeability may be measured according to ISO 9073-15 and/or ASTM D737-96.

[0028] The terms "tear strength" and "tear resistance", as used herein, may refer to a measure of how well a material can withstand the effects of tearing. For example, tear strength or tear resistance may refer to a fabric's resistance to tearing once cut. For the purposes of this disclosure, tear strength/tear resistance may be measured according to ISO 9073-4 and/or NWSP 100.R1.

[0029] The term "nonwoven", as used herein, may comprise a web having a structure of individual fibers, filaments, and/or threads that are interlaid but not in an identifiable repeating manner as in a knitted or woven fabric. Nonwoven fabrics or webs, according to certain embodiments of the invention, may be formed by any process conventionally known in the art such as, for example, meltblowing processes, spunbonding processes, hydroentangling, air-laid, and bonded carded web processes.

[0030] The term "meltspun", as used herein, may comprise fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine,

usually circular or trilobal, die capillaries of a spinneret and solidifying the extruded filaments by cooling them as they emerge from the die capillaries.

[0031] The term "spunbond", as used herein, may comprise fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular or trilobal, capillaries of a spinneret with the diameter of the extruded filaments then being rapidly reduced. According to an embodiment of the invention, spunbond fibers are generally not tacky when they are deposited onto a collecting surface and may be generally continuous.

[0032] The term "meltblown", as used herein, may comprise fibers formed by extruding a molten thermoplastic material through a plurality of fine die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter, according to certain embodiments of the invention. According to an embodiment of the invention, the die capillaries may be circular. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly disbursed meltblown fibers. Meltblown fibers are microfibers which may be continuous or discontinuous and are generally tacky when deposited onto a collecting surface.

[0033] The term "bicomponent fibers", as used herein, may comprise fibers formed from at least two different polymers extruded from separate extruders but spun together to form one fiber. Bicomponent fibers are also sometimes referred to as conjugate fibers or multicomponent fibers. The polymers are arranged in a substantially constant position in distinct zones across the cross-section of the bicomponent fibers and extend continuously along the length of the bicomponent fibers. The configuration of such a bicomponent fiber may be, for example, a sheath/core arrangement wherein one polymer is surrounded by another, or may be a side-by-side arrangement, a homo-homo arrangement, a pie arrangement, or an "islands-in-the-sea" arrangement, each as is known in the art of multicomponent, including bicomponent, fibers. The "bicomponent fibers" may be thermoplastic fibers that comprise a core fiber made from one polymer that is encased within a thermoplastic sheath made from a different polymer or have a side-by-side arrangement of different thermoplastic fibers. The first polymer often melts at a different, typically lower, temperature than the second polymer. In the sheath/core arrangement, these bicomponent fibers provide thermal bonding due to melting of the sheath polymer, while retaining the desirable strength characteristics of the core polymer.

II. Recyclable Tufted Carpet Product

[0034] Certain embodiments according to the invention provide tufted carpet products that are fully recyclable.

ble and utilize a polyester nonwoven primary backing having a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength after the fabric is tufted. For example, certain embodiments of the invention provide tufted carpet products having a tear strength of greater than 100 N in MD and CD, tensile strength of greater than 220 N/50 mm in MD and CD, and tuft bind strength of greater than 6 lbs loop and greater than 3 lbs cut pile. In particular, embodiments of the invention are directed to recyclable tufted carpet products having a polymer nonwoven primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa / 20 cm², a plurality of polymer yarns tufted through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing, and an adhesive that anchors the plurality of yarn loops to the second surface of the primary backing. As such, the recyclable tufted carpet product includes a primary backing with an advantageous air permeability that provides improved tear strength, tensile strength, and tuft bind strength. In this regard, layers of the tufted carpet product all comprise a polyester and are joined together without a latex adhesive. These features make the tufted carpet product fully recyclable.

[0035] Turning now to FIG. 1, a tufted primary backing **1** is illustrated in accordance with certain embodiments of the invention. As shown in FIG. 1, the primary backing **1** includes a plurality of yarns **12** tufted through the primary backing **1** such that a plurality of loops **14** of yarn **12** are provided both at a first surface **10** of the primary backing **1** and a second surface **17** of the primary backing **1**. As indicated by line **13**, the plurality of loops **14** of yarn **12** may be cut to create piles **15**, shown in FIGs. 2 and 3. In some embodiments, yarns **12** may comprise a polyester. For example, in certain embodiments, yarns **12** may comprise polyethylene terephthalate (PET).

[0036] Primary backing **1** may comprise a polymer nonwoven. Yarns **12** similarly may comprise a polymer that may be the same as or similar to the polymer of primary backing **1**. For instance, primary backing **1** may comprise a polyester nonwoven. For example, in some embodiments, primary backing **1** may comprise PET and a copolymer of PET (coPET). Indeed, in some embodiments and as shown in FIG. 4, for instance, primary backing **1** may comprise a plurality of PET filaments **32** and a plurality of coPET filaments **34** randomly interspersed among the plurality of PET filaments **32**. This random interspersions can be achieved via, for example, a spunbonding or meltblowing process. In such embodiments, for example, PET filaments **32** may have a larger filament titer than coPET filaments **34**. For instance, in some embodiments PET filaments **32** may be about 4-12 denier, while coPET filaments **34** may be about 2-5 denier. In further embodiments, for example, PET filaments **32** may be about 6 denier, while coPET filaments **34** may be about 2-3 denier. Although FIG. 4 illustrates the coPET filaments **34** as being randomly interspersed with the

PET filaments **32**, the coPET filaments **34** may also be distributed evenly and/or according to a pattern as understood by one of ordinary skill in the art. In addition, FIG. 4 (and FIGs. 5-7 as discussed below) is a schematic view for ease of illustration of the different filament types, and in practice the filaments would be generally more densely-packed and randomly-oriented. Further, after the coPET filaments are at least partially melted, a substantial portion of primary backing **1** may remain in the form of the PET filaments **32**.

[0037] Moreover, although primary backing **1** has been described thus far as having separate PET filaments and coPET filaments, primary backing **1** may, in other embodiments, comprise all or a portion of bicomponent fibers having a core formed at least in part by PET and a low melt sheath formed at least in part by coPET. FIG. 5, for example, illustrates a cross-section of primary backing **1** in accordance with certain embodiments of the invention. As shown in FIG. 5, coPET may be disposed at or along, at least in part, the sheath **44** (i.e. the outside surface) of the bicomponent fiber **40**, and PET may be disposed in the core **42** (i.e. inner portion) of the bicomponent fiber **40**. During heating, coPET sheath **44** may melt while the PET in the core substantially maintains its fiber shape and structural integrity. As a person of ordinary skill in the art would comprehend having the benefit of this disclosure, both the amount of coPET in the fiber of primary backing **1** and the extent of energy (e.g., heat) supplied to primary backing **1** will be determinative of the extent of melting in primary backing **1** relative to other layers heated in the same manner but having perhaps a different amount of coPET in the fiber and/or the extent of energy (e.g., heat) supplied. In addition, although all of the fibers illustrated in Fig. 5 are shown as having a bicomponent form, embodiments of the invention also include primary backings where only a portion of the fibers are bicomponent, and the remaining fibers are of another type, such as coPET filaments **34** and/or PET filaments **32**. Regardless of whether individual filaments or bicomponent fibers are used, in some embodiments, for example, primary backing **1** may include approximately 0-20 wt% coPET and 80-100 wt% PET. In further embodiments, for instance, primary backing **1** may include approximately 15-20 wt% coPET and 80-85 wt% PET.

[0038] As noted above, primary backing **1** may be a polyester nonwoven. According to certain embodiments of the invention, primary backing **1** may comprise a spunbond, meltblown, or meltspun fabric. In further embodiments, the primary backing **1** may comprise multiple layers having any combination of spunbond, meltblown, and meltspun fabric bonded together as understood by a person of ordinary skill in the art. In certain embodiments, for example, primary backing **1** may comprise a weight of about 2.4-4.4 oz/yd². In further embodiments, for instance, primary backing **1** may comprise a weight of about 3.7 oz/yd².

[0039] Polyester nonwovens have, to date, been unable to serve as primary backing due to poor tear resist-

ance, tensile strength, and tuft bind strength. Primary backing **1**, however, has a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength that allows it to operate as a strong primary backing. Indeed, according to certain embodiments, primary backing **1** has an air permeability after the fabric is formed but before it is tufted, as measured according to ISO 9073-15 and/or ASTM D737-96, greater than 100 1/m²/sec at 200 Pa / 20 cm². In further embodiments, for instance, primary backing **1** has an air permeability greater than 1000 1/m²/sec at 200 Pa / 20 cm². In some embodiments, for example, primary backing **1** has an air permeability from about 1000 to about 4000 1/m²/sec at 200 Pa / 20 cm². In this way, and without being bound by theory, a primary backing with such air permeability may improve tear resistance, tensile strength, and tuft bind strength, as air permeability is indicative of fiber mobility. Indeed, more mobile fibers during tufting means that the fibers can be more easily moved out of the way by the tufting needles rather than broken by the needles. This in turn means that there are fewer sites for tear propagation and/or more sites where overlapping filaments can form bonded nodes with each other, which in turn improves tear strength. In further embodiments, for instance, lubricants may be used to further improve fiber mobility.

[0040] Moreover, according to certain embodiments, primary backing **1** may have a thickness, as measured according to ISO 9073-2 and/or ASTM D5729-97, greater than 0.35 mm at 0.5 Pa / 25 cm². For example, in some embodiments, primary backing **1** may have a thickness from about 0.5 to about 1.5 mm at 0.5 Pa / 25 cm². Moreover, in certain embodiments, for instance, primary backing **1** may have a basis weight, as measured according to ISO 9073-1 and/or ASTM D6242-98, of about 80-140 gsm. In further embodiments, for example, primary backing **1** may have a basis weight of 100-120 gsm. Such thickness and basis weight may also improve tear resistance, tensile strength, and tuft bind strength. However, while going beyond this thickness and basis weight may further improve tear resistance, tensile strength, and tuft bind strength, the primary backing may become uneconomical as too much raw material is required to make a saleable product.

[0041] Tear resistance, tensile strength, and tuft bind strength may be further improved by processing primary backing **1** prior to tufting. For example, in some embodiments, primary backing **1** may be hydroentangled or needled prior to tufting. In such embodiments, for example, primary backing **1** may be hydroentangled or needled in two directions, once from each side of the fabric. In other embodiments, for instance, primary backing **1** may be calendered prior to tufting to at least partially melt the coPET, as shown, for example, FIG. 8, which is described in more detail below. Such calendering may occur with a calender gap or opening of 0.1 mm. In further embodiments, for example, primary backing **1** may be subjected to through air bonding, i.e. by sucking and/or blowing hot

air (e.g., above the coPET melting point) through the primary backing to at least partially melt the coPET prior to tufting. Regardless of the exact processing steps used, primary backing **1** provides most, if not all, of the tear strength to the final recyclable tufted carpet product.

[0042] Additionally, recyclable tufted carpet product **16** may include an adhesive **11** that anchors the plurality of loops **14** of yarn **12** to the second surface **17** of the primary backing **1**. For example, FIG. 2 illustrates the application of adhesive **11** to tufted primary backing **1** to form recyclable tufted carpet product **16**, as illustrated in FIG. 3. In applying adhesive **11**, however, the loops **14** of yarn **12** do not need to be further fused to the primary backing **1** such as with relative movement between a heated roll or knife and the loops of the tufts as is known in the prior art. In some embodiments, for example, adhesive **11** may be a glue. For instance, in further embodiments, adhesive **11** may be a liquid glue comprising, for example, coPET. Indeed, in some embodiments, adhesive **11** may be a hot melt adhesive, e.g., molten coPET.

[0043] In other embodiments, however, such as those illustrated in FIGs. 6 and 7, adhesive **11** may be a secondary backing. In such embodiments, for example, adhesive **11** (i.e. the secondary backing) may comprise PET and a copolymer of PET (coPET). Indeed, in some embodiments and as shown in FIG. 6, for instance, adhesive **11** (i.e. the secondary backing) may comprise a plurality of PET filaments **52** and a plurality of coPET filaments **54** randomly interspersed among the plurality of PET filaments **52**. This random interspersions can be achieved via, for example, a spunbonding or meltblowing process. Although FIG. 6 illustrates the coPET filaments **54** as being randomly interspersed with the PET filaments **52**, the coPET filaments **54** may also be distributed evenly and/or according to a pattern as understood by one of ordinary skill in the art. In this regard, after the coPET filaments are at least partially melted, a substantial portion of adhesive **11** (i.e. the secondary backing) may remain in the form of the PET filaments **52**.

[0044] Moreover, although adhesive **11** (i.e. the secondary backing) has been described thus far as having separate PET filaments and coPET filaments, adhesive **11** (i.e. the secondary backing) may, in other embodiments, comprise all or a portion of bicomponent fibers having a core formed at least in part by PET and a low melt sheath formed at least in part by coPET. FIG. 7, for example, illustrates a schematic view of adhesive **11** (i.e. the secondary backing) in accordance with certain embodiments of the invention. As shown in FIG. 7, the coPET may be disposed at or along, at least in part, the sheath **64** (i.e. the outside surface) of the bicomponent fiber **60**, and PET may be disposed in the core **62** (i.e. the inner portion) of the bicomponent fiber **60**. During heating, coPET sheath **64** may melt while the PET in the core substantially maintains its fiber shape and structural integrity. As a person of ordinary skill in the art would comprehend having the benefit of this disclosure, both the amount of coPET in the fiber of adhesive **11** (i.e. the

secondary backing) and the extent of energy (e.g., heat) supplied to adhesive **11** (i.e. the secondary backing) will be determinative of the extent of melting in adhesive **11** (i.e. the secondary backing) relative to other layers heated in the same manner but having perhaps a different amount of coPET in the fiber and/or the extent of energy (e.g., heat) supplied. In addition, although all of the fibers illustrated in Fig. 7 are shown as having a bicomponent form, embodiments of the invention also include secondary backings where only a portion of the fibers are bicomponent, and the remaining fibers are of another type, such as coPET filaments **54** and/or PET filaments **52**. Regardless of whether individual filaments or bicomponent fibers are used, in some embodiments, for example, adhesive **11** (i.e. the secondary backing) may include greater than 50 wt% coPET, with the remainder being PET. In further embodiments, for instance, adhesive **11** (i.e. the secondary backing) may include approximately 80 wt% coPET and 20 wt% PET. Moreover, in some embodiments, the secondary backing may comprise a basis weight, as measured according to ISO 9073-1 and/or ASTM D6242-98, of about 100-150 gsm. For example, in certain embodiments, the secondary backing may comprise a basis weight of approximately 135 gsm. As above with the primary backing, going beyond this thickness and basis weight may further improve tear resistance, tensile strength, and tuft bind strength, but the adhesive (secondary backing) may become uneconomical as too much raw material is required to make a saleable product.

[0045] In this regard, the resulting tufted carpet product is free of latex and is fully recyclable. Moreover, the recyclable tufted carpet product utilizes a polyester nonwoven primary backing having a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength.

III. Method of Preparing a Recyclable Tufted Carpet Product

[0046] In another aspect, certain embodiments according to the invention provide methods of preparing a recyclable tufted carpet product. In accordance with certain embodiments, the method comprises providing a primary backing having an air permeability greater than 100 1/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer nonwoven; tufting a polymer yarn through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and anchoring the plurality of yarn loops to the second surface of the primary backing.

[0047] FIG. 9, for example, is a block diagram of a method **90** of preparing a recyclable tufted carpet product in accordance with certain embodiments of the invention. As shown in FIG. 9, the method **90** includes the following steps:

Step **91**: Providing a primary backing having an air permeability greater than 100 1/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer nonwoven;

Step **92**: Tufting a polymer yarn through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and

Step **93**: Anchoring the plurality of yarn loops to the second surface of the primary backing.

[0048] Step **91** is shown in more detail in FIG. 8. As shown in FIG. 8, providing a primary backing **1** is shown in step **S1**. Primary backing **1** is a non-woven layer comprising continuous filaments **2**, provided by spunbonding technology. In this case the filaments **2** are bicomponent filaments. Two extruders **3**, each for one of the components of the filaments, are fed with respective polymer chips through respective inlets **4**. Filaments **2** are formed by extrusion and drawing through a spinning die **5** and aspirator (not shown). The filaments **2** are laid on a moving screen or belt **6** to form a web. The web may optionally be subjected to a bonding step **S2** e.g. by calender bonding. In calender bonding the web of loose filaments **2** is passed through the nip **7** of a set of rollers **8**, of which preferably at least one is heated. One or more of the rollers **8** may optionally be patterned.

[0049] As discussed previously herein, however, primary backing **1** may be processed prior to tufting by one or more of calendering, hydroentangling, needling, or through air bonding. FIG. 10 is a block diagram of a method **100** of preparing a recyclable tufted carpet product in accordance with certain embodiments of the invention, including options for the processing steps and options for the anchoring step. The below steps are merely options and, as such, their listed order is not limiting and several listed steps are interchangeable. For example, needling and hydroentangling are interchangeable, as are calendering and through air bonding. As shown in FIG. 10, the method **100** includes the following steps:

Step **101**: Needling the primary backing; and/or

Step **102**: Hydroentangling the primary backing; and/or

Step **103**: Calendering the primary backing; and/or
Step **104**: Through air bonding the primary backing; followed by

Step **105**: Tufting a polymer yarn through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and

Step **106**: Applying a polyester hot melt adhesive to the plurality of yarn loops and the second surface of the primary backing; and/or

Step **107**: Applying a nonwoven secondary backing to the plurality of yarn loops and the second surface

of the primary backing.

[0050] According to certain embodiments, for example, the recyclable tufted carpet product may be heated following Step **106** and/or Step **107** to at least partially melt the coPET in the secondary backing.

[0051] Moreover, according to certain embodiments of the invention, for example, tufting the plurality of yarns into the primary backing may comprise tufting with a tufting machine as understood by a person having ordinary skill in the art.

[0052] In this regard, the method provides a tufted carpet product that is fully recyclable and that utilizes a polyester nonwoven primary backing having a minimum air permeability that provides improved tear resistance, tensile strength, and tuft bind strength.

Exemplary Embodiments

[0053] Certain embodiments according to the invention provide fully recyclable tufted carpet products having polyester nonwoven primary backings with improved tear resistance and air permeability. In particular, according to a first aspect of the invention, a recyclable tufted carpet product is provided. The recyclable tufted carpet product comprises a primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer nonwoven; a plurality of polymer yarns tufted through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and an adhesive that anchors the plurality of yarn loops to the second surface of the primary backing.

[0054] According to certain embodiments, for example, the polymer of the nonwoven is similar or identical to the polymer of the yarn. In further embodiments, for instance, the polymer of the nonwoven and the polymer of the yarn are both a polyester.

[0055] According to certain embodiments, for example, the primary backing comprises an air permeability from about 1000 to about 4000 l/m²/sec. In further embodiments, for instance, the primary backing comprises a thickness greater than 0.35 mm at 0.5 Pa / 25 cm².

[0056] According to certain embodiments, for example, the adhesive comprises a polyester hot melt adhesive. In other embodiments, for instance, the adhesive comprises a polyester nonwoven secondary backing.

[0057] In a second aspect of the invention, a method of preparing a recyclable tufted carpet product is provided. The method of preparing a recyclable tufted carpet product comprises providing a primary backing having an air permeability greater than 1000 l/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer nonwoven; tufting a polymer yarn through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and anchor-

ing the plurality of yarn loops to the second surface of the primary backing.

[0058] According to certain embodiments, for example, the polymer of the nonwoven is similar or identical to the polymer of the yarn. In further embodiments, for instance, the polymer of the nonwoven and the polymer of the yarn are both a polyester.

[0059] According to certain embodiments, for example, the primary backing comprises an air permeability from about 1000 to about 4000 l/m²/sec. In some embodiments, for instance, prior to the tufting step the primary backing comprises a thickness greater than 0.35 mm at 0.5 Pa / 25 cm². In further embodiments, for example, the primary backing comprises polyethylene terephthalate (PET) filaments and copolymer of polyethylene terephthalate (coPET) filaments. In certain embodiments, for instance, the primary backing comprises 80-85 wt% PET and 15-20 wt% coPET.

[0060] According to certain embodiments, for instance, the primary backing is at least one of hydroentangled, needled, calendered, and/or through air bonded prior to tufting.

[0061] According to certain embodiments, for example, the recyclable tufted carpet product is free of latex.

[0062] According to certain embodiments, for example, anchoring the plurality of yarn loops to the second surface of the primary backing comprises applying a polyester hot melt adhesive to the plurality of yarn loops and the second surface of the primary backing. In some embodiments, for instance, the polyester hot melt adhesive comprises coPET. In other embodiments, for example, anchoring the plurality of yarn loops to the second surface of the primary backing comprises applying a nonwoven secondary backing to the plurality of yarn loops and the second surface of the primary backing. In certain embodiments, for instance, the nonwoven secondary backing comprises PET and coPET. In further embodiments, for example, the secondary backing comprises greater than 50 wt% coPET with the remainder being PET.

[0063] Modifications of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. A method of preparing a recyclable tufted carpet product, the method comprising:

providing a primary backing having an air per-

- meability greater than 100 l/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer nonwoven;
tufting a polymer yarn through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and
anchoring the plurality of yarn loops to the second surface of the primary backing.
2. The method according to claim 1, wherein the polymer of the nonwoven is similar or identical to the polymer of the yarn.
 3. The method according to any one of the claims 1 to 2, wherein the polymer of the nonwoven and the polymer of the yarn are both a polyester.
 4. The method according to any one of the claims 1 to 3, wherein the primary backing comprises an air permeability from about 1000 to about 4000 l/m²/sec.
 5. The method according to any one of the claims 1 to 4, wherein prior to the tufting step the primary backing comprises a thickness greater than 0.35 mm at 0.5 Pa / 25 cm².
 6. The method according to any one of the claims 1 to 5, wherein the primary backing comprises polyethylene terephthalate (PET) filaments and copolymer of polyethylene terephthalate (coPET) filaments.
 7. The method according to claim 6, wherein the primary backing comprises 80-100 wt% PET and 0-20 wt% coPET.
 8. The method according to any one of the claims 1 to 7, wherein the primary backing is at least one of hydroentangled, needled, calendered, and/or through air bonded prior to tufting.
 9. The method according to any one of the claims 1 to 8, wherein anchoring the plurality of yarn loops to the second surface of the primary backing comprises applying a polyester hot melt adhesive to the plurality of yarn loops and the second surface of the primary backing.
 10. The method according to any one of the claims 1 to 9, wherein anchoring the plurality of yarn loops to the second surface of the primary backing comprises applying a nonwoven secondary backing to the plurality of yarn loops and the second surface of the primary backing.
 11. A tufted carpet product comprising:
 - a primary backing having an air permeability greater than 100 l/m²/sec at 200 Pa / 20 cm², the primary backing comprising a polymer nonwoven;
 - a plurality of polymer yarns tufted through the primary backing such that a pile is provided at a first surface of the primary backing and a plurality of yarn loops are provided at a second surface of the primary backing; and
 - an adhesive that anchors the plurality of yarn loops to the second surface of the primary backing.
 12. The tufted carpet product according to claim 11, wherein the polymer of the nonwoven is similar or identical to the polymer of the yarn.
 13. The tufted carpet product according to any one of the claims 11 to 12, wherein the polymer of the nonwoven and the polymer of the yarn are both a polyester.
 14. The tufted carpet product according to any one of the claims 11 to 13, wherein the primary backing comprises an air permeability from about 1000 to about 4000 l/m²/sec.
 15. The tufted carpet product according to any one of the claims 11 to 14, wherein the primary backing comprises a thickness greater than 0.35 mm at 0.5 Pa / 25 cm².

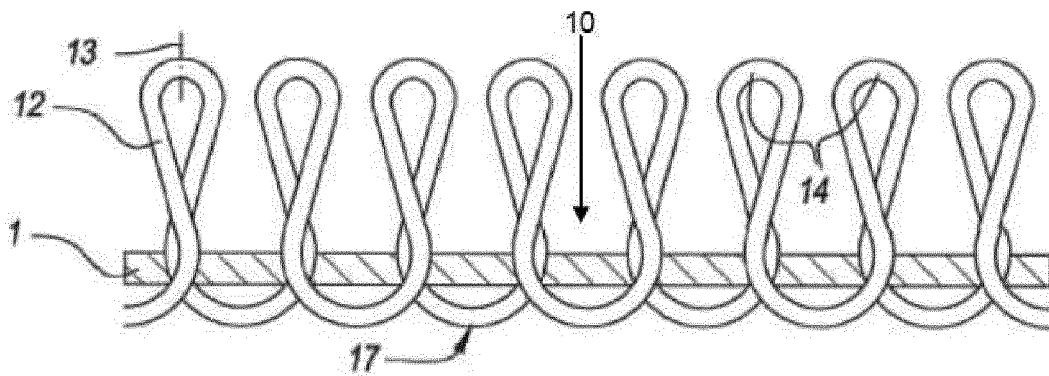


FIG. 1

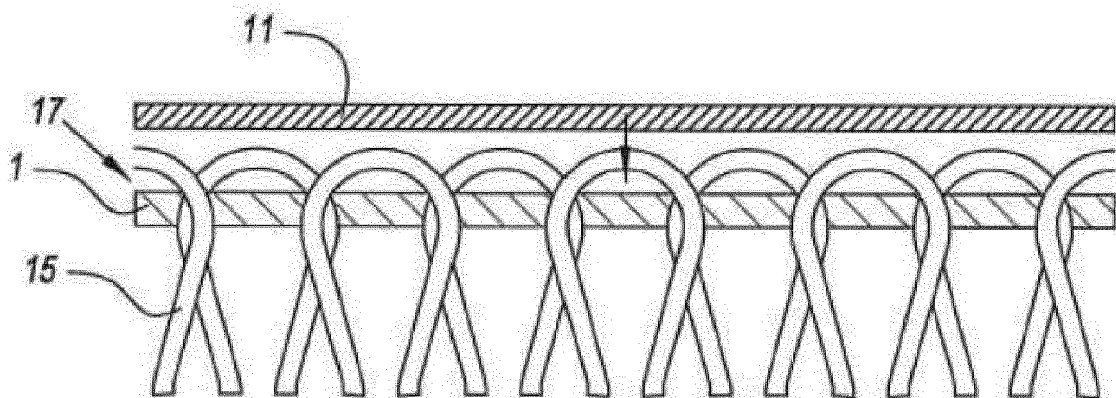


FIG. 2

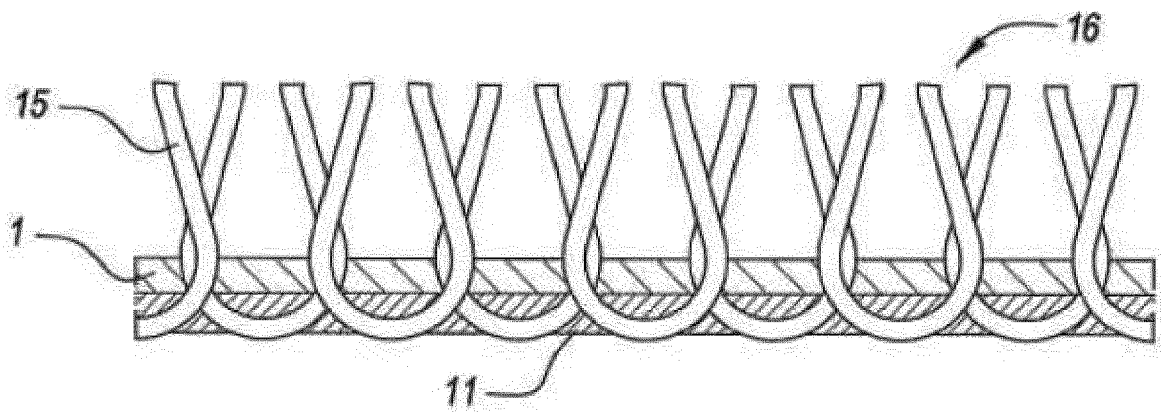


FIG. 3

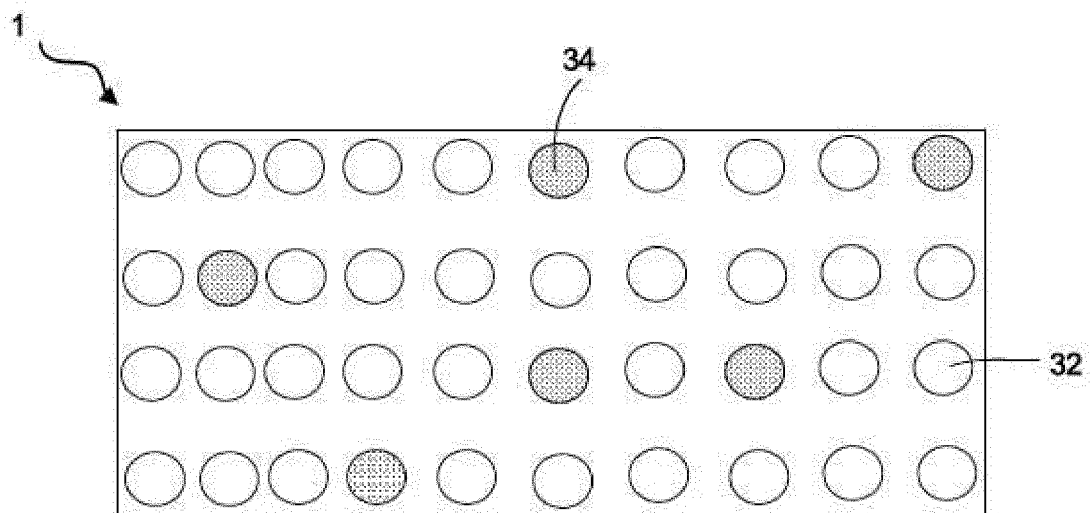


FIG. 4

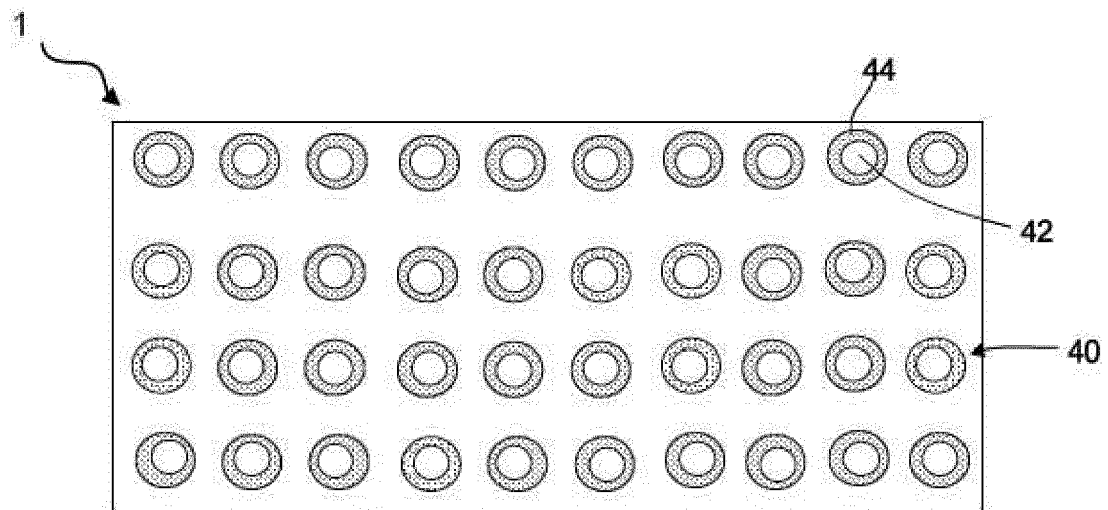


FIG. 5

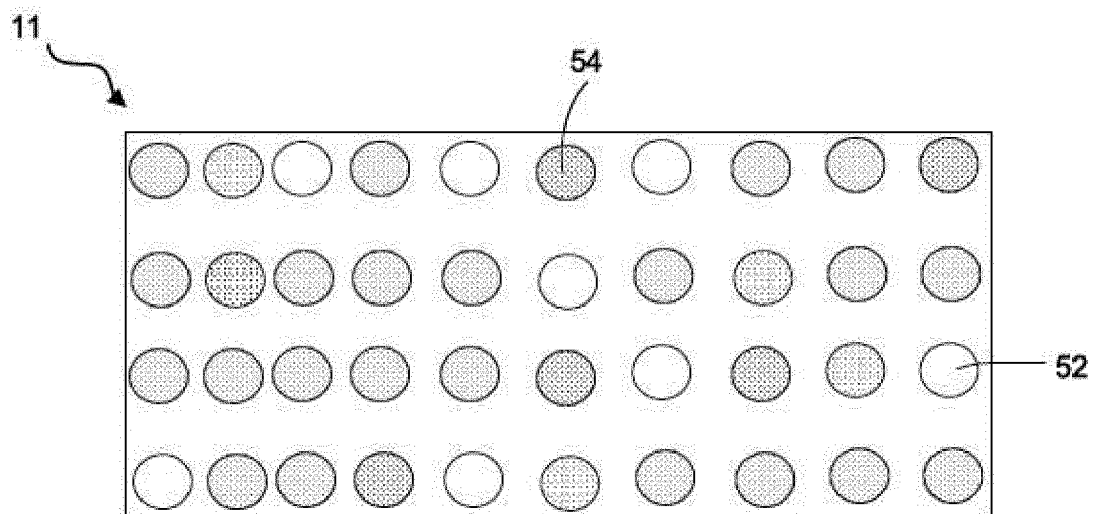


FIG. 6

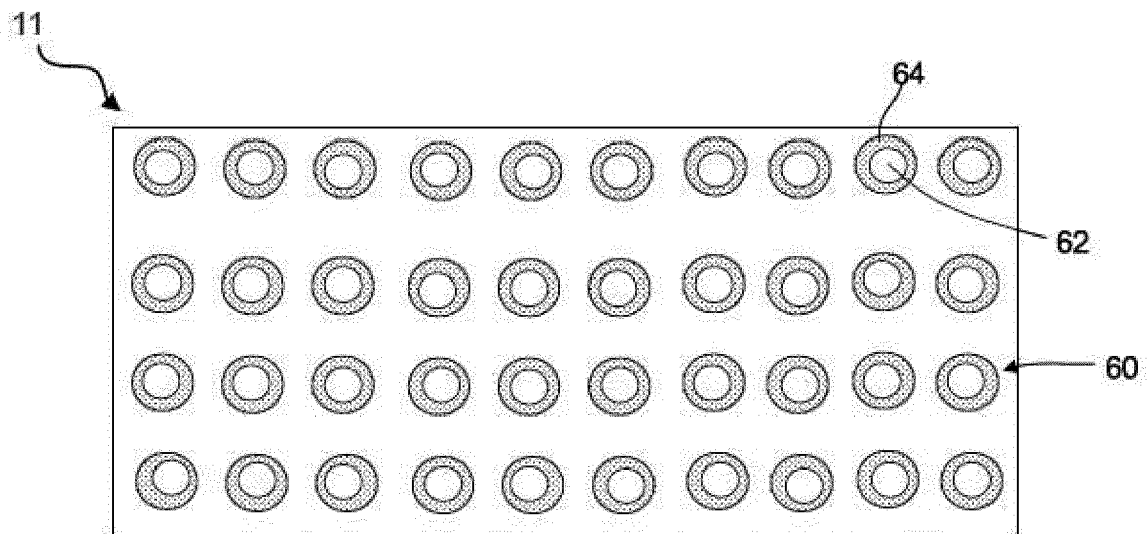


FIG. 7

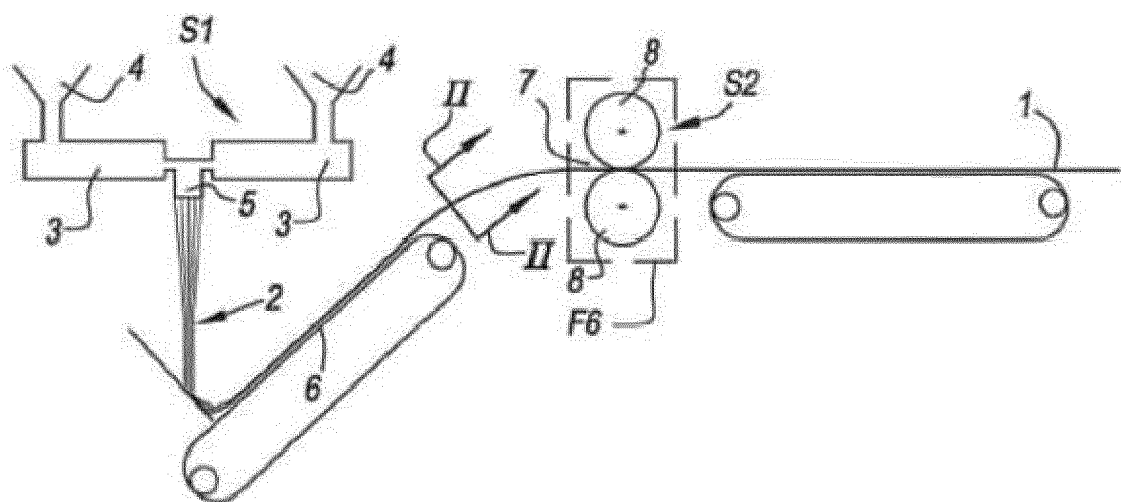


FIG. 8

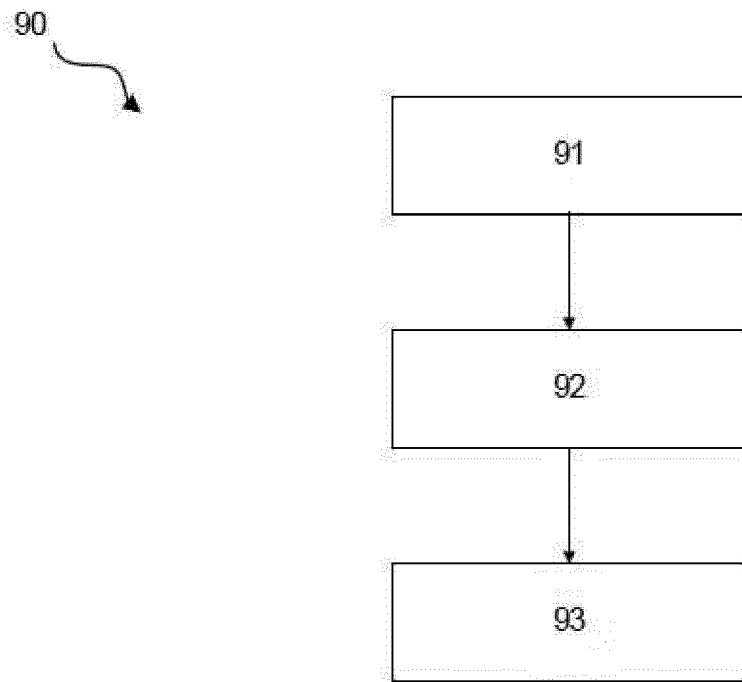


FIG. 9

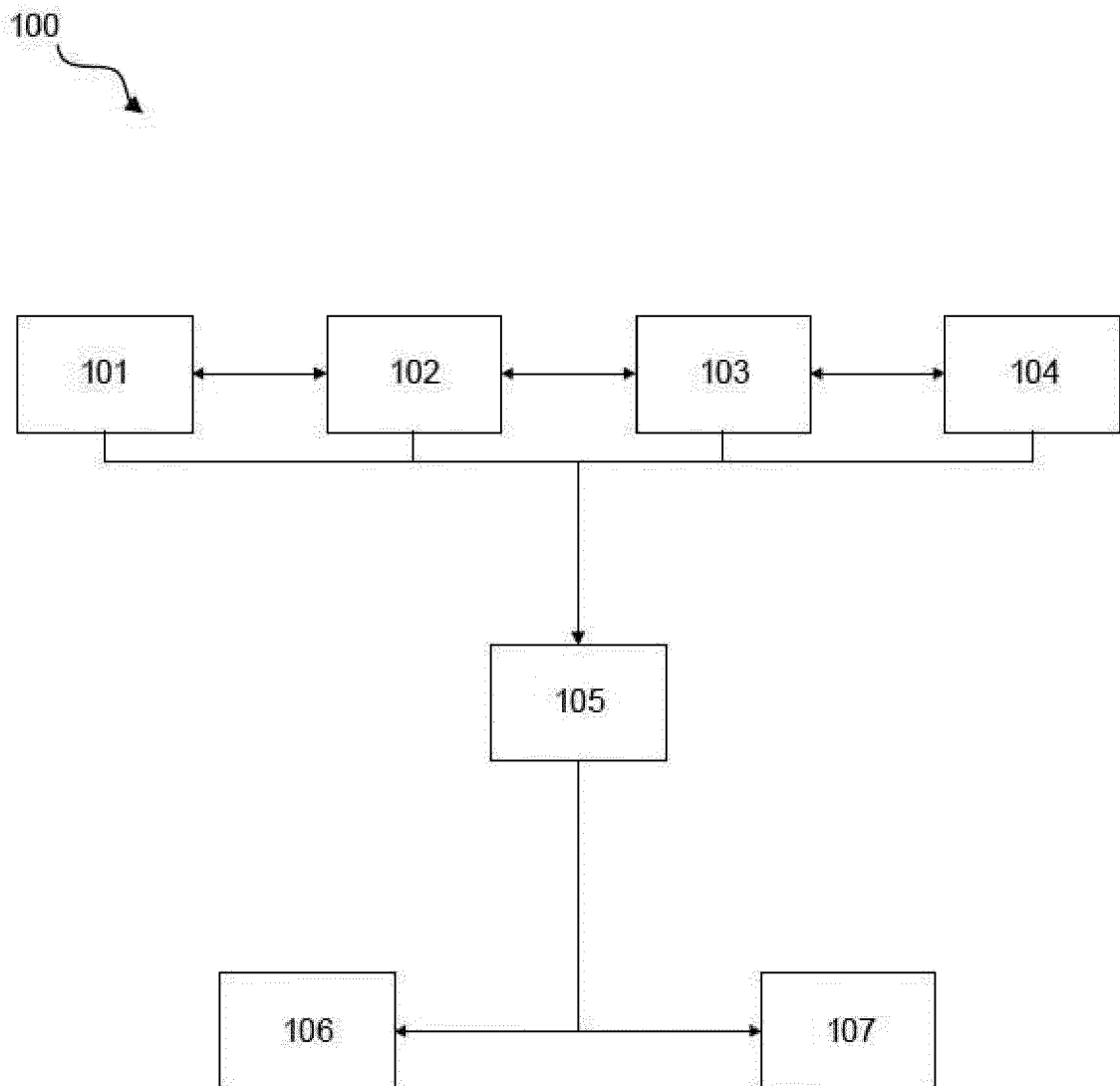


FIG. 10



EUROPEAN SEARCH REPORT

Application Number
EP 19 20 4778

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 2019 0058253 A (KOLON GLOTECH INC [KR]) 29 May 2019 (2019-05-29)	1-5,9-15	INV. D06N7/00 B32B5/06 B32B5/26 D05C17/02
Y	* paragraphs [0007], [0025], [0032], [0036] - [0049], [0060], [0062] - [0065], [0085] - [0086], [0097]; figures 1,10; examples 1-4 *	6-9	
Y	US 5 532 035 A (CORBIN JAMES A [US] ET AL) 2 July 1996 (1996-07-02) * column 1, lines 5-14; example 1 * * column 2, lines 23-40 * * column 3, line 30 - column 4, line 6 *	6-8	
Y	US 2014/272262 A1 (WILLIAMS DALE R [US] ET AL) 18 September 2014 (2014-09-18) * paragraph [0002]; examples 1-21 *	8,9	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			D06N B32B D05C
Place of search		Date of completion of the search	Examiner
The Hague		8 April 2020	Menard, Claire
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 20 4778

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-04-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20190058253 A	29-05-2019	NONE	
US 5532035 A	02-07-1996	US 5532035 A	02-07-1996
		US 5630896 A	20-05-1997
		ZA 9303072 B	30-10-1994
US 2014272262 A1	18-09-2014	AU 2014249099 A1	01-10-2015
		CN 105229223 A	06-01-2016
		CN 110144739 A	20-08-2019
		EP 2971329 A2	20-01-2016
		US 2014272262 A1	18-09-2014
		US 2016136844 A1	19-05-2016
		US 2019389094 A1	26-12-2019
		WO 2014164672 A2	09-10-2014