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(54) **FACE MASK**

(57) A face mask comprising: a mask body; and a fastening element adapted to be placed over both ears, or the head, of a wearer to fix the mask body onto a portion of a face of said wearer such to cover at least nose and mouth of said wearer when said mask is worn; wherein said mask body comprises: an outer layer; and a filtration layer, wherein the filtration layer is positioned

on a body-facing surface of said outer layer such that when worn said filtration layer is closer to said nose and mouth compared to said outer layer, wherein said filtration layer is a nonwoven laminate comprising at least one meltblown layer and at least one spunbond layer, and wherein said mask body comprises at least two meltblown nonwoven layers.

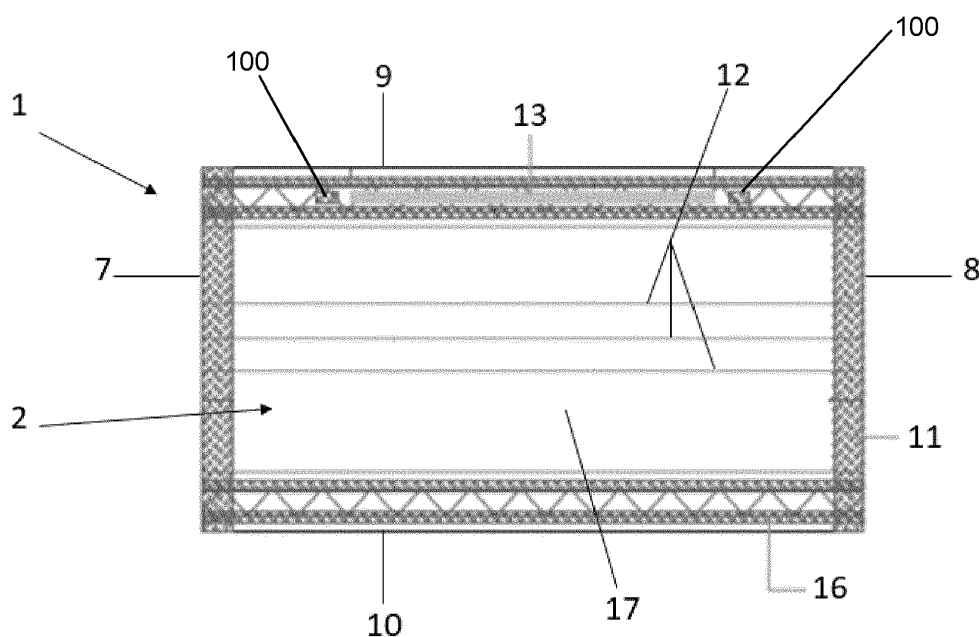


FIG. 1A

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Description

TECHNICAL FIELD

[0001] The disclosure relates to facial masks, and in particular relates to masks with excellent Bacterial Filtration Efficiency (BFE) and low breathing resistance.

BACKGROUND

[0002] Generally, masks are designed so as to cover the nose and/or the mouth for the purpose of preventing bacteria, viruses and the like from entering, and preventing penetration of blood.

[0003] In general, such masks usually have a 3 layer configuration including an outer layer, a filter layer, and an inner layer. The main purpose of the outer layer is to protect the filter layer, however it may for example be colored to make it fashionable, and a spunbond nonwoven fabric such as polypropylene is generally employed for the outer layer. The filter layer is generally considered the most important material forming part of the mask, and functions to filter out bacteria, viruses, pollen and the like. The filter layer is accordingly generally designed by employing fine diameter fibers such that foreign objects do not readily pass through, whilst air passes through easily. The inner layer is positioned on the side of the mouth of the wearer, and is a portion that makes direct contact with the skin of the wearer. The inner layer is accordingly designed so as not to cause skin irritation through contact. Generally, materials such as thermal bonded nonwoven fabric, mixed material papers made from a mixture of pulp and polyester fibers, and rayon papers are employed for the inner layer.

[0004] An exemplary mask is described in US4,802,473 wherein a face mask is disclosed that includes a layer of Meltblown Polypropylene fabric having pleats formed therein; ear loops formed from lycra spandex are attached to the corners of the layer. Application of heat along seams attach the ear loops thereto in addition to securing the ends of the pleats. In this manner, internal fibers of the layer (12) are restrained from entering the surrounding environment.

[0005] Further attempts have been made to improve effectiveness of masks by limiting air escape from nose/eye upper region of the mask and sides (when worn by a subject), such as exemplified in WO01/82727 A2. What is described is an improved multi-layer face mask that has at least one adhesive strip applied between the inner face cover layer and the intermediate filter layer. The adhesive strip is defined so as to extend across the filter body and is bounded on each longitudinal side by longitudinally extending regions that are free of adhesive. The adhesive strip may be disposed along a pleat formed in the face mask body. For example, the adhesive strip may have a width so as to extend between parallel fold lines of a pleat.

[0006] With the global pandemic of the covid-19 virus

that has exponentially increased the need to introduce surgical facemasks across multiple subjects in the world population to control the contagious effects of the virus, a need has arisen to provide effective face masks that not only provide excellent Bacterial Filtration Efficiency (BFE) and low breathing resistance but also that are cheaper and affordable for wide-scale global usage, and preferably limit environment impacts upon disposal.

10 SUMMARY

[0007] In a first aspect, the disclosure relates to a face mask comprising: a mask body; and a fastening element adapted to be placed over both ears, or the head, of a wearer to fix the mask body onto a portion of a face of said wearer such to cover at least nose and mouth of said wearer when said mask is worn; wherein said mask body comprises: an outer layer; and a filtration layer, wherein the filtration layer is positioned on a body-facing surface of said outer layer such that when worn said filtration layer is closer to said nose and mouth compared to said outer layer, wherein said filtration layer is a nonwoven laminate comprising at least one meltblown layer and at least one spunbond layer, and wherein said mask body comprises at least two meltblown nonwoven layers.

[0008] In a further aspect, the disclosure relates to a face mask comprising: a mask body; and a fastening element adapted to be placed over both ears, or the head, of a wearer to fix the mask body onto a portion of a face of said wearer such to cover at least nose and mouth of said wearer when said mask is worn; wherein said mask body comprises: an outer layer; and a filtration layer, wherein the filtration layer is positioned on a body-facing surface of said outer layer such that when worn said filtration layer is closer to said nose and mouth compared to said outer layer, and wherein the fastening element comprises at least one, preferably only one, crossing element at a position distal from the mask body, said position being proximal to an occiput of a wearer when the mask is worn, preferably wherein the crossing element is substantially Y-shaped or X-shaped. Preferably the crossing element forms a unitary structure.

BRIEF DESCRIPTION OF THE FIGURES

[0009]

Fig. 1 illustrates a mask according to an embodiment of the disclosure, with **Fig.1A** being a planar view showing the mask in laid out flat state, **Fig.1B** is a schematic of a side cross-sectional view taken along a transversal edge of Fig.1A, and **Fig. 1C** is a schematic of a bottom cross-sectional view taken along a longitudinal edge of Fig.1A.

Fig. 2A-C illustrate a fastening element according to embodiments of the disclosure.

Fig. 3 illustrates a fastening element according to embodiments of the disclosure, with **Fig. 3A** being an exploded view of the laminate, and **Fig. 3B** and **3C** being a planar view of said laminate.

Fig. 4A-B illustrate masks according to an embodiment of the disclosure according to similar views of Fig. 1B and 1C respectively.

DETAILED DESCRIPTION

[0010] Unless otherwise defined, all terms used in disclosing characteristics of the disclosure, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present disclosure.

[0011] As used herein, the following terms have the following meanings:

"A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

"About" as used herein referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of $\pm 20\%$ or less, preferably $\pm 10\%$ or less, more preferably $\pm 5\%$ or less, even more preferably $\pm 1\%$ or less, and still more preferably $\pm 0.1\%$ or less of and from the specified value, in so far such variations are appropriate to perform in the disclosed disclosure. However, it is to be understood that the value to which the modifier "about" refers is itself also specifically disclosed.

"Comprise", "comprising", and "comprises" and "comprised of" as used herein are synonymous with "include", "including", "includes" or "contain", "containing", "contains" and are inclusive or open-ended terms that specifies the presence of what follows e.g. component and do not exclude or preclude the presence of additional, non-recited components, features, element, members, steps, known in the art or disclosed therein.

"Unitary structure" as used herein means forming a single component or being the same component and with reference to crossing element(s) typically excludes a plurality of individual or distinct components that are overlapped to form a cross-like shape.

The expression "% by weight" (weight percent), here and throughout the description unless otherwise defined, refers to the relative weight of the respective

component based on the overall weight of the formulation.

The use of the term "layer" can refer, but is not limited, to any type of substrate, such as a woven web, nonwoven web, films, laminates, composites, elastomeric materials, or the like. A layer can be liquid and air permeable, permeable to air but impermeable to liquids, impermeable both to air and liquid, or the like. When used in the singular, it can have the dual meaning of a single element or a plurality of elements, such as a laminate.

The term "laid-flat state" is intended to refer to the article when it is flattened into a plane or is substantially flattened into a plane and is used in contrast to when the article otherwise positioned, such as when the article is folded or shaped in or for use by a wearer.

"Laminate" refers to elements being attached together in a layered arrangement.

The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints unless otherwise stated.

"Bonded" refers to the joining, adhering, connecting, attaching, or the like, of at least two elements. Two elements will be considered to be bonded together when they are bonded directly to one another or indirectly to one another, such as when each is directly bonded to intermediate elements.

The term "consisting essentially of" does not exclude the presence of additional materials which do not significantly affect the desired characteristics of a given composition or product. Exemplary materials of this sort would include, without limitation, pigments, antioxidants, stabilizers, surfactants, waxes, flow promoters, solvents, particulates and materials added to enhance processability of the composition.

The term "disposable" is used herein to describe absorbent articles that generally are not intended to be laundered or otherwise restored or reused as an absorbent article (i.e., they are intended to be discarded after a single use and, preferably, to be recycled, composted or otherwise disposed of in an environmentally compatible manner).

"Occiput" as used herein means the lower back of the skull of a wearer, typically within the lower back half of the skull.

"Join", "joining", "joined", or variations thereof, when used in describing the relationship between two or

more elements, means that the elements can be connected together in any suitable manner, such as by heat sealing, ultrasonic bonding, thermal bonding, by adhesives, stitching, or the like. Further, the elements can be joined directly together, or may have one or more elements interposed between them, all of which are connected together.

As used herein, the "body-facing" or "bodyside" or "skin-facing" surface means that surface of the article or component which is intended to be disposed toward or placed adjacent to the body (e.g. the face) of the wearer during ordinary use, while the "outward", "outward-facing" surface is on the opposite side, and is intended to be disposed to face away from the wearer's body during ordinary use.

As used herein, the terms "elastic", "elastomeric", "elasticity" or derivations thereof are used to describe the ability of various materials and objects comprised of such to reversibly undergo deformation under stress, e.g., become stretched or extended, in at least one direction when a force is applied to the material and to resume substantially to their original dimensions upon relaxing, i.e., when the force is released, without rupture or breakage. Preferably, it refers to a material or composite which can be elongated in at least one direction by at least 50% of its relaxed length, i.e., elongated to at least 150% of its relaxed length, and which will recover upon release of the applied tension at least 40% of its elongation. Accordingly, upon release of the applied tension at 50% elongation, the material or composite contracts to a relaxed length of not more than 130% of its original length. Examples of suitable elastomer materials include polyether-polyamide block copolymers, polyurethanes, synthetic linear A-B-A and A-B block copolymers, chlorinated rubber/EVA (ethylene-vinyl acetate) blends, EPDM (ethylene-propylene diene monomer) rubbers, EPM (ethylene-propylene monomer) rubbers, blends of EPDM/EPM/EVA, and the like.

[0012] Embodiments of the articles and processes according to the disclosure will now be described. It is understood that technical features described in one or more embodiments maybe combined with one or more other embodiments without departing from the intention of the disclosure and without generalization therefrom.

THE MASK

[0013] Referring to Fig.1-4, the face mask (1) may comprise: a mask body (2); and a fastening element (3) adapted to be placed over both ears, or the head, of a wearer to fix the mask body (2) onto a portion of a face of said wearer such to cover at least nose and mouth of said wearer when said mask is worn; wherein said mask

body (2) comprises: an outer layer (4); and a filtration layer (5), wherein the filtration layer (5) is positioned on a body-facing surface of said outer layer (4) such that when worn said filtration layer (5) is closer to said nose and mouth compared to said outer layer (4). Preferably, said filtration layer (5) is a nonwoven laminate comprising at least one meltblown layer and at least one spunbond layer, and wherein said mask body (2) comprises at least two meltblown nonwoven layers. Advantageously this arrangement allows to maintain the required bacterial filtration whilst being a more cost effective solution compared to prior art masks making use of pure meltblown nonwovens as filter layer.

[0014] In an embodiment, the face mask may comprise: a mask body; and a fastening element adapted to be placed over both ears, or the head, of a wearer to fix the mask body onto a portion of a face of said wearer such to cover at least nose and mouth of said wearer when said mask is worn; wherein said mask body comprises: an outer layer; and a filtration layer, wherein the filtration layer is positioned on a body-facing surface of said outer layer such that when worn said filtration layer is closer to said nose and mouth compared to said outer layer, and wherein the fastening element comprises at least one, preferably only one, crossing element at a position distal from the mask body, said position being proximal to an occiput of a wearer when the mask is worn, preferably wherein the crossing element is substantially Y-shaped or X-shaped. Preferably the crossing element forms a unitary structure. Additionally, any of the embodiments that follow may further be comprised in this embodiment.

[0015] Preferably, the mask body (2) comprises more than two meltblown nonwoven layers, preferably from 3 to 5, more preferably from 3 to 4, meltblown nonwoven layers. Advantageously this arrangement allows for increasing filtration efficiency without having to increase the basis weight of a single or fewer layers of pure meltblown layers.

[0016] In a highly preferred embodiment, the mask body (2) comprises more than 20 g/m² of meltblown fibers, preferably wherein the basis weight of meltblown fibers comprised in said mask body (2) is from 21 g/m² to 50 g/m², preferably from 22 g/m² to 45 g/m², more preferably from 23 g/m² to 40 g/m², even more preferably from 25 g/m² to 30 g/m². Without wishing to be bound by theory, especially when using laminates of meltblown and spunbond nonwovens, maintaining the correct basis weight of meltblown fibers within the product allows for achieving the optimal balance of bacterial filtration efficiency and reduced resistance to breathing. Materials within these ranges are beneficial for this purpose.

[0017] In an embodiment, at least the filtration layer (5) and outer layer (4) comprise one or more meltblown layers, wherein the filtration layer (5) comprises a first basis weight of meltblown fibers and the outer layer (4) comprises a second basis weight of meltblown fibers, wherein the first basis weight of meltblown fibers is greater than

the second basis weight of meltblown fibers, preferably wherein a ratio of said first basis weight of meltblown fibers to said second basis weight of meltblown fibers is from 1.2 gsm to 8.0 gsm, preferably from 1.5 gsm to 7 gsm.

[0018] In an alternative embodiment, at least the filtration layer (5) and outer layer (4) comprise one or more meltblown layers, wherein the filtration layer (5) comprises a first basis weight of meltblown fibers and the outer layer (4) comprises a second basis weight of meltblown fibers, wherein the second basis weight of meltblown fibers is greater than the first basis weight of meltblown fibers, preferably wherein said second basis weight is greater than the basis weight of meltblown fibers in any of the other layers of the mask body, more preferably wherein a ratio of said second basis weight of meltblown fibers to said first basis weight of meltblown fibers is from 1.2 to 8.0, preferably from 1.5 to 7.

[0019] The meltblown fiber basis weight measurements should be preferably made on the nonwoven raw material before it is converted into a mask body or requested to the nonwoven manufacturer. If this is not possible, a sufficient nonwoven sample should be obtained from the finished masks by manually extracting the nonwoven layers from the mask, measurements should then follow the basis weight measurement procedure that follows: Coupon samples (25.4 mm x 25.4 mm and typically having a thickness of about 3mm) are compression molded at 190°C according to ASTM D4703-00 and cooled using procedure B. Once the sample cooled to 40-50°C, it is removed. Once the sample reaches 23°C, its dry weight and weight in isopropanol is measured using an Ohaus AP210 balance (Ohaus Corporation, Pine Brook NJ). Density (or as used herein basis weight) is calculated as prescribed by ASTM D792 procedure B.

[0020] In an embodiment, the mask body (2) further comprises an inner layer (6) positioned on the body-facing surface of the filtration layer (5) such that it is in direct contact with the face of said wearer when the mask is worn, preferably wherein said inner layer (6) comprises a spunbond nonwoven layer.

[0021] Preferably, the mask body (2) has a Bacterial Filtration Efficiency (BFE) of more than 96%, preferably more than 97%, even more preferably at least 98%, most preferably from 98% to 99.9%, according to method UNI EN 14683.

[0022] In an embodiment, the filtration layer (5), preferably the outer layer (4) and optionally the inner layer (6), consists of a synthetic polymer selected from the group consisting of polypropylene, polyethylene, and mixtures thereof, most preferably consists of 100%wt polypropylene (PP) or 100%wt polyethylene (PE) by weight of said layer(s). Advantageously this arrangement allows for improved recycling advantages, especially when consisting of PP or PE.

[0023] Preferably, the filtration layer (5) comprises at least two meltblown layers, preferably said layers are in contact with one another. Advantageously, such a double

layer allows for an overlaying of crossings in the fibers that improves the filtration capabilities of the substrate more so than a single layer of meltblown at comparative overall basis weight.

[0024] In an embodiment, the filtration layer (5) comprises at least two spunbond layers and the meltblown layer(s) is sandwiched therebetween. Advantageously, this allows for improved perceived softness.

[0025] In an embodiment, the outer layer (4) is free of meltblown layers, and optionally wherein the inner layer (6) is a nonwoven laminate comprising at least one meltblown nonwoven layer and at least one spunbond nonwoven layer, and preferably wherein said meltblown layer is positioned on a outward-facing surface of the spunbond layer such that said spunbond layer is in contact with the face of the wearer when the mask is worn.

[0026] Alternatively, the outer layer (4) consists of a nonwoven laminate comprising at least one spunbond nonwoven layer and at least one meltblown nonwoven layers, and optionally wherein the inner layer (6) is a nonwoven laminate comprising at least one meltblown nonwoven layer and at least one spunbond nonwoven layer, and preferably wherein said meltblown layer is positioned on a outward-facing surface of the spunbond layer such that said spunbond layer is in contact with the face of the wearer when the mask is worn.

[0027] Preferably, at least the outer layer (4) is hydrophobic and optionally wherein the inner layer (6) is treated such as with one or more surfactants to make it hydrophilic. In an embodiment, the filtration layer and the outer layer are hydrophobic, and the inner layer is hydrophilic. Advantageously these arrangements allow for water vapour to permeate through the inner layer but be trapped at least by the outer layer, thus aiding to reduce skin irritation upon prolonged wearing.

[0028] In a preferred embodiment, the mask body (2) comprises oppositely disposed first transversal edge (7) and second transversal edge (8) extending along a width of said mask body (2), and oppositely disposed first and second longitudinal edges (9,10) extending along a length of the mask body (2) and connecting said first and second transversal edges (7,8) to form a perimeter of said mask body (2) wherein the longitudinal edges (9,10) are longer than said transversal edges (7,8), and wherein a pliable reinforcement element (11) is comprised along substantially the entire length of each of said transversal edges (7,8) and typically arranged to resist deformation caused by tightening of the fastening element (3) so that said transversal edges (7,8) can rest onto portions of the face of the wearer without forming openings or gaps between the face of the wearer and said edges when the fastening element (3) is tightened. Preferably, the pliable reinforcement element (11) is sized to have a length that is from 80% to 100%, preferably from 85% to 99%, more preferably from 90% to 98%, of the width of said mask body (2); and a width that is from 5% to 15%, preferably from 6% to 10%, of the length of said mask body (2). Measurements herein are carried out in laid-flat state.

Advantageously this arrangement allows for improved wearing comfort.

[0029] Preferably, the pliable reinforcement element (11) is selected from the group consisting of a hotmelt adhesive, a foam, a metal wire, melted fibers, and combinations thereof. Typically, the pliable reinforcement element (11) comprises, preferably consists of a hotmelt adhesive positioned between the filtration layer (5) and at least one of the outer layer (4) and inner layer (6).

[0030] In an embodiment, each of the outer layer (4), filtration layer (5) and optionally the inner layer (6), comprise at least two pleats (12), preferably at least three pleats (12), superposedly arranged such that each pleat of one of said layers is directly superposed over the pleat of a neighbouring other said layer. Pleats on each layer of the mask are beneficial for allowing additional extension and coverage of the contour of a wearer's face and allow enough space and clearance from the nose to limit breathing impairment.

[0031] In a preferred embodiment, the mask body (2) further comprises a semi-rigid element (13) such as a metal wire positioned along an edge thereof that is to be placed adjacent the nose of the wearer when the mask is worn, preferably wherein said semi-rigid element (13) is positioned along the first longitudinal edge (9). Preferably, the semi-rigid element (13) is joined to the body-facing surface of the outer layer (4), which is oversized such that said layer folds over and around said semi-rigid element (13) to enclose it therein in a C-fold. Advantageously this allows for an effective way of securing the element to the mask with strong mechanical resistance whilst limiting the overall use of material.

[0032] In an embodiment, the fastening element (3) is joined to the outward-facing surface of the outer layer (4) and wherein said outer layer (4) is oversized compared to the other layer(s) such that at least a first and second oppositely disposed longitudinal edges (14,15) are folded over themselves such that a body-facing surface of said outer layer (4) is joined to a body-facing surface of the filtration layer (5) or inner layer (6) forming a C-fold, and wherein when worn the fastening element (3) is adjacent the face of the wearer. This arrangement has the advantage of providing added reinforcement for the fastening element attachment and ultimately improve comfort over extended periods of time whilst limiting the risk of splitting or separation of the fastening element from the mask body.

[0033] Alternatively, the fastening element (3) is joined to the outward-facing surface of the outer layer (4) and wherein said outer layer (4) is oversized compared to the other layer(s) such that at least a first and second oppositely disposed longitudinal edges (14,15) are folded over themselves such that a body-facing surface of said outer layer (4) is joined to a body-facing surface of said same layer (4) forming a C-fold, and wherein when worn the fastening element (3) is adjacent the face of the wearer.

[0034] In an embodiment, the filtration layer (5) has a basis weight of less than 45 g/m², preferably less than

41 g/m², more preferably less than 30 g/m², preferably from 10 g/m² to 29 g/m², more preferably from 12 g/m² to 28 g/m², even more preferably from 14 g/m² to 27 g/m², even more preferably from 15 g/m² to 26 g/m², even more preferably from 20 g/m² to 25 g/m².

[0035] Preferably, the mask further comprises a longitudinal sealing pattern (16) extending along at least one of, preferably both, the first and second longitudinal edges (9,10). Preferably, the mask further comprises at least two sealing blocks (100) on either side of the semi-rigid element (13) typically such that together with the sealing pattern (16) forms a perimetrical sleeve surrounding the entire element (13). Advantageously this allows to keep the element in better position and prevent shifting whilst minimising the use of adhesives.

[0036] Preferably, at least a portion of the perimeter of the mask body (2) comprises a hotmelt adhesive and wherein a central portion (17) positioned inboard of, and circumscribed by, said perimeter is free of adhesive such that all layers of the mask body (2) are free to move relative to each other in said central portion (17). Advantageously this arrangement reduces breathing resistance as well as reducing the cost of assembly.

[0037] In a highly preferred embodiment, the fastening element (3) comprises at least one, preferably at least two, crossing element (18) at a position distal from the mask body (2), said position being proximal to an occiput of a wearer when the mask is worn, preferably wherein the crossing element (18) is substantially Y-shaped or X-shaped. Advantageously, this arrangement allows for improved comfort. Moreover, when combined with a reinforcement nonwoven, as described herein, aids to create lateral evacuations to limit fogging of glasses when worn by a subject in combination with the mask.

[0038] In an embodiment, the fastening element (3) comprises at least one, preferably at least two, connecting element (19) extending between two consecutive crossing elements (18). Preferably, the fastening element (3) comprises at least four terminal elements (20), typically one for each branch (21) of the crossing element (18), and wherein each terminal element (20) is connected to the mask body (2). The length of each connecting element (19) is preferably greater than the distance between terminal elements (20) along an axis substantially perpendicular to said length.

[0039] Preferably, the fastening element (3) comprises, preferably consists of, a laminate comprising an elastic layer (22) and at least one nonwoven layer (23), preferably wherein the elastic layer is sandwiched between at least two nonwoven layers, more preferably wherein the elastic layer (22) comprises, typically consists of, an elastic film or a plurality of elastic strands. Advantageously this allows for cheaper elastics compared to known knitted elastics used in masks.

[0040] Preferably, the elastic layer (22) comprises a perimeter that is less than a perimeter of the nonwoven layer (23) such that one or more void regions (24) free of elastic layer are formed at least along a longest dimen-

sion of the fastening element (3). Typically wherein the nonwoven layer (23) is selected from a spunbond (S), spunbond-meltblown (SM), spunbond-meltblown-spunbond (SMS) and spunbond-meltblow-meltblown-spunbond SMMS). Advantageously this allows for softness at least on the surface in contact with the wearer's skin whilst retaining acceptable mechanical resistance to tearing.

[0041] Alternatively, the fastening element (3) comprises, preferably consists of, one or more elastic knitted strings, preferably comprising: at least 25%wt, preferably at least 30%wt, of polyamide; at least 25%wt, preferably at least 30%wt, of polyester; and at least 25%wt, preferably at least 30%wt, of elastane; and is typically free of latex.

[0042] In a preferred embodiment, the fastening element (3) comprises, preferably consists of, a laminate comprising an elastic layer (22) and at least one nonwoven layer (23), preferably wherein the elastic layer is sandwiched between at least two nonwoven layers, more preferably wherein the elastic layer (22) comprises, typically consists of, an elastic film, and wherein the elastic film is joined to the nonwoven layer by mechanical bonding, preferably ultrasonic bonding, such to form a plurality of bonds having a first density. Typically wherein the two nonwoven layers are joined to each other in regions outboard of the elastic film by mechanical bonding, preferably ultrasonic bonding, such to form a plurality of bonds having a second density, and wherein the first density is greater than the second density such that the laminate forms a plurality of accordion-like peaks and troughs or wrinkles at least in a region of the laminate overlapping the film and/or outboard of said film, when in relaxed state. Advantageously, this allows to reduce necking which is desirable especially when not using knitted elastics.

[0043] In a preferred embodiment, the air permeability of each layer of the mask body (2) is from 100 l/m²/s to 550 l/m²/s, preferably from 130 l/m²/s to 450 l/m²/s, according to method WSP 70.1(15) from INDA and EDANA.

[0044] Preferably, each layer of the mask body (2) has a differential pressure of less than 55 Pa/cm², preferably from 5 Pa/cm² to 54 Pa/cm², more preferably from 10 Pa/cm² to 53 Pa/cm², according to method UNI EN 14683. For measurements herein the test method according to UNI EN 14683 is carried out with the following test modality: Nitrogen or air flow through sample seized between aluminium/Teflon flanges. Gas flow rate: 46.2 ±5% liters/min on a circular passage section with a diameter of 60 mm, corresponding to 8 liters/min on a section of 25 mm. Measuring instrument: GE DRUCK LPM9381 range -10/+ 10 mbar, 1/1000 FS, 5V output. Measurement uncertainty ±10%. Advantageously this allows for reduced breathing impairment.

[0045] In an embodiment, the mask body (2) comprises a reinforcement nonwoven (24) applied over the outer layer (4) and/or inner layer (6), such that a portion of the fastening element (3), comprising at least the part thereof

that is joined to the outward-facing surface of the outer layer (4), is interposed between said reinforcement nonwoven layer (24) and said outer layer (4), preferably wherein said reinforcement nonwoven layer (24) is in the form of at least two distinct strips of nonwoven applied to, and extending along, each of the first and second transversal edges (7,8). Typically wherein said layers are joined by a joining element (25) selected from the group consisting of adhesive, mechanical bonding, and combinations thereof.

THE MASK TREATMENT COMPOSITION

[0046] In some embodiments the masks herein may comprise a treatment composition having bacteriocidal properties.

[0047] Preferably, at least the filtration layer (5) comprises a bacteriocidal composition comprising one or more metal oxides preferably selected from the group consisting of zinc oxide, copper oxide, and mixtures thereof, preferably zinc oxide. Advantageously this allows for permitting the mask to be worn for longer than the typically recommended period of 4 hours of standard surgical masks on the market. Such materials are further easily suspended and can be applied directly in-line in the lamination process to form the mask bodies.

[0048] Alternatively, or additionally, the above mentioned bacteriocidal composition may be comprised on the outer layer (4). Without wishing to be bound by theory, bacteriocidal effectiveness of metal oxides, and in particular zinc oxide, is improved with the further exposure to light. Thus ensuring that the outer layer that is typically mostly exposed to light comprises such composition allows for an even more effective bacteriocidal effectiveness of the mask over a wider range of bacterial strains.

[0049] The composition may comprise at least 5%wt of metal oxides, preferably from 7%wt to 35%wt, more preferably from 10%wt to 30%wt, by weight of the composition.

[0050] In a preferred embodiment, the metal oxides are in the form of nanoparticles having an average diameter of from 10 nm to 100 nm, preferably from 15 nm to 85 nm, even more preferably from 16 nm to 70 nm, most preferably from 17 nm to 50 nm. Advantageously this allows for ease of dispersion and effectiveness of coverage and bacteriocidal efficacy.

[0051] In a preferred embodiment, the composition is, typically applied, in the form of a, preferably uniform, colloidal suspension. Nanoparticles of metal oxides herein are typically resuspended in sterile double-distilled water and sonicated (e.g. using an ultrasonic bath at frequency of more than 20kHz) to form such colloidal suspension typically before application onto a substrate of the mask.

[0052] Preferably the composition is applied e.g. by spraying prior to laminating the layers to form the mask body (2).

[0053] It is supposed that the present invention is not restricted to any form of realization described previously

and that some modifications can be added to the presented example of fabrication without reappraisal of the appended claims.

Claims

1. A face mask (1) comprising:

a mask body (2); and
a fastening element (3) adapted to be placed over both ears, or the head, of a wearer to fix the mask body (2) onto a portion of a face of said wearer such to cover at least nose and mouth of said wearer when said mask is worn; wherein said mask body (2) comprises:

an outer layer (4); and
a filtration layer (5), wherein the filtration layer (5) is positioned on a body-facing surface of said outer layer (4) such that when worn said filtration layer (5) is closer to said nose and mouth compared to said outer layer (4), **characterised in that** said filtration layer (5) is a nonwoven laminate comprising at least one meltblown layer and at least one spunbond layer, and **in that** said mask body (2) comprises at least two meltblown nonwoven layers.

2. A mask according to Claim 1 wherein the mask body (2) comprises more than two meltblown nonwoven layers, preferably from 3 to 5, more preferably from 3 to 4, meltblown nonwoven layers.

3. A mask according to any of the preceding Claims wherein the mask body (2) comprises more than 20 g/m² of meltblown fibers, preferably wherein the basis weight of meltblown fibers comprised in said mask body (2) is from 21 g/m² to 50 g/m², preferably from 22 g/m² to 45 g/m², more preferably from 23 g/m² to 40 g/m², even more preferably from 25 g/m² to 30 g/m².

4. A mask according to any of the preceding Claims wherein the mask body (2) further comprises an inner layer (6) positioned on the body-facing surface of the filtration layer (5) such that it is in direct contact with the face of said wearer when the mask is worn, preferably wherein said inner layer (6) comprises a spunbond nonwoven layer.

5. A mask according to any of the preceding Claims wherein the mask body (2) has a Bacterial Filtration Efficiency (BFE) of more than 96%, preferably more than 97%, even more preferably at least 98%, most preferably from 98% to 99.9%, according to method UNI EN 14683.

6. A mask according to any of the preceding Claims wherein the filtration layer (5) comprises at least two meltblown layers.

7. A mask according to any of the preceding Claims wherein the filtration layer (5) comprises at least two spunbond layers and the meltblown layer(s) is sandwiched therebetween.

8. A mask according to any of the preceding Claims wherein the outer layer (4) consists of a nonwoven laminate comprising at least one spunbond nonwoven layer and at least one meltblown nonwoven layers, and optionally wherein the inner layer (6) is a nonwoven laminate comprising at least one meltblown nonwoven layer and at least one spunbond nonwoven layer, and preferably wherein said meltblown layer is positioned on a outward-facing surface of the spunbond layer such that said spunbond layer is in contact with the face of the wearer when the mask is worn.

9. A mask according to any of the preceding Claims wherein at least the outer layer (4) is hydrophobic and optionally wherein the inner layer (6) is treated such as with one or more surfactants to make it hydrophilic.

10. A mask according to any of the preceding Claims wherein the mask body (2) comprises oppositely disposed first transversal edge (7) and second transversal edge (8) extending along a width of said mask body (2), and oppositely disposed first and second longitudinal edges (9,10) extending along a length of the mask body (2) and connecting said first and second transversal edges (7,8) to form a perimeter of said mask body (2) wherein the longitudinal edges (9,10) are longer than said transversal edges (7,8), and wherein a pliable reinforcement element (11) is comprised along substantially the entire length of each of said transversal edges (7,8) and typically arranged to resist deformation caused by tightening of the fastening element (3) so that said transversal edges (7,8) can rest onto portions of the face of the wearer without forming openings or gaps between the face of the wearer and said edges when the fastening element (3) is tightened.

11. A mask according to Claim 10 wherein the pliable reinforcement element (11) is selected from the group consisting of a hotmelt adhesive, a foam, a metal wire, melted fibers, and combinations thereof.

12. A mask according to any of the preceding Claims wherein the fastening element (3) is joined to the outward-facing surface of the outer layer (4) and wherein said outer layer (4) is oversized compared to the other layer(s) such that at least a first and

second oppositely disposed longitudinal edges (14,15) are folded over themselves such that a body-facing surface of said outer layer (4) is joined to a body-facing surface of the filtration layer (5) or inner layer (6) forming a C-fold, and wherein when worn the fastening element (3) is adjacent the face of the wearer.

13. A mask according to any of the preceding Claims wherein the fastening element (3) comprises at least one, preferably at least two, crossing element (18) at a position distal from the mask body (2), said position being proximal to an occiput of a wearer when the mask is worn, preferably wherein the crossing element (18) is substantially Y-shaped or X-shaped
14. A mask according to any of the preceding Claims wherein the fastening element (3) comprises, preferably consists of, a laminate comprising an elastic layer (22) and at least one nonwoven layer (23), preferably wherein the elastic layer is sandwiched between at least two nonwoven layers, more preferably wherein the elastic layer (22) comprises, typically consists of, an elastic film or a plurality of elastic strands.
15. A mask according to Claim 14 wherein the elastic layer (22) comprises a perimeter that is less than a perimeter of the nonwoven layer (23) such that one or more void regions (24) free of elastic layer are formed at least along a longest dimension of the fastening element (3).

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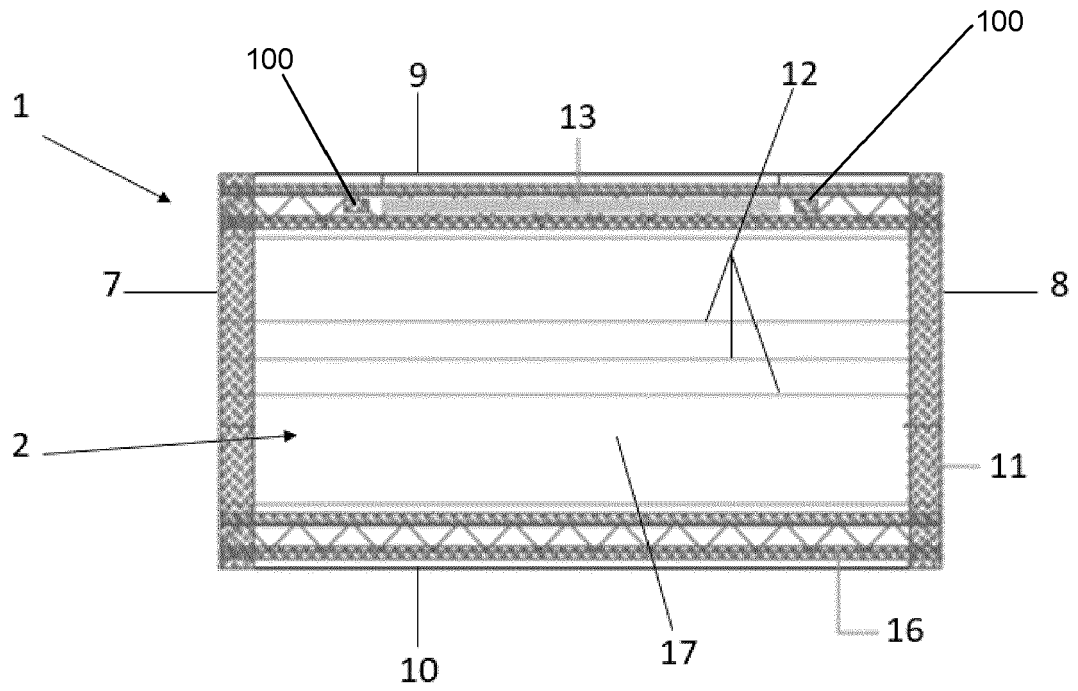


FIG. 1A

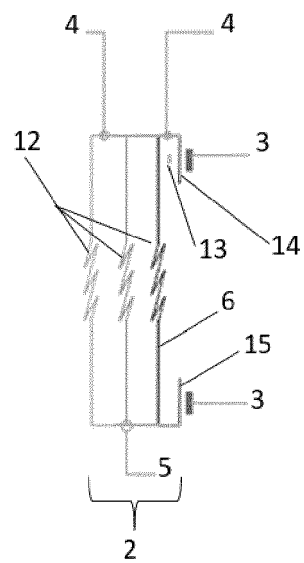


FIG. 1B

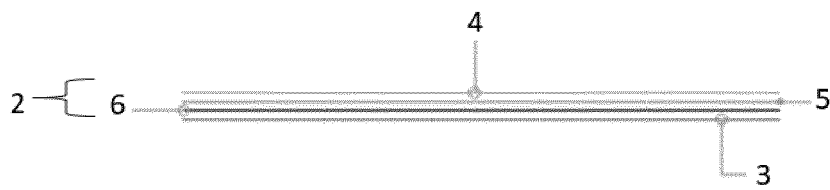


FIG. 1C

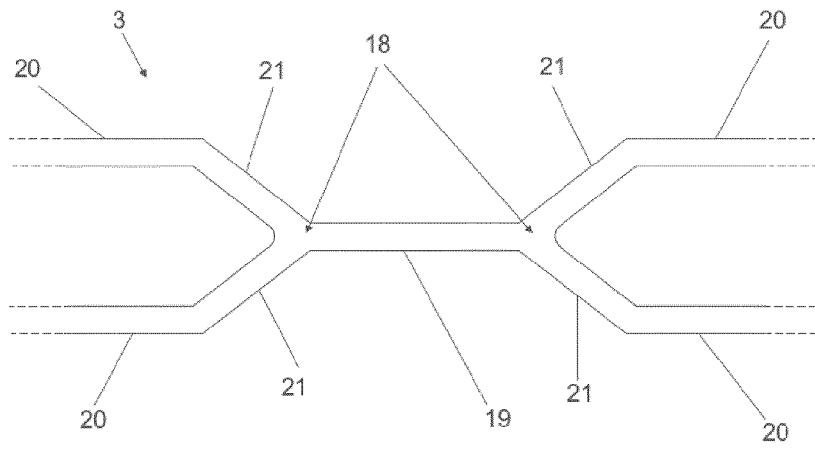


FIG. 2A

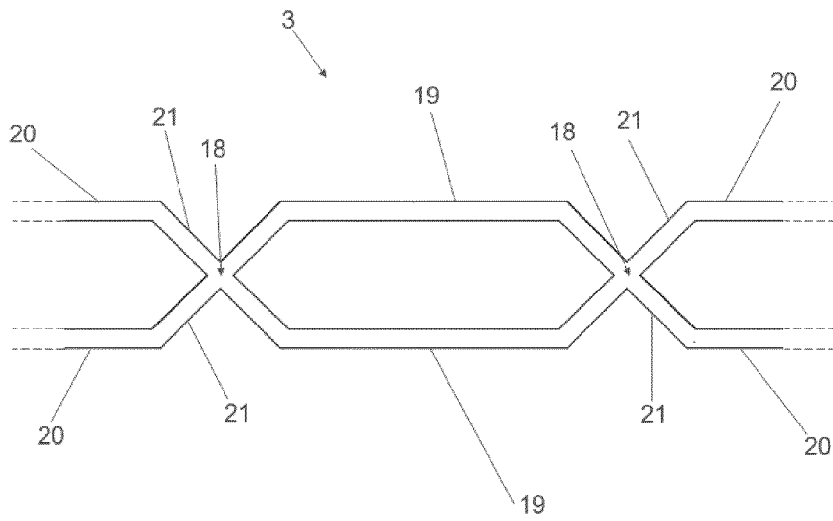


FIG. 2B

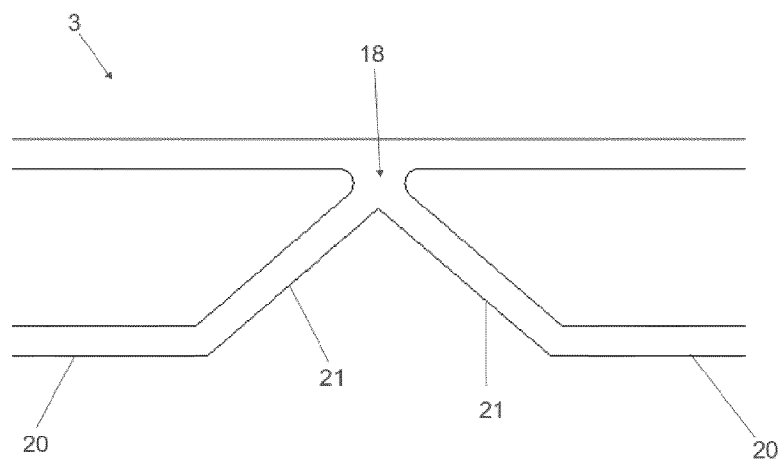


FIG. 2C

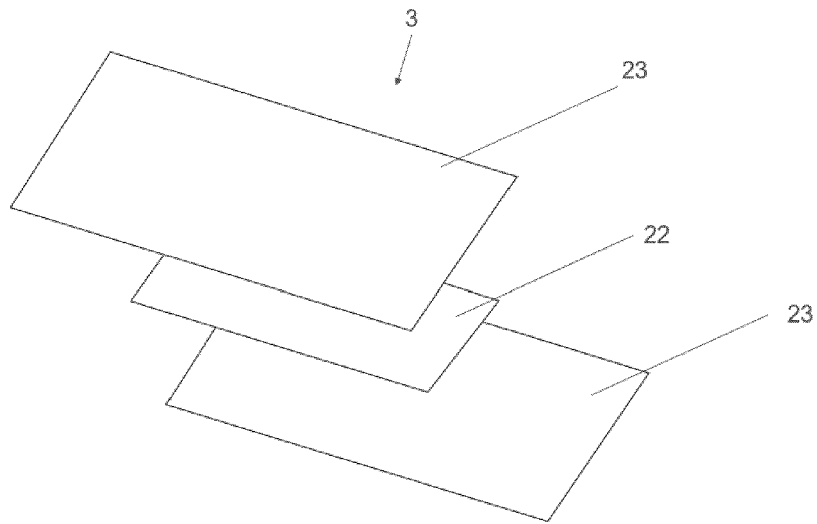


FIG. 3A

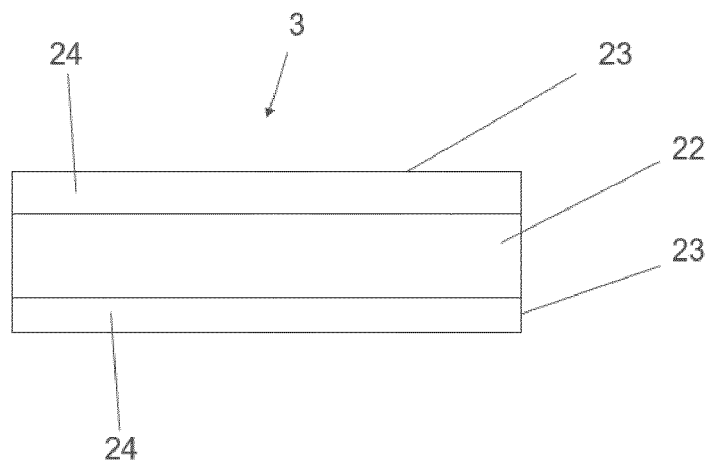


FIG. 3B

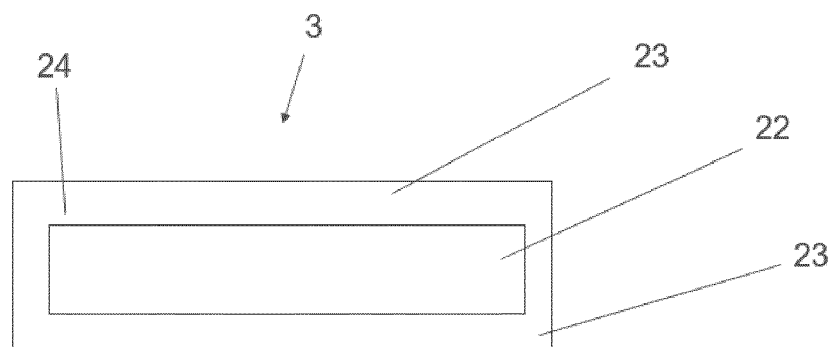


FIG. 3C

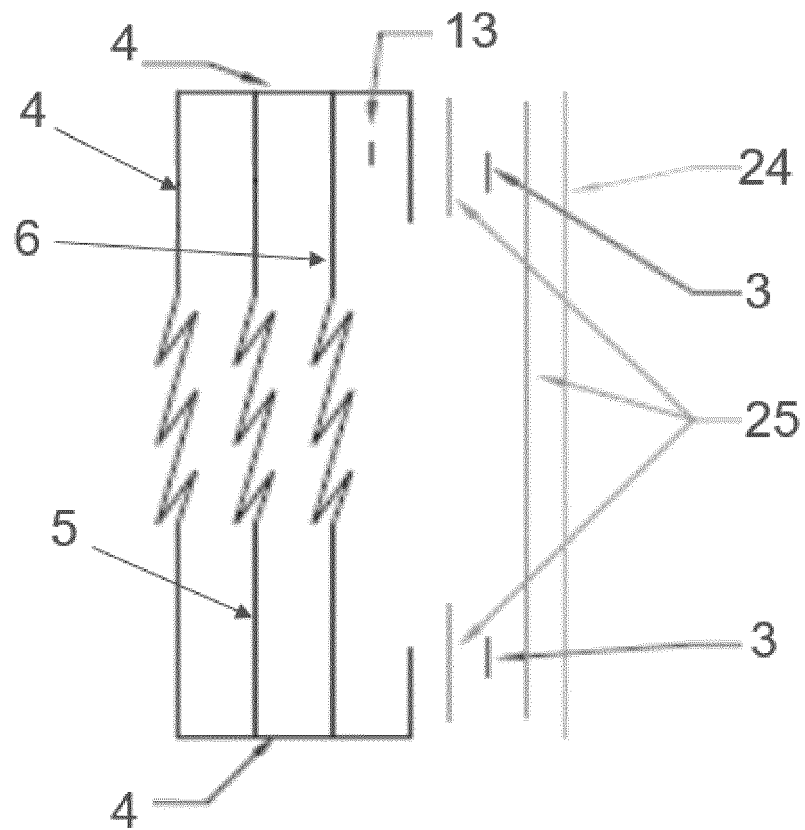


FIG. 4A

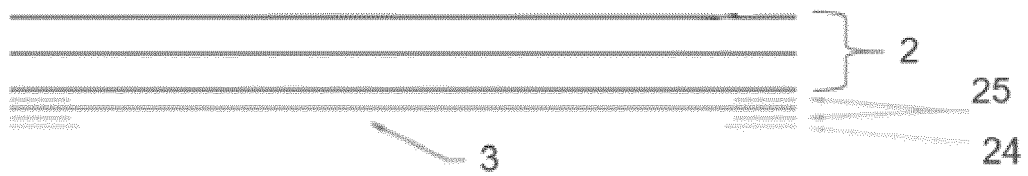


FIG. 4B



EUROPEAN SEARCH REPORT

 Application Number
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			A41D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 September 2020	Examiner van Voorst, Frank
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