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(54) **A membrane, in particular a waterproofing membrane, and a method of producing a membrane, in particular a waterproofing membrane**

Membran, insbesondere wasserdichte Membran und Verfahren zu ihrer Herstellung

Membrane, en particulier membrane d'étanchéité et sa méthode de fabrication

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(73) Proprietor: **MONARFLEX A/S**
2730 Herlev (DK)

(72) Inventor: **Kühl, Jan Johan**
Camp Road,
London SW19 4UR (GB)

(74) Representative: **Nielsen, Henrik Sten**
Budde Schou A/S
Vester Søgade 10
1601 Copenhagen V (DK)

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Description

[0001] The present invention relates generally to the technical field of membranes, in particular water proofing membranes and further to composite grid or mesh reinforced composite membranes. The present invention relates in particular to membranes for use in the field of house building or construction, such as membranes for use as an underroof membrane, scaffold sheeting, tarpaulins, geo membranes, vapour barriers, wind barriers, damp proof membranes, world aid shelters, military shelters etc. The present invention also relates to a method of producing a membrane, in particular a waterproofing membrane.

[0002] Within the technical field of membranes, in particular membranes for use in house building or construction, a number of membrane structures are known and described in the litterature, such as in US5229197, EP0491454, DE29805622, EP0177364, US5422179, US5860225, EP0855479, JP2162037, EP0708212, WO97/00362. Further, within the technical field of membranes, certain techniques include methods of producing and machines for the production of membranes are known, e.g. from DK 105423, DK 136082, DE OS 1635579 and DE OS 2030203. Reference is made to the above patent applications and patents and the above US patents are further hereby incorporated in the present specification by reference. For many years, it has been realised that the provision of mesh or grid reinforced membranes allows for the utilisation of fairly thin foils constituting part of the grid or mesh reinforced composite membrane, still providing membranes exhibiting excellent properties as to mechanical strength, in particular tensile strength. It has commonly been known that in the composite membrane structures, in which two foil layers sandwich a reinforcing mesh or grid, the mechanical strength as expressed in tensile strength is predominantly determined by the strength of the reinforcing mesh or grid.

[0003] As the known foil materials have, for several reasons, to fulfil certain requirements as to thickness, as the foil materials need to have a certain thickness for allowing the foil materials to have sufficient tear resistance, puncture resistance and for providing UV resistance, the composite membrane has, for most applications, been made from individual foil layers together providing a composite membrane structure of a foil layer thickness of 250 μm or even more. Generally, low density polyethylene (LDPE) materials or polypropylene (PP) materials have most often been used for the foil materials and woven, regularly laid or non-woven polymer fiber filament or wire materials have been used for the reinforcing mesh or grid.

[0004] The prior art LDPE based composite mesh or grid reinforced membranes have proven to be acceptable and proven to provide long term stable weather resistant and UV resistant membrane structures, provided the foil materials used for the composite material have been of a fairly large thickness for providing the properties required, such as the required surface properties and also providing a fairly stable and tough foil structure. In the use of membranes, such as waterproofing membranes for house buildings, the membranes have to fulfil further requirements in relation to the intentional use of the membranes and also the application of the membranes at the building sites such as requirements in relation to puncture proof resistance of the membrane structure which characteristic may be measured according to specific requirements or standards. Consequently, the membranes have to comply with certain requirements as to tear strength, as defined in relevant ISO, BS, EN or DIN standards and have additionally to fulfil certain additional characteristics, which are often difficult to measure or specifically determine, which characteristics are, however, within the industry, often referred to as toughness, crack resistance, abrasive resistance, draping and noise characteristics.

[0005] It is to be realised that the membranes to be used in the house construction industry have, apart from the above properties, also to be easily folded and comply with certain physical configurations and therefore, the membranes have to fulfil certain standards, as to draping, known from the clothing industry as a term, and further, the membranes to be used in housings, need to be extremely flexible and lightweight for allowing the workers to handle the membranes at the building site without damaging by puncturing, distorting, ripping the membranes and still further, should be of a type preventing the membranes from generating noise provided the membranes be exposed to wind pressure, fluctuation from ventilation air, impact or other mechanical influence, even below roofing materials such as tiles. Further, the membranes should, for obvious reasons, exhibit characteristics preventing the membranes from cracking or being torn apart through abrasive impact and still further should be resistant to delamination. In most applications, the relevant building membranes are further to constitute waterproof structures.

[0006] Within the last few years, a number of new foil materials, such as VLDPE and LLDPE have been developed and become commercially available, which materials, as compared to conventional LDPE foil materials exhibit comparable or even improved characteristics. Within the building industry, the costs for transporting and handling, i.e. mounting the various building elements, have become a major factor and therefore, the industry has attempted to reduce the weight of the composite reinforced membranes by simply reducing the thickness of the foil materials used. Such products have, however, proven not to be entirely successful, even in spite of the use of the above described new and advantageous foil materials, including VLDPE and LLDPE materials, as the reduced thickness of the foils in the composite grid or mesh reinforced membrane structure may cause the foils to be easily torn apart, or punctured by sharp objects, provided the composite membrane be exposed to mechanical influences, such as tearing forces, e.g. tearing forces providing impacts to the composite membrane, which impact is not orientated along the predominant orientation of the fibers of the mesh or grid. It is contemplated, that the presence of the reinforcing grid within a membrane structure reinforced by means of the mesh or grid may, under certain circumstances concentrate a force impact to specific minor areas of the foil materials and in doing so, provided the foil materials are extremely thin, even tear apart the foil materials, as the foil materials, due to their extreme small thickness exhibit a high degree of flexibility and bendability allowing the foil materials themselves to substantially accommodate any specific geometric configuration.

[0007] It is therefore an object of the present invention to provide a novel technique and in particular a novel composite membrane structure, including a reinforcing mesh or grid in which composite structure the excessive force accumulations within specific areas or at specific points of the composite reinforced structure be eliminated for preventing the mesh or grid from tearing apart the thin foils.

[0008] It is further an object of the present invention to provide a novel technique allowing the industry to provide composite, i.e. mesh or grid reinforced membranes having a lower weight as compared to the prior art composite mesh structures, still exhibiting the same mechanical properties, as the prior art composite membranes or even improved mechanical properties as expressed in tear strength and/or puncture proof resistance.

[0009] It is an advantage of the present invention, that the present invention allows for the provision of composite membranes, i.e. membranes including two foil layers sandwiching a reinforcing mesh or grid structure which composite membranes provide the same properties and characteristics or even improved properties or characteristics as compared to the prior art composite membranes, still providing a lower weight and also improved properties as expressed in better draping, higher toughness and reduced noise.

[0010] It is a particular feature of the present invention, that the invention makes it possible to provide high strength, highly bendable and low noise composite membranes, including a reinforcing mesh or grid, which mesh or grid, as is well-known in the art, provides the overall tensile strength of the composite membrane and includes foils constituting a reduced percentage of the overall weight of the composite membrane as compared to the percentage by weight of foil materials of comparable prior art membranes, i.e. membranes exhibiting properties as to mechanical strength etc. comparable to the properties of the novel membranes according to the present invention.

[0011] The above objects, the above advantage and the above feature together with numerous other objects, advantages and features which will be evident from the below description, are according to the teachings of the present invention obtained by a membrane, according to a first aspect of the present invention, in particular a waterproofing membrane, for use in the field of house building or construction, in particular for use as an underroof membrane, scaffold sheeting, tarpaulins, geo textiles, vapour barriers, wind barriers, damp proof membranes, world aid shelters, military shelters etc. comprising:

a reinforcing regularly laid, woven or non woven mesh comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,

a first foil of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,

a second foil of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and said reinforcing mesh being interlayered in a sandwich structure between said first and second foils and being moveable relative to said first and second sandwiching foils as said mesh be coated with a lubricating material, such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils and substantially non-dissolvable within said polymer materials of said first and second foils. It is to be realised that the foils have to be effectively laminated together. In this context, the expression "effectively laminated together" means or implies that delamination does not occur or does not occur to any substantial extent, even under dynamically mechanically loading. Consequently, provided the foils be effectively laminated together, the peel strength of the laminated foils simply can not be measured.

[0012] It is a characteristic feature of the present invention, that the reinforcing mesh is, as distinct from the prior art reinforced membranes, allowed to be moved within the composite structure relative to the sandwiching foils through the provision of the lubricating material, and in doing so, allows the overall composite membrane to accommodate to a higher degree to the mechanical influences, for preventing the reinforcing mesh from exposing minor areas or points of the sandwiching foils to excessive forces which might else tear apart the foils in localised places. In the present context, the moveability of the polymer fiber, filament or wire material of the reinforcing mesh is established as the individual fibers, filaments etc. of the reinforcing mesh be allowed to move in the longitudinal direction of the fibers, filaments etc. in relation to the sandwiching foils of the composite membrane structure. It is to be realised that the membranes are typically of a large size or a large overall transversal dimension necessitating or allowing that the membranes be rolled or folded together for allowing the membranes to be shipped or transported. In this context, it is to be realised that the transportation of the membranes include transportation from the factory to the construction site and further moving or shifting the membranes around on the construction site, e.g. from a position on ground to a position on a roof structure. The membranes need to be mechanically tough and flexible for allowing handling or transportation under these circumstances.

[0013] In the present context, the following terms: grid or mesh, foil and membrane, are to be construed as follows: The term grid or mesh is to be construed comprising any fiber, filament or wire structure of plastics material or any other relevant material, such as e.g. carbon reinforced plastic material etc. which exhibits an overall geometrical configuration resembling a mesh or any other structure differing from a conventional grid or mesh, still fulfilling the same purpose as a reinforcing grid or mesh. In the below description, it is stated that the grid or mesh may have any appropriate configuration and also have varying dimensions and all embodiments complying with the above definition are consequently to be considered covered by the term grid or mesh.

[0014] It is to be realised that all mechanical properties, including mechanical strength, tear resistance, barrier properties, such as water, vapour or damp proof etc., are in general to be considered in the context of use of the membranes, i.e. in the intentional application of the membranes, such as use for underroof covering, scaffold sheeting etc. In connection with geo membranes, the relevant properties are to be considered in the context of a relevant water pressure level, such as a water pressure level equivalent to 50-cm water column. Still further, it is to be realised that the ability of resistance to a specific property, such as weather resistance, is to be considered in relation to the relevant lifetime of the products in question, i.e. the membranes. Consequently, a relevant lifetime for membranes to be used in the construction industry in general is often of the order of a few months to several years for the intentional application, being a temporary application and a so called permanent application, respectively, e.g. including 10 - 30 years, 30 - 50 years or even 50 - 100 years. The term weather resistance is, in accordance with the above statements, to be considered in the context of the intentional use of the membrane or the membranes in question. For e.g. a scaffolding foil, the weather resistance is to be considered in conjunction with the relevant lifetime of the membrane or the membranes in question, which lifetime is typically of the order of a maximum of 1-2 years. For this kind of product, the expression weather resistance means that within the relevant lifetime, the membrane is resistant to the weather conditions including the wind, any rain or snow and also the exposure to the sun as the UV radiation from the sun deteriorates the membrane materials. As an alternative example, e.g. an underroof membrane which is not exposed to the sunlight, may, for the relevant lifetime of the order of 30-50 years or even more, be resistant to the exposure of wind and also water due to rain and snow and even the temperature variation from e.g. - 40°C to + 40°C or even larger temperature variations.

[0015] In the present context, the terms foil and membrane, which in some aspects may be considered synonymous, are distinctly used for separate intentional purposes. The term foil is used as the term defining an element or rather two elements of an overall foil or sheet configuration, which elements are together with the grid or mesh, composed into a composite structure constituting the membrane. It is to be understood that the foils which are combined with the reinforcing mesh or grid for establishing the membrane may themselves constitute membranes and be composed of individual foils, sheets, reinforcing fibers or mesh or grids without deviating from the meaning of the term foil as used in the present context. Also, the membrane according to the present invention may for other applications be considered constituting a foil or alternatively a sheet and the interpretation of the membrane as a foil or a sheet is not to be construed limiting in the present context. The use of the terms foil and membrane as defined above, only serve the purpose of distinctly differentiating the components from which the membrane is composed, i.e. the foils and the reinforcing mesh or grid and the membrane itself.

[0016] Within the industry of manufacturing plastic membranes, including several foil layers and even reinforcing meshes or grids, the use of lubricating materials such as lubricating oils have been well-known for decades. The lubricating oils have been used for specific properties, in particular for providing improved water repellent characteristics of the plastic membranes and also for reducing the surface adhesive contact and the surface frictional characteristics of the plastic membranes. However, lubricating oils are normally avoided in the foils for laminated membranes, since they often reduce lamination strength between the individual layers of foils. Provided the plastic membranes, or alternatively plastic fibers or filaments, which may also be provided with a lubricating surface coating for improving the ability of handling of the fibers or filaments be used in a lamination process in which one or more foils and/or plastic filaments or fibers or alternatively multilayer membranes or reinforced membranes be laminated to another plastics materials, precautions have been made for rinsing off any residual lubricating material or materials or precautions have been taken for eliminating any inadvertent degrading influence or impact from the residual lubricating materials in the final laminated product. Quantitative measurements of commercial prior art membranes often exhibit a oil or lubricate content of the order of 1-2%, still, the lubricating materials previously used within the industry, have been used for the above purpose as distinct from the usage of the lubricating materials in accordance with the teachings of the present invention for allowing the reinforcing mesh to be moveable and shiftable relative to the sandwiching foils in the sandwich structure of the membrane and in doing so allowing the overall membrane structure to accommodate force impact or mechanical stress which might else tear apart the foil's materials through the concentration of the force impact through the mesh at certain areas or points of the foil materials.

[0017] Through the provision of the lubricating material within the membrane structure, the content of the foil materials within the membrane structure may be reduced for reducing the overall weight of the membrane structure. Consequently, according to the teachings of the present invention, the first and second polymer materials may together constitute less than 90%, such as 80% or 50 - 80%, e.g. 60 - 80% or 70 - 80%, or alternatively 50 - 60%, 60 - 70%, 70 - 80% or 80 - 90% of the total weight of said membrane.

[0018] The provision of the lubricating material characteristic of the present invention allows, through the possible reduction of the overall weight of the membrane as compared to the prior art reinforced membranes through the reduction of the weight of the polymer material foils that the ratios as expressed in terms of mechanical strength in relation to the thickness or alternatively the weight per unit area of the membrane be increased as compared to the prior art membranes.

[0019] In accordance with the teachings of the present invention, the membrane preferably exhibits a tear strength of the order of more than 800 N/mm thickness, preferably more than 1000 N/mm thickness, such as more than 1200 N/mm or even more than 1500 N/mm (measured according to ASTM D 1117-80 at a speed of 100mm/min., or ISO 6381/1 or prEN 12112-2:1995) also preferably exhibits a puncture resistance pr. thickness of more than 250 N/mm thickness, preferably more than 300 N/mm or even more than 350 N/mm (according to NT Build 336/1988-9 except with a 10mm chisel), and additionally preferably exhibits a nail tear resistance of more than 2500 N/mm, preferably more than 3000 N/mm, or even more than 3500 N/mm (according to EN12310-1:1999). According to the above realisation as to improved mechanical characteristics in relation to a reduced weight, the membrane according to the present invention preferably exhibits a ratio as expected in tear strength to weight of higher than 1,0 N/(g/m^2), preferably higher than 1,4 N/(g/m^2). In the present context the ratios expressing dependency of thickness or thicknesses are to be construed in terms of the foil or foils rather than the composite membrane or membranes.

[0020] The mesh or grid of the composite membrane according to the present invention may be made from any appropriate polymer fiber, filament or wire material, e.g. the materials polypropylene, preferably isotactic polypropylene, polyethylene, preferably high density polyethylene, polyester or polyesters, preferably polyethylene terephtalene (PET), polyamide or polyamides, polyacrylonitrile or polyurethane or polyurethanes or a combination of the above materials. Additionally, fibers of carbon fiber, aramide fibers (Kevlar ®), glass fibers etc. commonly used for reinforcing purposes within the plastics industry may be alternatively be used for the mesh or grid of the composite membrane according to the present invention.

[0021] The reinforcing mesh has to exhibit specific properties as to strength, which properties are predominantly determined by the material of the reinforcing mesh in question and the dimensions and size of the mesh material. According to presently preferred embodiments of the membrane according to the first aspect of the present invention, the reinforcing mesh may be made from a polymer fiber, filament or wire material of a thickness of 0.1 - 1 mm, preferably 0.1 - 0.4 mm or of a thickness of 0.1 - 0.15 mm, 0.15 - 0.2 mm, 0.2 - 0.25 mm, 0.25 - 0.3 mm, 0.3 - 0.35 mm, 0.35 - 0.4 mm, 0.4 - 0.45 mm, 0.45 - 0.5 mm, 0.5 - 0.55 mm, 0.55 - 0.6 mm, 0.6 - 0.65 mm, 0.65 - 0.7 mm (if circular), and/or said reinforcing mesh being made of polymer fiber, filament or wire material of a thickness of 300 - 4000 dtex (g/10.000m), e.g. 1000 - 2000 dtex, preferably 1000 - 1500 dtex, or of a thickness of 300 - 400 dtex, 400 - 500 dtex, 500 - 600 dtex, 600 - 700 dtex, 700 - 800 dtex, 800 - 900 dtex, 900 - 1000 dtex, 1000 - 1250 dtex, 1250 - 1500 dtex, 1500- 1750 dtex, 1750 - 2000 dtex, 2000 - 2500 dtex, 2500 - 3000 dtex, 3000 -3500 dtex or 3500 - 4000 dtex.

[0022] Apart from the dimensions of the mesh providing the reinforcing of the membrane according to the teachings of the present invention, the mesh itself has to define a mesh structure of an appropriate configuration and size and according to presently preferred and advantageous embodiments of the membrane according to the present invention, the mesh preferably and advantageously defines a mesh size of the order of 5 - 40 mm, such as 5 - 20 mm, preferably 5 - 15 mm, such as approximately 10 mm, or a mesh size of the order of 5 - 7 mm, 7 - 9 mm, 9 - 11 mm, 11 - 13 mm, 13 - 15 mm, 15 - 20 mm, 20 - 25 mm, 25 -30 mm, 30 - 35 mm or 35 - 40 mm.

[0023] For establishing an integral and stable membrane structure, the foils constituting the sandwiching structure in which the reinforcing mesh is interlayered, have to establish a fairly large area of contact, as compared to the overall surface area of the membrane. Provided the area of contact between the two foils is extremely low, the foils will themselves be exposed to forces attempting to tear apart the two foils from one another causing a delamination of the membrane structure or alternatively the integrity and stability of the membrane structure is reduced or deteriorated. According to the teachings of the present invention, it has been realised, that the first and second foils in the sandwich structure should preferably provide an area of contact therebetween constituting more than 50%, such as 50 - 60%, preferably 60 - 70% or 70 - 80% or even more, preferably 80 - 90% of the overall surface area of said membrane.

[0024] The reinforcing mesh interlayered between the two foils of the membrane structure may define any appropriate mesh or grid configuration or grid structure, preferably a square or rectangular configuration or any other polygonal or similar configuration. As an example, the reinforcing mesh may alternatively define a rhombing configuration or a grid of any other geometrical configuration including triangular, elliptical, circular or any other geometrical configuration including linear or curved boundary lines including convex or concave configurations or any combination of the above geometrical configurations. Further, it is to be realised that the mesh itself may be woven or simply composed of laid strands of polymer fiber, filament or wire material.

[0025] The lubricant material providing the feature characteristic of the present invention of allowing the reinforcing mesh to be moveable relative to the first and second sandwiching foils may be a lubricant oil or wax, a mineral lubricant oil or wax or a synthetic lubricant oil or wax, such as an oil or wax having a melting point above approximately 30° - 50°C, or an oil or wax originally dispersed in water or another solvent which is evaporated in the process of producing the membrane.

[0026] The lubricant material may be present in the integral sandwich structure as the surface coating of the fiber or wire material of the reinforcing mesh. As the lubricant material being a wax or oil material, e.g. as described above, is present in the integral structure, the lubricant material may only be defined in terms of the amount present within the integral structure rather than as a dimensional surface coating thicknesses. In the presently preferred embodiment of the membrane according to the present invention, the lubricant material is present in amount of 10-40% by weight of the weight of the reinforcing mesh, such as 15-30% by weight, preferably 20-25% by weight, or alternatively 10-20%, 20-30% or 30-40% by weight.

[0027] Provided the reinforcing mesh is made from e.g. multifilament fibers, the amount of lubricant material present within the integral membrane structure is somewhat higher than the amount present within a comparable membrane structure in which solid monofilament fibers be used for the reinforcing mesh, as the multifilament structure exhibits an increased total surface area as compared to the surface area of the monofilament structure. Similarly, provided the mesh be made from woven or non-woven laid materials, the amount of lubricant material is of course higher than the amount of lubricant used for a monofilament fiber mesh structure.

[0028] The foil materials of the two foils of the membrane according to the present invention may be selected from any appropriate polymer or other relevant foil material being a compound material normally and preferably including specific additions for the provision of specific properties, such as UV stabilisers, antioxidants, anti ozonants, light stabilisers, pigments, nucleants, impact modifiers, plastizicers, heat stabilisers providing the relevant and adequate characteristics and features complying with the characteristics and features in questions. Provided the membrane is a water and gas impermeable membrane, the materials chosen for the two foil materials of course have to comply with this requirement. Alternatively, provided the membrane has e.g. to provide gas permeability and water impermeability, the materials selected for the two foils have correspondingly to comply with these requirements. In the present technical field, a multiplicity of materials are relevant, however especially polymer materials, such as flexible thermoplastics, i.e. polymers with low or medium crystallinity, and glass transition temperature below the lowest relevant application temperature are relevant. Also, copolymers, both random polymers and block copolymers, and blends of polymers can be applied. Crosslinkable polymers, which are crosslinked after manufacturing of the foils, can also be used. Generally, polyolefins are preferred.

[0029] Particularly preferred materials include, polyethylene (PE), especially low-density polyethylene (LDPE), medium density polyethylene (MDPE, up to about 0,945 g/cm3 density); random copolymers of ethylene and an alpha-olefine (known as linear low density polyethylenes, LLDPE; or very low density polyethylenes, VLDPE's, alternatively termed plastomers; ethylene and vinylacetate (EVA); ethylene and butylacrylate (EBA); ethylene and methylacrylate (EMA); ethylene and acrylic acid (EAA); polypropylene (PP) material, especially isotactic polypropylene homopolymer, random copolymers of propylene and ethylene (alternatively termed raco-PP); copolymers of propylene, ethylene and optionally higher alpha-olefins such as heterophasic block polymers, thermoplastic polyolefins (TPO's) and polyolefine plastomers (POP's); Polybutylene (Poly(1-butene)); block copolymers; thermoplastic elastomers such as ethylene propylene diene terpolymer (EPDM), styrene-butadiene copolymer (SBR), ethylene propylene rubber (EPR), polyisobutadiene (PIB), crosslinkable polyethylene (XLPE) such as vinylsilane ethylene copolymers, polyisoprene (PIP), polyisobutylene and thermoplastic polyurethanes (TPU's); Plasticized polyvinylchloride (PVC)); and blends or mixtures of any of the above.

[0030] It is to be realised that the polymers applicable for use in the foil material within the scope of the present invention, may in general be subdivided into 2 types: A) flexible thermoplastics, capable of large plastic deformations, such as PE, and B) elastomers or rubbers.

[0031] Flexible plastics made up of polymers like polyethylene and polypropylene are different from rigid plastics in that they don't resist deformation as well, but they tend not to break when deformed. Instead they make plastic deformation, making yielding. This deformation can be of several hundred percent, the major part being irreversible. Accordingly, flexible plastics are not as strong as rigid ones, but they have a higher toughness.

[0032] Elastomers like polyisoprene, polybutadiene, polyisobutylene and thermoplastic polyurethanes have completely different mechanical behaviour from the other types of polymer-based materials mentioned above, since they are not just highly stretchable, but highly reversibly stretchable.

[0033] Although the above considerations pertaining to mechanical properties might apply in general for the types of polymers mentioned above, it is possible to alter the stress-strain behaviour of a plastic with so called plasticizers. For example, without plasticizisers, poly(vinyl chloride) (PVC) is a rigid plastic, but with addition of plasticizers PVC can be made very flexible.

[0034] Apart from tensile properties, other properties, like compressional properties or flexural properties might influence the choice of polymer for use in a foil material of the membrane according to the present invention.

[0035] Foil materials may include flexible thermoplastics, i.e. polymers with low or medium crystallinity, and glass transition temperature below the relevant application temperature. Also, copolymers, both random polymers and block copolymers, and blends of polymers can be applied. Crosslinked polymers can also be used. Generally, polyolefins are preferred.

[0036] Examples of foil materials include:

- polyethylene (PE) material, especially low-density polyethylene (LDPE), medium density polyethylene (MDPE, up to about 0,945 g/cm3 density), random copolymers of ethylene and an alpha-olefins (known as linear low density polyethylenes, LLDPE; or very low density polyethylenes, VLDPE's, and sometimes also termed plastomers like Exact from DEX PLASTOMERS or Engage from Dow Chemicals); ethylene and vinylacetate (EVA), ethylene and butylacrylate (EBA); ethylene and methylacrylate (EMA); ethylene and acrylic acid (EAA); and blends of the above mentioned polymers,

- polypropylene (PP) material, especially isotactic polypropylene homopolymer, random copolymers of propylene and ethylene (sometimes called raco-PP), copolymers of propylene, ethylene and optionally higher alpha-olefins such as heterophasic block polymers (e.g. Hifax and Astryn from Montell), thermoplastic polyolefins (known as TPO's); polyolefine plastomers (known as POP's), e.g. EXACT from DEX PLASTOMERS or AFFINITY from DOW Chemicals; and mixtures thereof;

- Polybutylene (Poly(1-butene));

- block copolymers and optionally crosslinked polymers such as ethylene propylene diene terpolymer (EPDM), styrene-butadiene copolymer (SBR), ethylene propylene rubber (EPR), polyisobutadiene (PIB), crosslinkable polyethylene (PEX), with e.g. a vinyl silane comonomer, polyisoprene (PIP), polyisobutylene and thermoplastic polyurethanes (TPU's).

- Plasticized polyvinylchloride (PVC).

[0037] The polymers can be prepared by various well-known catalyst technologies like Ziegler-Natta catalysts, metallocene based or single-site catalysts. The polymerisation conditions may also favourably be set as to provide for bimodal molecular weight distribution, block copolymers or combinations of block and copolymers. All of these techniques and possibility of combinations are well-known to persons skilled in the art.

[0038] As described above some of the foil-polymers can optionally be cross-linked following the extrusion process, e.g. cross-linking of LDPE to form XLPE using gamma radiation or crosslinking of vinyl silane containing ethylene copolymers using water.

[0039] In addition it might be desirable to combine different individual foil-layers made from different polymer materials, thereby combining the desirable properties of each of the individual layers, e.g. their different colours, fire properties, IR-reflection properties, gas-barrier properties, wear-properties, etc. It is evident to a person skilled in the art that the number of possible combinations will be limited by the fact that in order to be functional any such combination will have to be made between foils, which indeed can be effectively laminated, even though this may off course be facilitated by the use of adhesion polymers in additional foil layers.

[0040] It should be evident that apart from the inherent properties of the foil materials, based on their chemical composition, also the thickness of the foil materials of choice will be determining for their mechanical properties.

[0041] With the above in mind it will be evident that the materials for use in the foils of the membrane according to the present invention may be selected from any of the polymers, copolymers, elastomers, immiscible blends, composite materials or combinations thereof mentioned above.

[0042] According to alternative embodiments of the membrane according to the present invention, the polymer material of the first foil may be identical to the polymer material of the second foil, however, according to an alternative embodiment, the polymer materials of the first and the second foils are different from one another. Provided one of the same foil materials be chosen for the two foils, the process of contacting and laminating the two foils together is of course easily established, due to the compatibility of the two foils being of the same material, whereas provided different materials be chosen for the two foils, certain precautions may necessitate that one or both foils be primed or otherwise treated for allowing the two foils to be contacted and sealed together. The sealing or lamination should be effective, to form a durable or long term stable structure, not only under static conditions; but also dynamic conditions, such as conditions prevailing in a roof structure under various wind loading.

[0043] Apart from single layer foil materials, multilayer foil materials may be used for one or both foils of the membrane according to the present invention, or alternatively, for making a special surface layer, such as highly UV-stabilised or flame retardant layer, which may be utilised in connection with the membrane according to the present invention. According to a particular aspect of the present invention, one or both foils of the reinforced membrane according to the present invention may be provided with a coating of a metallic or alternatively a non-metallic compound providing a specific radiation opaqueness or radio transmission characteristic, such as a specific IR transmission/reflection spectrum, e.g. an IR reflection spectrum corresponding to the IR reflection spectrum of soil.

[0044] Alternatively or additionally, the first and/or second foils may be light reflecting or alternatively light transmitting or at least partly translucent or alternatively pigmented for providing a specific light transmission colouring or transparency.

[0045] As will be discussed in greater details below with reference to a second aspect of the present invention relating to a method of producing the membrane according to the present invention, the polymer material of the first foil and or the second foil may advantageously be provided through extrusion of the polymer material in question at a specific extrusion temperature, such as an extrusion temperature within the range 150°C -270°C, such as 220°C - 230°C, and be applied in the lamination process to the other foil for providing the sandwich structure in which the reinforcing mesh or grid is embedded in accordance with the teachings of the present invention.

[0046] Alternatively, the polymer material of the first and/or the second foil may be made through curing the polymer material or materials in question, as the curing may be carried out at a curing temperature providing a softening point above 100°C and preferably a melting point above 100°C.

[0047] As will be described in greater details below, the two foils of the composite membrane according to the present invention may be produced through any appropriate per se well-known techniques, such as extrusion coating, hot melt application, hot melt powder application etc.

[0048] For complying with the physical and mechanical requirements as to strength, toughness and durability, the membrane has to fulfil certain requirements as discussed above as to tensile strength and the membrane preferably provides a tensile strength of the order of no less than 6 kN/m width or equivalently 300N/5 cm width, such as 6 - 20 kN/m width.

[0049] According to a particular aspect of the present invention, the membrane including the features characteristic of the membrane according to the present invention may constitute a microporous or microperforated foil as the first and second foils may be laminated together and may constitute a microporous film produced from the laminated original first and second foils which are exposed after lamination to a uni- or bi-directional stretching process for causing micro-particulate generators included in the original foil materials to create micropores of the laminated and unidirectional or bidirectional stretched laminated foils, and the polymer fiber or monofilament material of the reinforcing mesh further being constituted by fiber or monofilament material converted from unstretched fiber or monofilament material into stretched fiber or monofilament material in a stretching process carried out in conjunction with the unidirectional or bidirectional stretching of the laminated original first and second foils.

[0050] According to this particular aspect of the present invention, the unidirectional or bidirectional elongation of the original first and second foils being an elongation of the order of 10 - 1000%, such as 50 - 500%, e.g. 100- 400%, and the stretching of the fiber or wire material of the mesh structure being of the same order as the uni- or bidirectional elongation of the original first and second foil materials.

[0051] It is to be realised that the technique of providing a microporous foil through the uni or bidirectional elongation of the foil and the utilisation of microparticulate generators is in itself known in numerous publications, such as e.g. EP 0 492 942. Reference is made to this publication.

Preferably, said polymer materials of said first and/or second foil comprising VLDPE or LLDPE, have a bimodal molecular weight distribution, and polymerised utilising a single-site catalyst or a metallocene catalyst technology.

[0052] The above objects, the above advantage and the above feature together with numerous other objects, features and advantages which will be evident from the below detailed description of presently preferred embodiments of the invention is, according to a second aspect of the present invention obtained by a method of producing a membrane, in particular a waterproofing membrane for use in the field of house building or construction, in particular for use as an underroof membrane, scaffold sheeting, tarpaulins, geo membranes, vapour barriers, wind barriers, damp proof membranes, world aid shelters, military shelters etc., the method comprising:

providing a reinforcing regularly laid, woven or non woven mesh comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,

providing a first foil of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,

providing a second foil of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and

applying a lubricating material such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils and substantially non-dissolvable within said polymer materials of said first and second foils to said mesh for coating said mesh with said lubricating material, and

interlaying and sandwiching said reinforcing mesh provided with said lubricating material coating between said first and second foils and laminating said first and second foils together for allowing said lubricating material coated reinforcing mesh to be moveable relative to said first and second sandwiching foils within said sandwich structure.

[0053] As indicated above, the sandwich structure establishing the enclosure for the reinforcing mesh in the membrane according to the present invention may be established in accordance with two alternative techniques, as in the first place, the first and second foils may be produced separately and prefabricated prior to the laminating of the foils together in the sandwich structure or alternatively, the first foil may be extruded prior to, and the second foil in conjunction with the step of laminating the first and the second foil together in the sandwich structure.

[0054] The invention is now to be further described with reference to the drawings, in which

Fig. 1 is an overall perspective and schematic view illustrating a first embodiment of a method of producing, in accordance with the teachings of the present invention, a membrane including a reinforcing grid or mesh,

Fig. 2a is similar to Fig. 1 an overall perspective and schematic view illustrating an alternative and presently preferred embodiment of a method according to the present invention of producing a grid or mesh reinforced membrane according to the present invention,

Fig. 2b is, similar to Figs. 1 and 2a, an overall perspective and schematic view illustrating a further alternative embodiment of the method according to the present invention of producing a grid or mesh reinforced membrane according to the present invention.

Fig. 3 is a perspective and schematic view illustrating a further or third embodiment of the method of producing a grid or mesh reinforced membrane according to the present invention,

Fig. 4 is a perspective, schematic and partly sectional view of a membrane according to the present invention including a reinforcing grid or mesh,

Figs. 5 and 6 are perspective, schematic and partly sectional views similar to the view of Fig. 4, illustrating a particular aspect of the present invention of producing a unidirectional or alternatively a bidirectional stretched foil for generating a microporous membrane, and,

Figs. 7 and 8 are perspective and schematic views illustrating the advantages accomplished through the grid or mesh reinforcing technique characteristic of the present invention as to mechanical tear resistance as compared to a prior art grid or mesh reinforced membrane.

[0055] In Fig. 1, a process line is shown designated the reference numeral 10 in its entirety for carrying out a method of producing a composite grid or mesh reinforced membrane composed of two laminated plastic foils between which a reinforcing mesh or grid is interlayered. In Fig. 1, the reference numerals 12 and 20 designate two plastic foils from which the composite or reinforced membrane is produced. The foils 12 and 20 constitute a bottom and top layer, respectively, of the final membrane and are delivered from two rolls 14 and 22, respectively. The rolls 14 and 22 are journalled on axle 16 and 24, respectively. The two foils 12 and 20 are joint together by means of two pressure rollers 18 and 26 for contacting the two foils 12 and 20 to one another. From a grid or mesh supply or roll 30, a mesh or grid 28 is delivered. The roll 30 is journalled on an axle 32 and is passed round a supporting roller 34 for allowing a lubricating oil or wax to be sprayed on to the fibers of the grid or mesh 28. The lubricating oil or wax is designated the reference numeral 40 and is delivered from dies 38 from a container 36, preferably a heated container, in which the lubricating oil or wax is contained.

[0056] The foils 12 and 20 may be constituted by any appropriate, preferably weather resistant plastics material, such as a PE, preferably LDPE or MDPE; LLDPE; VLDPE, alternatively termed plastomers; EVA; EBA; EMA; EAA; PP, preferably isotactic polypropylene homopolymer; random copolymers of propylene and ethylene, alternatively termed raco-PP; copolymers of propylene, ethylene and optionally higher alpha-olefins such as heterophasic block polymers, TPO; Polybutylene (Poly(1-butene)); block copolymers; crosslinked polymers such as EPDM, SBR, EPR, PIB, PEX, PIP, polyisobutylene and TPU; Plasticized PVC ; and blends or mixtures of any of the above, preferably having a bimodal molecular weight distribution, being block copolymers or combinations of block and copolymers.

[0057] The fibers of the mesh or grid 28 may be constituted by any relevant fiber, filament or wire material which is compatible with the foil materials of the foils 12 and 20 and which are further compatible with the lubricating oil or wax 40. Examples of relevant materials are polypropylene, preferably isotactic or syndiotactic polypropylene, polyethylene, preferably high density polyethylene polyester or polyesters, polyamide or polyamides, polyacrylonitrile or polyurethane or polyurethanes or a combination of the above materials.

[0058] The reinforcing grid or mesh may be made from polymer fiber, filament or wire material of a thickness of 0.1 - 1mm, preferably 0.1 - 0.4 mm or of a thickness of 0.1 - 0.15 mm, 0.15 - 0.2 mm, 0.2 - 0.25 mm, 0.25 - 0.3 mm, 0.3 - 0.35 mm, 0.35 - 0.4 mm, 0.4 - 0.45 mm, 0.45 - 0.5 mm, 0.5 - 0.55 mm, 0.55 - 0.6 mm, 0.6 - 0.65 mm, 0.65 - 0.7 mm, 0.7 - 0.75 mm, 0.75 - 0.8 mm, 0.8 - 0.85 mm, 0.85 - 0.9 mm, 0.9 - 0.95 mm, 0.95 - 1 mm, and/or said reinforcing mesh being made of polymer fiber, filament or wire material of a thickness of 300 - 4000 dtex (g/10.000m), e.g. 1000 - 2000 dtex, preferably 1000 - 1500 dtex, or of a thickness of 300 - 600 dtex, 600 - 700 dtex, 700 - 800 dtex, 800 - 900 dtex, 900 - 1000 dtex, 1000 - 1250 dtex, 1250 - 1500 dtex, 1500 - 1750 dtex, 1750- 2000 dtex, 2000 - 2500 dtex, 2500 - 3000 dtex, 3000 -3500 dtex or 3500 - 4000 dtex.

[0059] The grid or mesh 28 may advantageously define a square or alternatively a rectangular mesh configuration defining a mesh size of the order of 5 - 40mm, such as 5 - 20 mm, preferably 5 - 15 mm, such as approximately 10 mm, or a mesh size of the order of 0 - 7 mm, 7 - 9 mm, 9 - 11 mm, 11 - 13 mm, 13 - 15 mm, 15 - 20 mm, 20 - 25 mm, 25 -30 mm, 30 - 35 mm or 35 - 40 mm.

[0060] After the joining of the two plastics foils 12 and 14 together sandwiching the mesh or grid 28, a composite sandwich 42 is produced which is input to a heating oven 44 in which the plastic materials of the foils 12 and 40 are softened for causing the two foils 12 and 20 to adhere to one another. The resulting or final product is output from an output aperture 46 of the oven 44 and is shown in the right hand part of Fig. 1 and is designated the reference numeral 50.

[0061] The structure of the final grid or mesh reinforced membrane 50 is described in greater details below with reference to Fig. 4.

[0062] In Fig. 2a, an alternative embodiment of a plant for producing the composite grid or mesh reinforced membrane according to the present invention is shown designated the reference numeral 10' in its entirety. In the below description, components or elements which have been described previously and are designated in the previous description a specific reference numeral, are in the description designated the same reference numeral as previously used and are only discussed or described in the context necessitated by the description itself. Components or elements differing from components or elements, respectively, described previously, still fulfilling the same purpose as a component or element previously described, is designated the same reference integer, however added a marking for identifying the difference to the previously described component or element.

[0063] The process line outlined in Fig. 2a basically differs from the above-described plant 10 shown in Fig. 1 in that the softening oven 44 is omitted and the prefabricated foil 20 is substituted by a foil 25 which is readily extruded from an extruder 21 prior to the step of contacting the foil with the reinforcing grid or mesh 28 and the bottom foil 12 and may be considered constituting a molden foil. In Fig. 2a, an extruder 21 is shown including an extrusion die 23 from which the extruded foil 25 is delivered. The foil 25 is, along with the reinforcing grid or mesh 28 and the bottom foil 12 input to a small gap between a pressure roller 17 which is pressed in the direction indicated by an arrow 19 into contact with a large diameter cooling roller 27 which is journalled on an axle 29. In Fig. 2a, the grid or mesh 28 is passed round an additional roller 35 prior to introducing the grid or mesh into the gap between the prefabricated bottom foil 12 and the readily extruded foil 25.

[0064] In Fig. 2a, the softening oven 44 is omitted and the final product delivered from the large diameter cooling roll 27 is passed round two rollers 31 and 33 before the finalised and cooled off membrane 50 is collected on a roll 52 which is journalled on an axle 54.

[0065] In the right hand top part of Fig. 2a, an additional supply 22' of an additional foil is shown in phantom lines indicating a technique of producing a multilayer membrane by the supply of an additional foil 20' similar to the previously described foil 20 shown in Fig. 1 to the gap between the rollers 17 and 27 as the additional foil 20' is positioned on top of the readily extruded foil 25.

[0066] In Fig. 2b, a further alternative embodiment of a plant for producing the composite grid or mesh reinforced membrane according to the present invention is shown, designated the reference numeral 10" in its entirety.

[0067] The process line outlined in Fig. 2b basically differs from the process line or plant 10' shown in Fig. 2a in that the bottom foil 12 is produced online by means of a further extruder 21' including an extrusion die 23' from which the extruded foil 25' is delivered. The extruded and softened foil 25' is passed round a cooling roller 27' which is journalled on an axle 29' from the cooling roller 27', a soft, yet partly solidified foil constituting the bottom foil 12 is delivered to the gap between the pressure roller 17 and the large diameter cooling roller 27, also shown in Fig. 2a.

[0068] Although the process of laminating the foils together in the plants described above with reference to Fig. 1, 2a and 2b, include the lamination of two individual foils, it is to be realised that each of the two laminating foils 12 and 14 may be composed of a plurality of individual foils or alternatively constitute co-extruded multilayer foils.

[0069] In Fig. 3, an alternative or third method of producing the grid or mesh reinforced, composite membrane according to the present invention is shown. In Fig. 3a, the membrane is produced by sequentially laying the individual components of the membrane on top of one another. From the right hand side of Fig. 3, the bottom foil 12 is shown, on top of which transversal fibers 28a extend. Further, on top of the transversal fibers 28a, longitudinally extending fibers 28b are positioned extending longitudinally relative to the foil 12 and at the same time, the lubricating oil or wax 40 is discharged and applied to the mesh or grid 28 from the dies 38. Finally, on top of the grid or mesh 28 composed of the individual orthogonal fibers 28a and 28b, the top foil 20 is applied.

[0070] In Fig. 4, a particular feature characteristic of the present invention is illustrated. For allowing the reinforcing grid or mesh 28 to move within the sandwich structure defined by the two foils 12 and 20, the fibers 28a and 28b of the grid or mesh 28 are provided with or coated with a lubricating wax or oil. In Fig. 4, the reference numeral 40a designate microglobules or microdroplets of the lubricating wax or oil allowing the fibers 28a and 28b to move and shift relative to the sandwiching foils 12 and 20 and in doing so allowing the composite membrane structure to accommodate force impacts which might else cause the composite membrane structure to be torn apart, as is illustrated in Figs. 7 and 8. Alternatively and preferably, the wax or oil is applied in and present as a thin surface coating rather than present in individual microglobules or microdroplets.

[0071] In Figs. 5 and 6, a further feature of the present invention is illustrated. In Fig. 5, microgenerators, for the generation of microperforations of the sandwiching foils 12 and 40 are shown, which generators are designated the reference numeral 52. The foils 12 and 20 are in the embodiment shown in Fig. 5 constituted by unidirectionally stretched foils and similarly, at least the fibers 28b are constituted by longitudinally extendable or stretchable fibers. In Fig. 6, the foils 12 and 20 and also the fibers 28b have been stretched, as indicated by the arrow 57 and through the elongation of the foils 12 and 20, the microperforation generators 53 cause the foils 12 and 20 to be perforated, as is illustrated in the left hand part of Fig. 6, in which part the reference numeral 55 designates a microperforation of the top foil 20. As the perforations, such as the perforation 55 of the foil 20 is generated by means of microperforation generators 53, originally present at the interface between the two foils 12 and 20, the generation of a microperforation in the one foil, such as the foil 20, most likely also causes the generation due to the same microperforation generator of the opposite foil, such as the foil 12. Consequently, the perforation generation technique illustrated in Figs. 5 and 6 results in the generation of a microperforated two-layer foil structure, which foil structure is also a grid or mesh reinforced membrane structure. Provided the foils 12 and 20 are bidirectionally stretchable foils and also the fibers 20a constitute stretchable fibers, the elongation step illustrated by the arrow 57 may be complemented by an additional elongation step for elongating the foils 12 and 20 and also the fibers 28a in a transversal direction relative to the direction indicated by the arrow 54 and consequently along the longitudinal direction of the fibers 28a. Consequently, a mesh reinforced bidirectionally stretched microperforated mesh or grid reinforced membrane structure is provided.

[0072] In Figs. 7 and 8, the toughness or mechanical strength improving aspect of the present invention is perceptually illustrated as in Fig. 7, the membrane according to the present invention is shown, which membrane is exposed to a force impact along the direction indicated by the arrow 58. The foil is maintained in the specific position shown in Fig. 8 by means of an arresting post 56. As the force impact is applied in direction differing from the direction of the orthogonal reinforcing mesh 28, the force impact or the pull 58 will inevitably generate stresses in the foils 12 and 20 of the membrane structure 50. As the foils 12 and 20 are themselves of a strength far lower than the strength of the fibers 28a and 28b, the force impact to the membrane structure is transformed into a force impact to the foils 12 and 20 through the whole membrane structure. Provided the grid or mesh 28 is maintained in a fixed position relative to the foils 12 and 20, the impact may cause local stress concentrations at certain areas or points of the foil and may tear apart the membrane structure. The presence of the lubricating oil or wax at the fibers 28a and 28b of the reinforcing grid or mesh 28, however, allows the reinforcing fibers 28a and 28b to move within the sandwiching structure defined by the two foils 12 and 20 and in doing so, reduces the potential energy accumulated within the membrane structure and thereby prevents the foils 12 and 20 from being exposed to excessive local stresses which might else tear apart the fairly weak foils.

[0073] In Fig. 8, a similar situation is shown in which a conventional grid or mesh reinforced membrane 60 is shown in which the sandwiching foils are designated the reference numerals 62 and 64 and the reinforcing grid or mesh is designated the reference numeral 66. Contrary to the membrane shown in Fig. 7 according to the present invention, the reinforcing grid or mesh 66 of the membrane structure 60 shown in Fig. 8 is rigidly fixated within the foil sandwiching structure and cannot be shifted relative to the sandwiching foils 62 and 64. Consequently, the force impact along the direction indicated by the arrow 58 may consequently cause a local stress to the foils 62 and 64 causing a tearing apart of the foils from the reinforcing grid or mesh 66, as is indicated by the reference numeral 70 which reference numeral indicates certain tearing lines along which the foils 62 and 64 are torn apart.

EXAMPLE 1

[0074] In a prototype implementation of the membrane 50 shown in Figs. 1, 2a, 2b, 3 and 4 the following elements were used. A bimodal MWD LLDPE, e.g. Borstar™ from Borealis, Grade FB 2230 was used to extrude the bottom foil 12 having a thickness corresponding to app. 60 g/m^2.

[0075] The bottom foil 12 was fitted with the 12 x 12 mm reinforcing mesh 28 made from PP multifilament 1100 denier using a PE-paraffin wax, and a blend of 70/30 LDPE and DEX PLASTOMERS' Exact plastomer was used to readily extrude the top foil 20 in a thickness corresponding to app 90 g/m^2. Black pigmentation (carbon black) and UV-stabiliser was added. Accordingly, the overall membrane was produced on a plant similar to the plant shown in Fig. 2, as the top foil was produced in an online extrusion process prior to the lamination process carried out by means of the large diameter cooling roller 27. The lubricant material was present in an amount of approximately 20% by weight of the weight of the multifilament reinforcing mesh 28.

[0076] The mechanical properties, i.e. tensile strength, tearing strength and puncture proof resistance, of the resulting membrane are compared to the corresponding properties of a conventional LDPE-based membrane produced by the above described conventional methods in the tables below.

Conventional membranes and membranes according to the invention

[0077]

Product Property	Conventional membrane 1	Conventional membrane 2	Membrane acc. to the invention 1	Membrane acc. to the invention 2
Structure	LDPE foils, 12x12 Multifil PP 1100 den matt	LDPE foils; 12x12 Multifil PP, 1100 den	Bimodal LLDPE foils, 12x12 multifil PP 1100 den., matt	Bimodal LLDPE foils, 12x12 multifil PP 1100 den.
Weight (g/m^2)	275	237	170	145
Foil Thickness (mm)	0.28	0.225	0.153	0.127
Tear strength, CD (N)	195	183	211	193
Tear strength pr. thickness (N/mm)	698	813	1377	1520
Specific tear strength (Nm^2/g)	0.71	0.77	1.24	1.33

[0078] The results indicate that specific tear strength is improved significantly compared to conventional LDPE membranes, with similar mesh net.

EXAMPLE 2

[0079] In a further prototype implementation of the membrane 50 shown in Figs. 1, 2a, 2b, 3 and 4 the following elements were used. A blend of LDPE and the Exact plastomer from DEX PLASTOMERS, i.e. a copolymer of ethylene and octene having a high comonomer-content, were mixed in a 70/30-ratio and used to extrude the bottom foil 12 having a thickness corresponding to app. 60 g/m^2.

[0080] The bottom foil 12 was fitted with the 8 x 8 mm reinforcing mesh 28 made from PP multifilament 1100 denier using a PE-paraffin wax, and a blend of LDPE and the Exact plastomer from DEX PLASTOMERS in a 70/30 ratio was used to readily extrude the top foil 20 in a thickness corresponding to app 90 g/m^2. Black pigmentation (carbon black) and UV-stabiliser was added. The lubricant material was present in an amount of approximately 20% by weight of the weight of the multifilament reinforcing mesh 28.

[0081] The mechanical properties are improved by using a blend having a higher content of the copolymer and a mesh made from 1800 denier. But this also increases production costs.

Product Property	Conventional membrane 1	Conventional membrane 2	Membrane according to the invention
Structure	LDPE foils; 8x8 net in PP multifil 1100 den	LDPE foils; 9x10 Leno weave HDPE tapes	LDPE/Plastomer blend foils; 8x8 net multifil in 1100 den.
Weight (g/m^2)	231	139	172
Foil Thickness (mm)	0.200	0.120	0.140
Tear strength MD (N)	208	106	240
Tear strength pr. thickness (N/mm)	1040	888	1713
Specific tear strength (Nm^2/g)	0.90	0.76	1.40
Nail resistance MD CD	483 468	268 280	425 296
Specific nail tear			

(continued)

Product Property	Conventional membrane 1	Conventional membrane 2	Membrane according to the invention
Structure	LDPE foils; 8x8 net in PP multifil 1100 den	LDPE foils; 9x10 Leno weave HDPE tapes	LDPE/Plastomer blend foils; 8x8 net multifil in 1100 den.
MD CD (N/mm)	2415 2340	2233 2336	3034 2831
Perforation resistance (N)	54.6	25.0	46.3
Specific perforation resistance (N/mm)	273	208	330

[0082] The results indicate that specific tear strength is improved significantly compared to a product with comparable net mesh by changing the foil material.

[0083] Specific Nail resistance and puncture resistance is also improved significantly.

EXAMPLE 3

[0084] In a further implementation of the membrane 50 shown in Fig. 1, 2, 3, and 4 the following elements are used. A polypropylene base copolymer, comprising a minor amount of ethylene (2 - 4 %), i.e. a raco (random copolymer) PP, with a melting point of app. 148°C, is used to extrude the bottom foil 12 having a thickness corresponding to app. 40 g/m^2.

[0085] The bottom foil is fitted with the 15 x 15 mm reinforcing mesh 28 made from PP multifilament 1100 denier using a PE-paraffin wax, and the same raco-PP is used to readily extrude the top foil 20 in a thickness corresponding to app 40 g/m^2, resulting in a membrane having a thickness corresponding to app. 105 g/m^2.

[0086] The resulting membrane has properties making it applicable for use as a vapour control layer in construction.

EXAMPLE 4

[0087] In a further implementation of the membrane 50 shown in Fig. 1, 2, 3, and 4 the following elements are used. A heterophasic copolymer of propylene and ethylene (TPO, termoplastic polyolefin), e.g. Hifax or Astryn from Montell, including blue dye is used to extrude the top foil 12 having a thickness corresponding to app. 150 g/m^2.

[0088] The top foil 12 is fitted with the 9 x 12 mm reinforcing mesh 28 made from 0,37 mm ∅ monofilament PET 1500 denier, and the same heterophasic copolymer including white dye is used to readily extrude the top foil 20 in a thickness corresponding to app 200 g/m^2, resulting in a membrane having a thickness corresponding to app. 390 g/m^2.

[0089] The resulting membrane has properties making it applicable for uses necessitating heat welding, i.e. as humid or wet room membranes.

EXAMPLE 5

[0090] In a further implementation of the membrane 50 shown in Fig. 5 and 6 the following elements are used. A PP bottom foil 12 including particles, e.g. the films described in EP 0 492 942, is fitted with the 12 x 12 mm reinforcing mesh 28 made from PP multifilament having partly stretched fibers (POY, partly oriented yarns).

[0091] Following heating to a temperature slightly below the melting temperature, the membrane is then stretched uni-axially or directionally or bib-axially or directionally, whereby the mesh-fibers are fully stretched (FOY, Fully oriented yarns), inducing high strength and low elongation.

[0092] This procedure ensures that the membrane becomes micro-porous.

[0093] Although the present invention has above been described with reference to specific an presently preferred embodiments, the present invention is by no means to be construed limited to the above embodiments, rather is the invention to be understood as defined in the appending claims.

Particular points characterising the present invention:

[0094]

1. A membrane, in particular a waterproofing membrane for use in the field of house building or construction, in particular for use as an underroof membrane, scaffold sheeting, tarpaulins, geo membranes, vapour barriers, wind barriers, damp proof membranes, world aid shelters, military shelters etc., comprising:

a reinforcing regularly laid, woven or non woven mesh comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,
a first foil of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,
a second foil of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and
said reinforcing mesh being interlayered in a sandwich structure between said first and second foils and being moveable relative to said first and second sandwiching foils as said mesh be coated with a lubricating material, such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils and substantially non-dissolvable within said polymer materials of said first and second foils.

2. The membrane according to point 1, said first and second polymer materials together constituting less than 90%, such as 80% or 50 - 80%, e.g. 60 - 80% or 70 - 80%, or alternatively 50 - 60%, 60 - 70%, 70 - 80% or 80 - 90% of the total weight of said membrane.

3. The membrane according to any of the points 1 or 2, said membrane exhibiting a specific tear strength/film thickness of the order of more than 800 N/mm thickness, preferably more than 1000 N/mm thickness, such as more than 1200 N/mm or even more than 1500 N/mm (measured according to ISO 6381/1).

4. The membrane according to point 3, said membrane exhibiting a ratio as expected in tear strength to weight of higher than 1,0 N/(g/m^2), preferably higher than 1,4 N/(g/m^2).

5. The membrane according to any of the points 1-4, said membrane exhibiting a puncture resistance, i.e. puncture resistance/film thickness of more than 250 N/mm thickness, preferably more than 300 N/mm or even more than 350 N/mm (according to NT Build 336/1988-9 except with a 10mm chisel).

6. The membrane according to any of the points 1-5, said membrane exhibiting a nail tear resistance of more than 1000 N/mm, preferably more than 1500 N/mm, or even more than 2000 N/mm (measured according to ASTM D 1117-80 at a speed of 100mm/min., or ISO 6381/1 or prEN 12112-2:1995).

7. The membrane according to any of the points 1-6, said polymer fiber or wire material of said reinforcing mesh being polypropylene, preferably isotactic polypropylene, polyethylene, preferably high density polyethylene polyester or polyesters, polyamide or polyamides, polyimide or polyimides, polyacrylonitrile or polyurethane or polyurethanes or polyvinylalcohols or a combination of the above materials.

8. The membrane according to any of the points 1-7, said reinforcing mesh being made of a polymer fiber, filament or wire material of a thickness of 0.1 - 1 mm, preferably 0.1 - 0.4 mm or of a thickness of 0.1 - 0.15 mm, 0.15 - 0.2 mm, 0.2 - 0.25 mm, 0.25 - 0.3 mm, 0.3 - 0.35 mm, 0.35 - 0.4 mm, 0.4 - 0.45 mm, 0.45 - 0.5 mm, 0.5 - 0.55 mm, 0.55 - 0.6 mm, 0.6- 0.65 mm, 0.65 - 0.7 mm, 0.7 - 0.75 mm, 0.75 - 0.8 mm, 0.8 - 0.85 mm, 0.85 - 0.9 mm, 0.9 - 0.95 mm, 0.95 - 1 mm, and/or said reinforcing mesh being made of polymer fiber, filament or wire material of a thickness of 300 - 4000 dtex (g/10.000m), e.g. 1000 - 2000 dtex, preferably 1000 - 1500 dtex, or of a thickness of 300 - 400 dtex, 400 - 500 dtex, 500 - 600 dtex, 600 - 700 dtex, 700 - 800 dtex, 800 - 900 dtex, 900 - 1000 dtex, 1000- 1250 dtex, 1250 - 1500 dtex, 1500 - 1750 dtex, 1750 - 2000 dtex, 2000 - 2500 dtex, 2500 - 3000 dtex, 3000 -3500 dtex or 3500 - 4000 dtex.

9. The membrane according to any of the points 1-8, said mesh defining a mesh size of the order of 5 - 40 mm, such as 5 - 20 mm, preferably 5 - 15 mm, such as approximately 10 mm, or a mesh size of the order of 0 - 7 mm, 7 - 9 mm, 9 - 11 mm, 11 - 13 mm, 13 - 15 mm, 15 - 20 mm, 20 - 25 mm, 25 -30 mm, 30 - 35 mm or 35 - 40 mm.

10. The membrane according to point 9, the area of contact between said first and second foils in said sandwich structure constituting more than 50%, such as 50 - 60%, preferably 60 - 70% or 70 - 80% or even more, preferably 80 - 90% of the overall surface area of said membrane.

11. The membrane according to any o the points 1-10, said reinforcing mesh defining a grid of a square configuration, a grid of a rectangular configuration, a grid of a rhombic configuration or a grid of any other geometrical configuration including triangular, elliptical, circular or any other geometrical configuration including linear or curved boundary lines including convex or concave configurations or any combination of the above geometrical configurations.

12. The membrane according to any of the points 1-11, said lubricant material being a lubricant oil or wax, being a mineral lubricant oil or wax or a synthetic lubricant oil or wax, such as an oil or wax having a melting point above approximately 30° - 50° C, or an oil or a wax originally dispersed in water or another solvent.

13. The membrane according to any of the points 1-12, said lubricant material being present in an amount of 10-40% by weight of the weight of said reinforcing mesh, such as 15-30% by weight, preferably 20-25% by weight, or alternatively 10-20%, 20-30% or 30-40% by weight.

14. The membrane according to any of points 1-13, said polymer material of said first and/or said second foil being PE, preferably LDPE or MDPE; LLDPE; VLDPE, alternatively termed plastomers; EVA; EBA; EMA; EAA; PP, preferably isotactic polypropylene homopolymer; random copolymers of propylene and ethylene, alternatively termed raco-PP; copolymers of propylene, ethylene and optionally higher alpha-olefins such as heterophasic block polymers, TPO; POP; Polybutylene (Poly(1-butene)); block copolymers; crosslinked polymers such as EPDM, SBR, EPR, PIB, PEX, PIP, polyisobutylene and TPU; Plasticized PVC ; and blends or mixtures of any of the above, preferably having a bimodal molecular weight distribution, being block copolymers or combinations of block and copolymers.

15. The membrane according to any of the points 1-14, said polymer material of said first foil being identical to said polymer material of said second foil or alternatively said polymer materials of said first and second foils being different from one another.

16. The membrane according to any of the points 1-15, said polymer material of said first foil being of a thickness of 20 μm - 1000 μm, preferably 40 - 200 μm, more preferably 50 - 100 μm and said polymer material of said second foil being of a thickness of 20 μm - 1000 μm, preferably 40-200 μm, more preferably 50-100 μm.

17. The membrane according to any of the points 1-16, said first foil and/or said second foil being made from a single or multilayer foil material provided with a coating of a metallic or non-metallic compound providing a specific radio opaqueness or radio transmission characteristic, such as a specific IR transmission/reflection spectrum, e.g. an IR reflection spectrum corresponding to the IR reflection spectrum of soil.

18. The membrane according to any of the points 1-17, said first and second foils being light reflecting or alternatively light transmitting or at least partly translucent or alternatively pigmented for providing a specific light transmission colouring.

19. The membrane according to any of the points 1-18, said polymer materials of said first foil and/or said second foil being provided through extrusion of the polymer material in question at a specific extrusion temperature, such as an extrusion temperature within the range 150°C - 270°C, such as 220°C - 230°C.

20. The membrane according to any of the points 1-19, the polymer materials of said first foil and/or said second foil being made through curing of the polymer materials in question, the curing being carried out a curing temperature providing a softening point above 100 °C and preferably a melting point above 120 °C.

21. The membrane according to any of the points 1-20, said membrane providing a tensile strength of the order of no less than 6 kN/m width or equivalently 300N/5cm width, such as 6 - 20 kN/m width.

22. The membrane according to any of the points 1-21, the first and second foils being laminated together and constituting a microporous film produced from the laminated original first and second foils which are exposed after lamination to a uni - or bi-directional elongation process for causing microparticulate generators included in the original foil materials to create micropores of the laminated and unidirectional or bidirectional stretched laminated foils, and the polymer fiber or wire material of the reinforcing mesh further being constituted by fiber or wire material converted from unstretched fiber or wire material into stretched fiber or wire material in a stretching process carried out in conjunction with the unidirectional or bidirectional elongation of the laminated original first and second foils.

23. The membrane according to point 22, the unidirectional or bidirectional elongation of the original first and second

foils being an elongation of the order of 10 - 1000%, such as 50 - 500%, e.g. 100 - 400%, and the stretching of the fiber or wire material of the mesh structure being of the same order as the uni- or bidirectional elongation of the original first and second foil materials.

24. A membrane, in particular a waterproofing membrane for use in the field of house building or construction, in particular for use as an underroof membrane, scaffold sheeting, tarpaulins, geo textiles, vapour barriers, wind barriers, damp proof membranes, world aid shelters, military shelters etc., comprising:

a reinforcing regularly laid, woven or non woven mesh comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,
a first foil of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,
a second foil of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and
said reinforcing mesh being interlayered in a sandwich structure between said first and second foils, said polymer materials of said first and/or said second foil being VLDPE or LLDPE, preferably having a bimodal molecular weight distribution or being SSC-(single side catalyst) or metallocene-type PE.

25. The membrane according to point 24, said reinforcing mesh being moveable relative to said first and second sandwiching foils as said mesh be coated with a lubricating material, such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils and substantially non-dissolvable within said polymer materials of said first and second foils.

26. The membrane according to points 24 or 25, further having any of the features of the membrane according to the points 2-12 and 14-22.

27. A method of producing a membrane, in particular a waterproofing membrane for use in the field of house building or construction, in particular for use as an underroof membrane, the method comprising:

providing a reinforcing regularly laid, woven or non woven mesh comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,
providing a first foil of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,
providing a second foil of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and
applying a lubricating material such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils and substantially non-dissolvable within said polymer materials of said first and second foils to said mesh for coating said mesh with said lubricating material, and
interlaying and sandwiching said reinforcing mesh provided with said lubricating material coating between said first and second foils and laminating said first and second foils together for allowing said lubricating material coated reinforcing mesh to be moveable relative to said first and second sandwiching foils within said sandwich structure.

28. The method according to point 27, said first and second foils being provided separately and being pre-fabricated prior to the laminating of the foils together in said sandwich structure.

29. The method according to point 28, said first foil and/or said second foil being extruded prior to and in conjunction with the step of laminating said first and second foils together in said sandwich structure.

30. The method according to any of the points 26-27, said mesh, said first foil, said second foil and said lubricating material together with said membrane in its entity exhibiting any of the features of the membrane according to the points 2-22.

Claims

1. A membrane (50), in particular a waterproofing membrane (50) for use in the field of house building or construction, in particular for use as an underroof membrane, scaffold sheeting, tarpaulins, geo membranes, vapour barriers, wind barriers, damp proof membranes, world aid shelters, military shelters etc., comprising:

   a reinforcing regularly laid, woven or non woven mesh (28) comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,
   a first foil (12) of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,
   a second foil (20) of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and
   said reinforcing mesh (28) being interlayered in a sandwich structure (42) between said first and second foils (12,20) and being moveable relative to said first and second sandwiching foils as said mesh be coated with a lubricating material (40), such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils (12,20) and substantially non-dissolvable within said polymer materials of said first and second foils (12,20).

2. The membrane (50) according to claim 1, said first and second polymer materials together constituting less than 90%, such as 80% or 50 - 80%, e.g. 60 - 80% or 70 - 80%, or alternatively 50 - 60%, 60 - 70%. 70 - 80% or 80 - 90% of the total weight of said membrane (50).

3. The membrane (50) according to any of the claims 1 or 2, said membrane (50) exhibiting a specific tear strength/film thickness of the order of more than 800 N/mm thickness, preferably more than 1000 N/mm thickness, such as more than 1200 N/mm or even more than 1500 N/mm.

4. The membrane (50) according to claim 3, said membrane exhibiting a ratio as expected in tear strength to weight of higher than 1,0 N/(g/m^2), preferably higher than 1.4 N/(g/m^2).

5. The membrane (50) according to any of the claims 1-4, said membrane exhibiting a puncture resistance, i.e. puncture resistance/film thickness of more than 250 N/mm thickness, preferably more than 300 N/mm or even more than 350 N/mm.

6. The membrane (50) according to any of the claims 1-5, said membrane exhibiting a nail tear resistance of more than 1000 N/mm, preferably more than 1500 N/mm, or even more than 2000 N/mm.

7. The membrane (50) according to any of the claims 1-6, said polymer fiber or wire material of said reinforcing mesh (28) being polypropylene, preferably isotactic polypropylene, polyethylene, preferably high density polyethylene polyester or polyesters, polyamide or polyamides, polyimide or polyimides, polyacrylonitrile or polyurethane or polyurethanes or polyvinylalcohols or a combination of the above materials.

8. The membrane (50) according to any of the claims 1-7, said reinforcing mesh (28) being made of a polymer fiber, filament or wire material of a thickness of 0.1 -1 mm, preferably 0.1 - 0.4 mm or of a thickness of 0.1- 0.15 mm, 0.15 - 0.2 mm, 0.2 - 0.25 mm, 0.25 - 0.3 mm, 0.3 - 0.35 mm, 0.35 - 0.4 mm, 0.4 - 0.45 mm, 0.45 - 0.5 mm, 0.5 - 0.55 mm, 0.55 - 0.6 mm, 0.6 - 0.65 mm, 0.65 - 0.7 mm, 0.7 - 0.75 mm, 0.75 - 0.8 mm, 0.8 - 0.85 mm, 0.85 - 0.9 mm, 0.9 - 0.95 mm, 0.95 -1 mm, and/or said reinforcing mesh being made of polymer fiber, filament or wire material of a thickness of 300 - 4000 dtex (g/10.000m), e.g. 1000 - 2000 dtex, preferably 1000 - 1500 dtex, or of a thickness of 300 - 400 dtex, 400 - 500 dtex, 500 - 600 dtex, 600 - 700 dtex, 700 - 800 dtex, 800 - 900 dtex, 900 - 1000 dtex, 1000 - 1250 dtex, 1250 -1500 dtex, 1500 - 1750 dtex, 1750 - 2000 dtex, 2000 - 2500 dtex, 2500 - 3000 dtex, 3000 -3500 dtex or 3500 - 4000 dtex.

9. The membrane (50) according to any of the claims 1-8, said mesh (28) defining a mesh size of the order of 5 - 40 mm, such as 5 - 20 mm, preferably 5-15 mm, such as approximately 10 mm, or a mesh size of the order of 0 - 7 mm, 7 - 9 mm, 9 -11 mm, 11 -13 mm, 13 -15 mm, 15-20 mm, 20 - 25 mm, 25 -30 mm, 30 - 35 mm or 35 - 40 mm.

10. The membrane (50) according to claim 9, the area of contact between said first and second foils (12,20) in said

sandwich structure constituting more than 50%, such as 50 - 60%, preferably 60 - 70% or 70 - 80% or even more, preferably 80 - 90% of the overall surface area of said membrane (50).

11. The membrane (50) according to any of the claims 1-10, said reinforcing mesh (28) defining a grid of a square configuration, a grid of a rectangular configuration, a grid of a rhombic configuration or a grid of any other geometrical configuration including triangular, elliptical, circular or any other geometrical configuration including linear or curved boundary lines including convex or concave configurations or any combination of the above geometrical configurations.

12. The membrane (50) according to any of the claims 1-11, said lubricant material (40) being a lubricant oil or wax, being a mineral lubricant oil or wax or a synthetic lubricant oil or wax, such as an oil or wax having a melting claim above approximately 30° - 50° C, or an oil or a wax originally dispersed in water or another solvent.

13. The membrane (50) according to any of the claims 1-12, said lubricant material (40) being present in an amount of 10-40% by weight of the weight of said reinforcing mesh (28), such as 15-30% by weight, preferably 20-25% by weight, or alternatively 10-20%, 20-30% or 30-40% by weight.

14. The membrane (50) according to any of the claims 1-13, said polymer material of said first and/or said second foil (12,20) being PE, preferably LDPE or MDPE; LLDPE; VLDPE, alternatively termed plastomers; EVA; EBA; EMA; EAA; PP, preferably isotactic polypropylene homopolymer; random copolymers of propylene and ethylene, alternatively termed raco-PP; copolymers of propylene, ethylene and optionally higher alpha-olefins such as heterophasic block polymers, TPO; POP; Polybutylene (Poly(1-butene)); block copolymers; crosslinked polymers such as EPDM, SBR, EPR, PIB, PEX, PIP, polyisobutylene and TPU; Plasticized PVC ; and blends or mixtures of any of the above, preferably having a bimodal molecular weight distribution, being block copolymers or combinations of block and copolymers.

15. The membrane (50) according to any of the claims 1-14, said polymer material of said first foil (12) being identical to said polymer material of said second foil (20) or alternatively said polymer materials of said first and second foils (12,20) being different from one another.

16. The membrane (50) according to any of the claims 1-15, said polymer material of said first foil (12) being of a thickness of 20 μm - 1000 μm, preferably 40 - 200 μm, more preferably 50 - 100 μm and said polymer material of said second foil (20) being of a thickness of 20 μm - 1000 μm, preferably 40-200 μm, more preferably 50-100 μm.

17. The membrane (50) according to any of the claims 1-16, said first foil (12) and/or said second foil (20) being made from a single or multilayer foil material provided with a coating of a metallic or non-metallic compound providing a specific radio opaqueness or radio transmission characteristic, such as a specific IR transmission/reflection spectrum, e.g. an IR reflection spectrum corresponding to the IR reflection spectrum of soil.

18. The membrane (50) according to any of the claims 1-17, said first and second foils (12,20) being light reflecting or alternatively light transmitting or at least partly translucent or alternatively pigmented for providing a specific light transmission colouring.

19. The membrane (50) according to any of the claims 1-18, said polymer materials of said first foil (12) and/or said second foil (20) being provided through extrusion of the polymer material in question at a specific extrusion temperature, such as an extrusion temperature within the range 150°C - 270°C, such as 220°C - 230°C.

20. The membrane (50) according to any of the claims 1-19, the polymer materials of said first foil (12) and/or said second foil (20) being made through curing of the polymer materials in question, the curing being carried out a curing temperature providing a softening claim above 100°C and preferably a melting claim above 120°C.

21. The membrane (50) according to any of the claims 1-20, said membrane (50) providing a tensile strength of the order of no less than 6 kN/m width or equivalently 300N/5cm width, such as 6 - 20 kN/m width.

22. The membrane (50) according to any of the claims 1-21, the first and second foils (12,20) being laminated together and constituting a microporous film produced from the laminated original first and second foils which are exposed after lamination to a uni - or bi-directional elongation process for causing microparticulate generators included in the original foil materials to create micropores of the laminated and unidirectional or bidirectional stretched laminated foils, and the polymer fiber or wire material of the reinforcing mesh (28) further being constituted by fiber or wire material converted from unstretched fiber or wire material into stretched fiber or wire material in a stretching process carried out in conjunction with the unidirectional or bidirectional elongation of the laminated original first and second foils.

23. The membrane (50) according to claim 22, the unidirectional or bidirectional elongation of the original first and second foils (12,20) being an elongation of the order of 10 -1000%, such as 50 - 500%, e.g. 100 - 400%, and the stretching of the fiber or wire material of the mesh structure being of the same order as the uni- or bidirectional elongation of the original first and second foil materials.

24. The membrane (50) according to any of the claims 1-23, said polymer materials of said first and/or said second foil being VLDPE or LLDPE, preferably having a bimodal molecular weight distribution or being SSC-(single side catalyst) or metallocene-type PE.

25. A method of producing a membrane (50), in particular a waterproofing membrane (50) for use in the field of house building or construction, in particular for use as an underroof membrane, the method comprising:

providing a reinforcing regularly laid, woven or non woven mesh (28) comprising a dimensionally mechanical stable polymer fiber, filament or wire material, such as a homogeneous or non-homogeneous fiber material, e.g. a monofilament, a tape, a split film fiber or a multifilament based material, a woven, a braided, a non-woven or a combined woven and non-woven fibrous material,
providing a first foil (12) of a polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration,
providing a second foil (20) of polymer material, preferably a weather resistant polymer material of a single layer configuration or a multilayer configuration, and
applying a lubricating material (40) such as a lubricating oil or wax which is substantially non-aggressive to said polymer materials of said first and second foils and substantially non-dissolvable within said polymer materials of said first and second foils to said mesh for coating said mesh with said lubricating material, and
interlaying and sandwiching said reinforcing mesh (28) provided with said lubricating material (40) coating between said first and second foils (12,20) and laminating said first and second foils (12,20) together for allowing said lubricating material coated reinforcing mesh to be moveable relative to said first and second sandwiching foils within said sandwich structure.

26. The method according to claim 25, said first and second foils (12,20) being provided separately and being prefabricated prior to the laminating of the foils together in said sandwich structure.

27. The method according to claim 26, said first foil (12) and/or said second foil (20) being extruded prior to and in conjunction (21,29) with the step of laminating said first and second foils (12,20) together in said sandwich structure.

Patentansprüche

1. Membran (50), insbesondere wasserdichte Membran (50) zum Gebrauch im Gebiet des Hausbaus, insbesondere zum Gebrauch als Unterdachmembran, Gerüstabdeckung, Planen, Geomembranen, Dampfsperren, Windsperren, feuchtigkeitsbeständige Membranen, Entwicklungshilfeschutzdächer, Militärschutzdächer usw., umfassend:

ein verstärkendes, regelmäßig gelegtes, gewebtes oder nichtgewebtes Netz (28), umfassend ein mechanisch-formbeständiges Polymerfaser-, Filament- oder Kabelmaterial, wie etwa ein homogenes oder nichthomogenes Fasermaterial, beispielsweise ein Material auf Monofilament-, Band-, Spaltfilm-, Faser- oder Multifilamentgrundlage, ein gewebtes, geflochtenes, nichtgewebtes oder kombiniert gewebtes und nichtgewebtes Fasermaterial,
eine erste Folie (12) aus einem Polymermaterial, vorzugsweise ein wetterbeständiges Polymermaterial mit einlagiger Gestaltung oder mehrlagiger Gestaltung,
eine zweite Folie (20) aus einem Polymermaterial, vorzugsweise ein wetterbeständiges Polymermaterial mit einlagiger Gestaltung oder mehrlagiger Gestaltung, und
wobei das verstärkende Netz (28) in Sandwichbauweise (42) zwischen die erste und zweite Folie (12,20) eingeschoben ist und bezüglich der ersten und zweiten Sandwichfolie verschiebbar ist, da das Netz mit einem Schmiermaterial (40), wie etwa einem Schmieröl oder -wachs, das im Wesentlichen nicht angreifend für die Polymermaterialien der ersten und zweiten Folie (12,20) und im Wesentlichen nichtlösbar innerhalb der Poly-

mermaterialien der ersten und zweiten Folie (12,20) ist, beschichtet ist.

2. Membran (50) nach Anspruch 1, wobei das erste und zweite Polymermaterial zusammen weniger als 90%, wie etwa 80% oder 50 - 80%, beispielsweise 60 - 80% oder 70 - 80%, oder alternativ 50 - 60%, 60 - 70%, 70 - 80% oder 80 - 90% des Gesamtgewichts der Membran (50) bilden.

3. Membran (50) nach einem der Ansprüche 1 oder 2, wobei die Membran (50) eine spezifische Reißfestigkeit/Folienstärke in der Größenordnung von über 800 N/mm Stärke, vorzugsweise über 1000 N/mm Stärke, wie etwa über 1200 N/mm oder sogar über 1500 N/mm aufweist.

4. Membran (50) nach Anspruch 3, wobei die Membran ein erwartungsgemäßes Reißfestigkeits/Gewichtsverhältnis von über 1,0 N/(g/m^2), vorzugsweise über 1,4 N/(g/m^2) aufweist.

5. Membran (50) nach einem der Ansprüche 1-4, wobei die Membran eine Durchstoßfestigkeit, d.h. eine Durchstoßfestigkeit/Folienstärke von über 250 N/mm Stärke, vorzugsweise über 300 N/mm oder sogar über 350 N/mm aufweist.

6. Membran (50) nach einem der Ansprüche 1-5, wobei die Membran eine Nagelreißfestigkeit von über 1000 N/mm, vorzugsweise über 1500 N/mm, oder sogar über 2000 N/mm aufweist.

7. Membran (50) nach einem der Ansprüche 1-6, wobei das Polymerfaser- oder Kabelmaterial des verstärkenden Netzes (28) Polypropylen, vorzugsweise isotaktisches Polypropylen, Polyethylen, vorzugsweise Polyethylen hoher Dichte, Polyester, Polyamid oder Polyamide, Polyimid oder Polyimide, Polyacrylnitril oder Polyurethan oder Polyurethane oder Polyvinylalkohole oder eine Kombination der obigen Materialien ist.

8. Membran (50) nach einem der Ansprüche 1-7, wobei das verstärkende Netz (28) aus einem Polymerfaser-, Filament- oder Kabelmaterial mit einer Stärke von 0,1 - 1 mm, vorzugsweise 0,1 - 0,4 mm oder einer Stärke von 0,1 - 0,15 mm, 0,15 - 0,2 mm, 0,2 - 0,25 mm, 0,25 - 0,3 mm, 0,3 - 0,35 mm, 0,35 - 0,4 mm, 0,4 - 0,45 mm, 0,45 - 0,5 mm, 0,5 - 0,55 mm, 0,55 - 0,6 mm, 0,6 - 0,65 mm, 0,65 - 0,7 mm, 0,7 - 0,75 mm, 0,75 - 0,8 mm, 0,8 - 0,85 mm, 0,85 - 0,9 mm, 0,9 - 0,95 mm, 0,95 - 1 mm hergestellt ist, und/oder wobei das verstärkende Netz aus einem Polymerfaser-, Filament- oder Kabelmaterial mit einer Stärke von 300 - 4000 dtex (g/10.000m), beispielsweise 1000 - 2000 dtex, vorzugsweise 1000 - 1500 dtex, oder einer Stärke von 300 - 400 dtex, 400 - 500 dtex, 500 - 600 dtex, 600 - 700 dtex, 700 - 800 dtex, 800 - 900 dtex, 900 - 1000 dtex, 1000 - 1250 dtex, 1250 - 1500 dtex, 1500 - 1750 dtex, 1750 - 2000 dtex, 2000 - 2500 dtex, 2500 - 3000 dtex, 3000 -3500 dtex oder 3500 - 4000 dtex hergestellt ist.

9. Membran (50) nach einem der Ansprüche 1-8, wobei das Netz (28) eine Maschenweite in der Größenordnung von 5 - 40 mm, wie etwa 5 - 20 mm, vorzugsweise 5 - 15 mm, wie etwa ungefähr 10 mm, oder eine Maschenweite in der Größenordnung von 0 - 7 mm, 7 - 9 mm, 9 - 11 mm, 11 - 13 mm, 13 - 15 mm, 15 - 20 mm, 20 - 25 mm, 25 -30 mm, 30 - 35 mm oder 35 - 40 mm definiert.

10. Membran (50) nach Anspruch wobei die Kontaktfläche zwischen der ersten und zweiten Folie (12,20) im Sandwichbau über 50%, wie etwa 50 - 60%, vorzugsweise 60 - 70% oder 70 - 80% oder sogar darüber, vorzugsweise 80 - 90% der Gesamtoberfläche der Membran (50) bildet.

11. Membran (50) nach einem der Ansprüche 1-10, wobei das verstärkende Netz (28) einen Raster mit quadratischer Gestaltung, einen Raster mit rechteckiger Gestaltung, einen Raster mit rautenförmiger Gestaltung oder einen Raster mit jeglicher anderen geometrischen Gestaltung beinhaltend dreieckige, elliptische, kreisförmige oder jegliche andere geometrische Gestaltung, beinhaltend lineare oder gekrümmte Grenzlinien, beinhaltend konvexe oder konkave Gestaltungen oder jegliche Kombination der obigen geometrischen Gestaltungen definiert.

12. Membran (50) nach einem der Ansprüche 1-11, wobei das Schmiermaterial (40) ein Schmieröl oder -wachs ist, ein mineralisches Schmieröl oder -wachs oder ein synthetisches Schmieröl oder -wachs, wie etwa ein Öl oder Wachs mit einem Schmelzpunkt über ungefähr 30° - 50° C, oder ein ursprünglich in Wasser aufgelöstes Öl oder ein Wachs oder ein anderes Lösungsmittel.

13. Membran (50) nach einem der Ansprüche 1-12, wobei das Schmiermaterial (40) in einer Menge von 10-40 Gew.% des Gewichtes des verstärkenden Netzes (28), wie etwa 15-30 Gew.%, vorzugsweise 20-25 Gew.%, oder alternativ 10-20, 20-30 oder 30-40 Gew.% vorhanden ist.

14. Membran (50) nach einem der Ansprüche 1-13, wobei das Polymermaterial der ersten und/oder zweiten Folie (12,20) PE, vorzugsweise LDPE oder MDPE; LLDPE; VLDPE, alternativ Plastomere genannt; EVA; EBA; EMA; EAA; PP, vorzugsweise isotaktisches Polypropylenhomopolymer; Random Copolymere aus Propylen und Ethylen, alternativ PP Raco genant; Copolymere aus Propylen, Ethylen und optional höhere Alpha-Olefine, wie etwa heterophasische Blockpolymere, TPO; POP; Polybutylen (Poly(1-buten)); Blockcopolymere; quervernetzte Polymere, wie etwa EPDM, SBR, EPR, PIB, PEX, PIP, Polyisobutylen und TPU; weichmacherhaltiges PVC; und Mischungen oder Gemische von jeglichen der vorstehenden ist, vorzugsweise mit einer bimodalen Molekulargewichtsverteilung, wenn sie Blockcopolymere oder Kombinationen aus Block und Copolymeren sind.

15. Membran (50) nach einem der Ansprüche 1-14, wobei das Polymermaterial der ersten Folie (12) mit dem Polymermaterial der zweiten Folie (20) identisch ist oder alternativ die Polymermaterialien der ersten und zweiten Folie (12,20) sich unterscheiden.

16. Membran (50) nach einem der Ansprüche 1-15, wobei das Polymermaterial der ersten Folie (12) eine Stärke von 20 μm - 1000 μm, vorzugsweise 40 - 200 μm, noch mehr vorzugsweise 50 - 100 μm aufweist, und das Polymermaterial der zweiten Folie (20) eine Stärke von 20 μm - 1000 μm, vorzugsweise 40-200 μm, noch mehr vorzugsweise 50-100 μm aufweist.

17. Membran (50) nach einem der Ansprüche 1-16, wobei die erste Folie (12) und/oder die zweite Folie (20) aus einem einschichtigen oder mehrschichtigen Folienmaterial hergestellt sind, das mit einer Beschichtung einer metallischen oder nichtmetallischen Verbindung versehen ist, die ein spezifisches Strahlenundurchlässigkeits- oder Strahlentransmissionsmerkmal, wie etwa ein spezifisches IR Durchlässigkeits/Reflexionsspektrum, beispielsweise ein IR Reflexionsspektrum entsprechend dem IR Reflexionsspektrum des Bodens bereitstellt.

18. Membran (50) nach einem der Ansprüche 1-17, wobei die erste und zweite Folie (12,20) lichtreflektierend oder alternativ lichtdurchlassend oder wenigstens teilweise lichtdurchlässig oder alternativ pigmentiert sind, um eine spezifische Lichtdurchlässigkeitsfärbung bereitzustellen.

19. Membran (50) nach einem der Ansprüche 1-18, wobei die Polymermaterialien der ersten Folie (12) und/oder der zweiten Folie (20) durch Extrusion des betreffenden Polymermaterials auf einer spezifischen Extrusionstemperatur, wie etwa einer Extrusionstemperatur im Bereich von 150°C - 270°C, wie etwa 220°C - 230°C, bereitgestellt werden.

20. Membran (50) nach einem der Ansprüche 1-19, wobei die Polymermaterialien der ersten Folie (12) und/oder der zweiten Folie (20) durch Erhitzen der betreffenden Polymermaterialien hergestellt werden, wobei das Erhitzen auf einer Temperatur ausgeführt wird, die einen Erweichungspunkt von über 100°C und vorzugsweise einen Schmelzpunkt von über 120°C vorsieht.

21. Membran (50) nach einem der Ansprüche 1-20, wobei die Membran (50) eine Zugfestigkeit in der Größenordnung von mindestens 6 kN/m Breite oder entsprechend 300N/5cm Breite, wie etwa 6 - 20 kN/m Breite bereitstellt.

22. Membran (50) nach einem der Ansprüche 1-21, wobei die erste und zweite Folie (12,20) aneinander laminiert sind und einen mikroporösen Film bilden, der aus der laminierten originalen ersten und zweiten Folie hergestellt ist, die nach Laminieren einem uni - oder bidirektionalen Dehnungsverfahren ausgesetzt sind, zum Bewirken, dass mikropartikuläre Generatoren, die in die originalen Folienmaterialien eingeschlossen sind, Mikroporen aus den laminierten und unidirektional oder bidirektional gestreckten laminierten Folien bilden, und wobei das Polymerfaser- oder Kabelmaterial des verstärkenden Netzes (28) ferner aus Faser- oder Kabelmaterial besteht, das in einem Streckverfahren, das zusammen mit der unidirektionalen oder bidirektionalen Dehnung der laminierten originalen ersten und zweiten Folie ausgeführt wird, aus ungestrecktem Faser- oder Kabelmaterial in gestrecktes Faser- oder Kabelmaterial umgewandelt wird.

23. Membran (50) nach Anspruch 22, wobei die unidirektionale oder bidirektionale Dehnung der originalen ersten und zweiten Folie (12,20) eine Dehnung in der Größenordnung von 10 - 1000%, wie etwa 50 - 500%, beispielsweise 100 - 400% ist, und das Strecken des Faser- oder Drahtmaterials des Netzbaus in der gleichen Größenordnung wie die uni- oder bidirektionale Dehnung des originalen ersten und zweiten Folienmaterials ist.

24. Membran (50) nach einem der Ansprüche 1-23, wobei die Polymermaterialien der ersten und/oder der zweiten Folie VLDPE oder LLDPE sind, vorzugsweise mit einer bimodalen Molekulargewichtsverteilung, oder die SSC (Single Site Katalysator) oder Organometall Typ PE sind.

25. Verfahren zur Herstellung einer Membran (50), insbesondere einer wasserdichten Membran (50) zum Gebrauch im Gebiet des Hausbaus, insbesondere zum Gebrauch als Unterdachmembran, wobei das Verfahren umfasst:

Bereitstellen eines verstärkenden, regelmäßig gelegten, gewebten oder nichtgewebten Netzes (28), umfassend ein mechanisch-formbeständiges Polymerfaser-, Filament- oder Kabelmaterial, wie etwa ein homogenes oder nichthomogenes Fasermaterial, beispielsweise ein auf Monofilament-, Band-, Spaltfilm-, Faser- oder Multifilamentgrundlage, ein gewebtes, geflochtenes, nichtgewebtes oder kombiniert gewebtes und nichtgewebtes Fasermaterial,
Bereitstellen einer ersten Folie (12) aus einem Polymermaterial, vorzugsweise ein wetterbeständiges Polymermaterial mit einlagiger Gestaltung oder mehrlagiger Gestaltung,
Bereitstellen einer zweiten Folie (20) aus einem Polymermaterial, vorzugsweise ein wetterbeständiges Polymermaterial mit einlagiger Gestaltung oder mehrlagiger Gestaltung, und
Auftragen eines Schmiermaterials (40), wie etwa eines Schmieröls oder -wachses, das im Wesentlichen nicht angreifend für die Polymermaterialien der ersten und zweiten Folie und im Wesentlichen nichtlösbar innerhalb der Polymermaterialien der ersten und zweiten Folie ist, auf das Netz zum Beschichten des Netzes mit dem Schmiermaterial, und
Einschieben des verstärkenden Netzes (28), das mit dem Schmiermaterial- (40) beschichtung versehen ist, in Sandwichbauweise zwischen die erste und zweite Folie (12,20) und Laminieren der ersten und zweiten Folie (12,20) aneinander, zum Ermöglichen, dass das verstärkende mit Schmiermaterial beschichtete Netz bezüglich der ersten und zweiten Sandwichfolie innerhalb des Sandwichbaus verschiebbar ist.

26. Verfahren nach Anspruch 25, wobei die erste und zweite Folie (12,20) vor dem Laminieren aneinander in Sandwichbauweise separat bereitgestellt und vorgefertigt werden.

27. Verfahren nach Anspruch 26, wobei die erste Folie (12) und/oder die zweite Folie (20) vor und zusammen (21,29) mit dem Schritt des Laminierens der ersten und zweiten Folie (12,20) aneinander in Sandwichbauweise extrudiert werden.

Revendications

1. Membrane (50), en particulier une membrane d'étanchéité (50) pour usage dans le domaine de la construction de logements ou du bâtiment, en particulier pour usage comme membrane de sous-toit, revêtement d'échafauds, bâches, géo-membranes, barrières anti-vapeur, barrières contre le vent, membranes étanche à la vapeur, abris d'aide humanitaire mondiale, abris militaires etc. comprenant:

maille tissée de renforcement repartie de manière régulière (28) et comprenant une matière de fibre, de filament ou de fil de polymère mécanique dimensionnellement stable, telle qu'une matière de fibre homogène ou non-homogène, par exemple un monofilament, une bande, une fibre fibrillé fendue ou une matière à base de multifilament, une matière tissée, tressée, non-tissée ou une combinaison de matières fibreuses tissées et non-tissées,
une première feuille (12) d'une matière polymère, préférablement une matière polymère à l'épreuve des intempéries d'une configuration mono-couche ou multicouche,
une deuxième feuille (20) de matière polymère, préférablement une matière polymère à l'épreuve des intempéries d'une configuration mono-couche ou multicouche, et
ladite maille tissée (28) étant intercalée en une structure sandwich (42) entre lesdites première et deuxième feuilles (12, 20) et étant orientable par rapport auxdites première et deuxième feuilles d'encadrement, ladite maille tissée étant revêtue d'une matière lubrifiante (40), telle qu'une huile ou une cire lubrifiante étant substantiellement non-agressives auxdites matières polymères desdites première et deuxième feuilles (12, 20) et substantiellement non-dissolubles au sein desdites matières de polymère desdites première et deuxième feuilles (12, 20).

2. La membrane (50) selon la revendication 1, lesdites premiere et deuxième matières polymères constituant en tout moins de 90%, telle que 80% ou de 50% et 80%, par exemple de 60% à 80% ou de 70% à 80%, ou alternativement de 50 à 60%, 60% à 70%, 70% à 80% ou de 80% à 90%du poids total de ladite membrane (50).

3. La membrane (50) selon l'une quelconque des revendications 1 ou 2, ladite membrane (50) présentant une résistance à la déchirure/épaisseur de feuille spécifique de l'ordre de plus de 800 N/mm d'épaisseur, préférablement plus de

1000 N/mm d'épaisseur, telle que plus de 1200 N/mm ou même plus de 1500 N/mm.

4. La membrane (50) selon la revendication 3, ladite membrane présentant un rapport comme estimé en ce qui concerne la résistance à la déchirure étant supérieure à 1,0 N/(g/m^2), préférablement supérieure à 1,4 N/(g/m^2).

5. La membrane (50) selon l'une quelconque des revendications 1 à 4, ladite membrane présentant une résistance à la perforation, c'est-à-dire une résistance à la perforation/une épaisseur de feuille supérieure à 250 N/mm d'épaisseur, préférablement supérieure à 300 N/mm ou même supérieure à 350 N/mm.

6. La membrane (50) selon l'une quelconque des revendications 1 à 5, ladite membrane présentant une résistance à la déchirure de clou supérieure à 1000 N/mm, préférablement supérieure à 1500 N/mm ou même supérieure à 2000 N/mm.

7. La membrane (50) selon l'une quelconque des revendications 1 à 6, ladite fibre de polymère ou matière de fil de ladite maille de renforcement (28) étant du polypropylène, préférablement du polypropylène isotactique, du polyéthylène, préférablement du polyester ou des polyesters de polyéthylène de haute densité, du polyamide ou des polyamides, du polyimide ou des polyimides, du polyacrylonitrile ou des polyuréthannes ou des polyalcools de vinyle ou une combinaison des matières susnommées.

8. La membrane (50) selon l'une quelconque des revendications 1 à 7, ladite maille de renforcement (28) étant faite d'une fibre de polymère, d'une matière de filament ou de fil d'une épaisseur de 0.1 à 1 mm, préférablement de 0.1 à 0.4 mm ou d'une épaisseur de 0.1 à 0.15 mm, de 0.15 à 0.2 mm, de 0.2 à 0.25 mm, de 0.25 à 0.3 mm, de 0.3 à 0.35 mm, de 0.35 à 0.4 mm, de 0.4 à 0.45 mm, de 0.45 à 0.5 mm, de 0.5 à 0.55 mm, de 0.55 à 0.6 mm, de 0.6 à 0.65 mm, de 0.65 à 0.7 mm, de 0.7 mm à 0.75 mm, de 0.75 à 0.8 mm, de 0.8 à 0.85 mm, de 0.85 à 0.9 mm, de 0.9 à 0.95 mm, de 0.95 à 1 mm, et/ou ladite maille de renforcement étant faite d'une matière de fibre de polymère, de filament ou de fil d'une épaisseur de 300 à 4000 dtex (g/10.000m), par exemple de 1000 à 2000 dtex, préférablement de 1000 à 1500 dtex, ou d'une épaisseur de 300 à 400 dtex, de 400 à 500 dtex, de 500 à 600 dtex, de 600 à 700 dtex, de 700 à 800 dtex, de 800 à 900 dtex, de 900 à 1000 dtex, de 1000 à 1250 dtex, de 1250 à 1500 dtex, de 1500 à 1750 dtex, de 1750 à 2000 dtex, de 2000 à 2500 dtex, de 2500 à 3000 dtex, de 3000 à 3500 dtex ou de 3500 à 4000 dtex.

9. La membrane (50) selon l'une quelconque des revendications 1 à 8, ladite maille (28) définissant une dimension de maille de l'ordre de 5 à 40 mm, telle que de 5 à 20 mm, préférablement de 5 à 15 mm, telle qu'environ 10 mm, ou une dimension de maille de l'ordre de 0 à 7 mm, de 7 à 9 mm, de 9 à 11 mm, de 11 à 13 mm, de 13 à 15 mm, de 15 à 20 mm, de 20 à 25 mm, de 25 à 30 mm, de 30 à 35 mm ou de 35 à 40 mm.

10. La membrane (50) selon la revendication 9, la surface de contact entre lesdites première et deuxième feuilles (12, 20) dans ladite structure sandwich constituant plus de 50%, telle que de 50% à 60%, préférablement de 60% à 70% ou de 70% à 80% ou même plus, préférablement entre 80% et 90% de la superficie totale de ladite membrane (50).

11. La membrane (50) selon l'une quelconque des revendications 1 à 10, ladite maille tissée de renforcement (28) définissant une grille d'une configuration carrée, une grille d'une configuration rectangulaire, une grille d'une configuration rhombique ou une grille de n'importe quel autre configuration géométrique, y compris des configurations triangulaires, elliptiques, circulaires ou toute autre configuration géométrique, y compris des lignes de contour linéaires ou courbés, y compris des configurations convexes ou concaves ou toute autre combinaison des configurations géométriques susnommés.

12. La membrane (50) selon l'une quelconque des revendications 1 à 11, ladite matière lubrifiante (40) étant une huile ou une cire lubrifiante, soit une huile ou une cire lubrifiante minérale ou une huile ou une cire lubrifiante synthétique, telle qu'une huile ou une cire ayant un point de fusion au dessus environ 30° à 50°C, ou une huile ou une cire étant initialement dispersée dans de l'eau ou une autre solvant.

13. La membrane (50) selon l'une quelconque des revendications 1 à 12, ladite matière lubrifiante (40) étant présente dans une quantité de 10 à 40% de poids par rapport au poids de ladite maille tissée de renforcement (28), telle que de 15 à 30% de poids, préférablement de 20 à 25% ou alternativement de 10 à 20%, de 20 à 30% ou de 30 à 40% de poids.

14. La membrane (50) selon l'une quelconque des revendications 1 à 13, ladite matière polymère de ladite première

feuille et/ou ladite deuxième feuille (12, 20) étant du PE, préférablement du LDPE ou MDPE, LLDPE, VLDPE, alternativement désignés des plastomères; EVA; EBA; EMA; EAA; PP, préférablement de l'homopolymère polypropylène isotactique; des copolymères au hasard de propylène et d'ethylène, alternativement désignés raco-PP; des copolymères de propylène, d'ethylène et éventuellement des alpha-oléfines supérieures comme par exemple des copolymères à blocs déphasés, TPO; POP; du polybutylène (Poly(1-butène)); des copolymères à blocs; des polymères à liaisons transversales comme par exemple du EPDM, SBR, EPR, PIB, PEX, PIP, du polyisobutylène et du TPU; du polychlorure de vinyle plastifié; et des combinaisons ou des mélanges de n'importe lesquels parmi les sus-mentionnés, préférablement ayant une distribution de poids moléculaire bimodale, étant des copolymères à blocs ou des combinaisons de bloc et de copolymères.

15. La membrane (50) selon l'une quelconque des revendications 1 à 14, ladite matière polymère de ladite première feuille (12) étant identique à ladite matière polymère de ladite deuxième feuille (20) ou alternativement, lesdites matières desdites première et deuxième feuilles (12, 20) étant différente l'une par rapport à l'autre.

16. La membrane (50) selon l'une quelconque des revendications 1 à 15, ladite matière polymère de ladite première feuille (12) étant d'une épaisseur de 20 μm à 1000 μm, préférablement de 40 à 200 μm, plus préférablement de 50 à 100 μm et ladite matière polymère de ladite deuxième feuille (20) étant d'une épaisseur de 20 μm à 1000 μm, préférablement de 40 à 200 μm, plus préférablement de 50 à 100 μm.

17. La membrane (50) selon l'une quelconque des revendications 1 à 16, ladite première feuille (12) et/ou ladite deuxième feuille (20) étant faites à partir d'une matière de feuille mono-couche ou multicouche munie d'un revêtement d'un mélange métallique ou non-métallique fournissant une opacité de radio spécifique ou une transmission de radio caractéristique, telle qu'une transmission IR spécifique/spectre de réflexion, par exemple un spectre de réflexion IR correspondant au spectre de réflexion IR du sol.

18. La membrane (50) selon l'une quelconque des revendications 1 à 17, lesdites première et deuxième feuilles (12, 20) réfléchissant la lumière ou alternativement transmettant la lumière ou au moins lesdites feuilles sont partiellement translucides ou alternativement pigmentées pour fournir une coloration spécifique de transmission de lumière.

19. La membrane (50) selon l'une quelconque des revendications 1 à 18, lesdites matières de polymère de ladite première feuille (12) et/ou de ladite deuxième feuille (20) étant fournies par l'extrusion de la matière polymère en question à une température d'extrusion spécifique, telle qu'une température d'extrusion dans les limites de l'étendue de 150°C à 270°C, telle que de 220° à 230°C.

20. La membrane (50) selon l'une quelconque des revendications 1 à 19, lesdites matières de polymère de ladite première feuille (12) et/ou ladite deuxième feuille (20) étant faites à travers le durcissement des matières de polymère en question, le durcissement étant effectué à une température de durcissement fournissant un point de ramollissement au dessus de 100°C et préférablement un point dé fusion au dessus de 120°C.

21. La membrane (50) selon l'une quelconque des revendications 1 à 20, ladite membrane (50) fournissant une résistance à la rupture de l'ordre d'au moins 6 kN/m de largeur ou l'équivalent de 300N/5cm de largeur, telle que de 6 à 20 kN/m de largeur.

22. La membrane (50) selon l'une quelconque des revendications 1 à 21, les première et deuxième feuilles (12, 20) étant laminées ensemble et constituant un film microporeux produit à partir des première et deuxième feuilles d'origine laminées qui sont exposées après lamination à un procédé d'élongation unidirectionnelle ou bidirectionnelle pour amener des générateurs micro-particules renfermés dans les matières de feuilles d'origines à créer des micropores des feuilles laminées et unidirectionnelle ou des feuilles laminées élongées bidirectionnelles, et la fibre de polymère ou la matière de fil de la maille de renforcement (28) étant en plus constitué par une matière de fibre ou de fil transformée de matière de fibre ou de fil non-élongée en une matière de fibre ou de fil élongée lors d'un processus d'extension effectué en liaison avec l'élongation unidirectionnelle ou bidirectionnelle des première et deuxième feuilles laminées.

23. La membrane (50) selon la revendication 22, l'élongation unidirectionnelle ou bidirectionnelle des première et deuxième feuilles d'origine (12, 20) étant une élongation de l'ordre de 10 à 1000%, telle que de 50 à 500%, par exemple de 100 à 400%, et l'extension de la matière de fibre ou de fil de la structure de maille étant du même ordre que l'élongation unidirectionnelle ou bidirectionnelle des matières des première et deuxième feuilles.

24. La membrane (50) selon l'une quelconque des revendications 1 à 23, lesdites matières de polymère de ladite première et/ou ladite deuxième feuille étant du VLDPE ou du LLDPE, préférablement ayant une distribution de poids moléculaire bimodale ou étant du PE du type catalyseur monosite ou metallocène.

25. Procédé de production d'une membrane (50), en particulier une membrane d'étanchéité (50) pour usage dans le domaine du bâtiment ou de construction des maisons, particulièrement pour usage comme membrane de sous-toit, le procédé comprenant:

la réalisation une maille tissée de renforcement (28) repartie de manière régulière et comprenant une matière de fibre, de filament ou de fil de polymère mécanique dimensionnellement stable, telle qu'une matière de fibre homogène ou non-homogène, par exemple un monofilament, une bande, une fibre fibrillée fendue ou une matière à base de multifilament, une matière tissée, tressée, non-tissée ou une combinaison de matières fibreuses tissées et non-tissées,
la réalisation d'une première feuille (12) d'une matière polymère, préférablement une matière polymère résistant aux intempéries et d'une configuration mono-couche ou multicouche,
la réalisation d'une deuxième feuille (20) de matière polymère, préférablement une matière polymère à l'épreuve des intempéries et d'une configuration mono-couche ou multicouche, et
l'étalage d'une matière lubrifiante (40), telle qu'une huile ou une cire étant substantiellement non-agressives auxdites matières de polymère desdites première et deuxième feuilles et substantiellement non-dissolubles au sein desdites matières polymères desdites première et deuxième feuilles à ladite maille afin de revêtir ladite maille avec ladite matière lubrifiante, et
l'intercalation et l'encadrement de ladite maille de renforcement (28) munie de ladite matière lubrifiante (40) de revêtement entre lesdites première et deuxième feuilles (12, 20) et la lamination desdites première et deuxième feuilles (12, 20) ensemble pour permettre ladite maille de renforcement revêtue d'une matière lubrifiante d'être orientable par rapport auxdites première et deuxième feuilles d'encadrement au sein de ladite structure sandwich.

26. Le procédé selon la revendication 25, lesdites première et deuxième feuilles (12, 20) étant établies séparément et étant préfabriqué en avance de la lamination des feuilles dans ladite structure sandwich.

27. Le procédé selon la revendication 26, ladite première feuille (12) et/ou ladite deuxième feuille (20) étant extrudées en avance de et en liaison (21, 29) avec l'étape consistant en laminant lesdites première et deuxième feuilles (12, 20) ensemble dans ladite structure sandwich.

Fig. 1

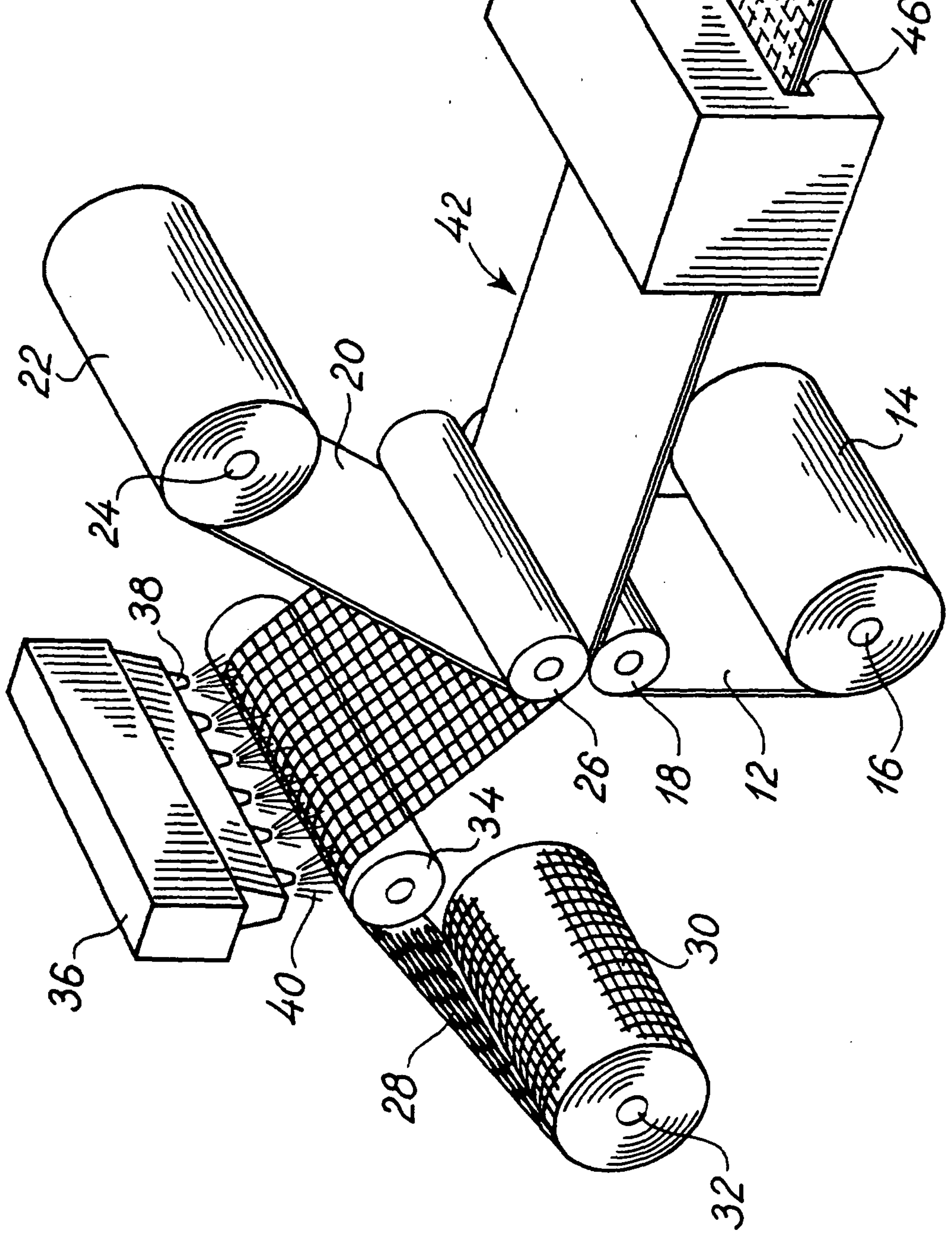
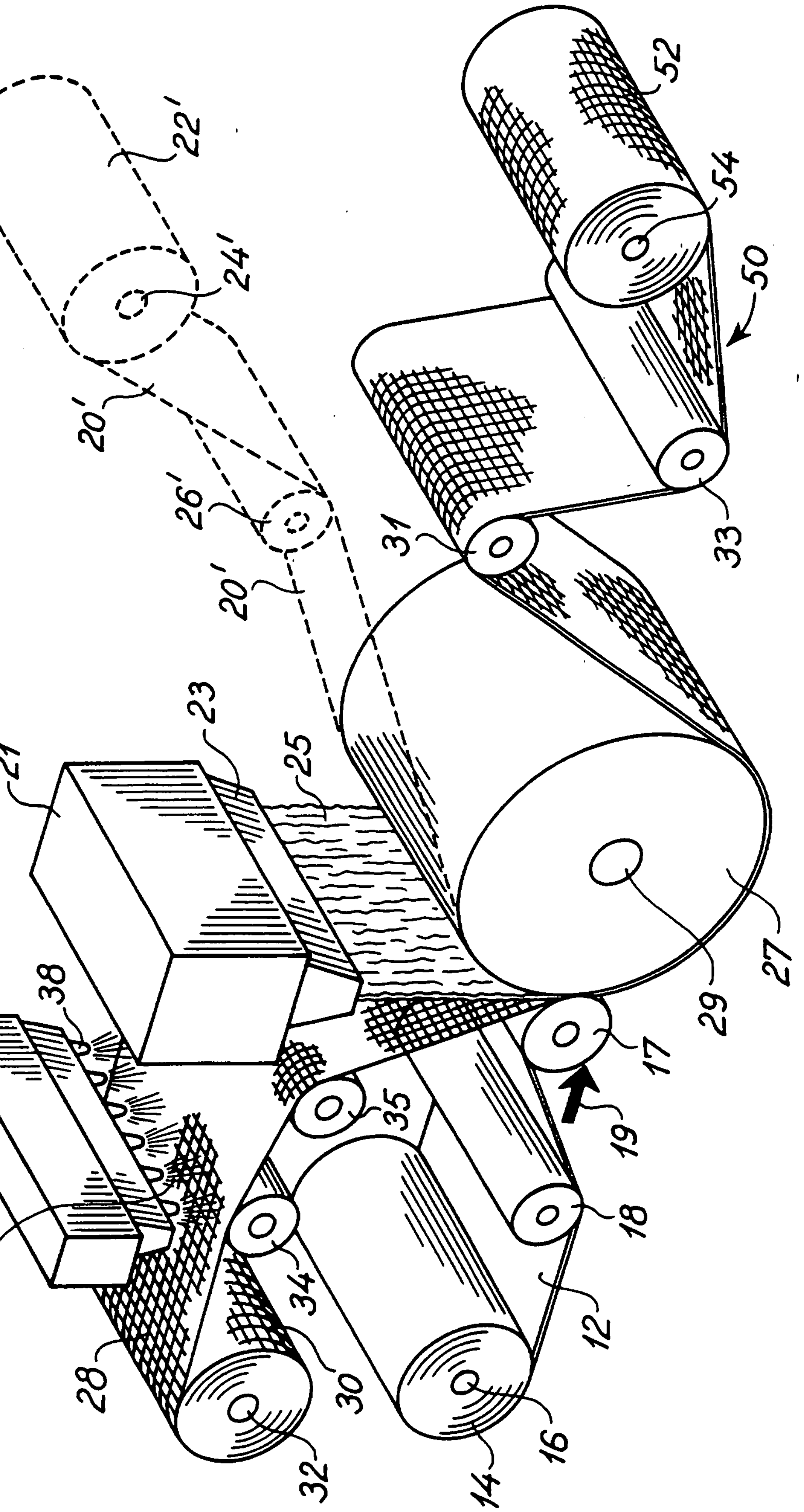


Fig. 2a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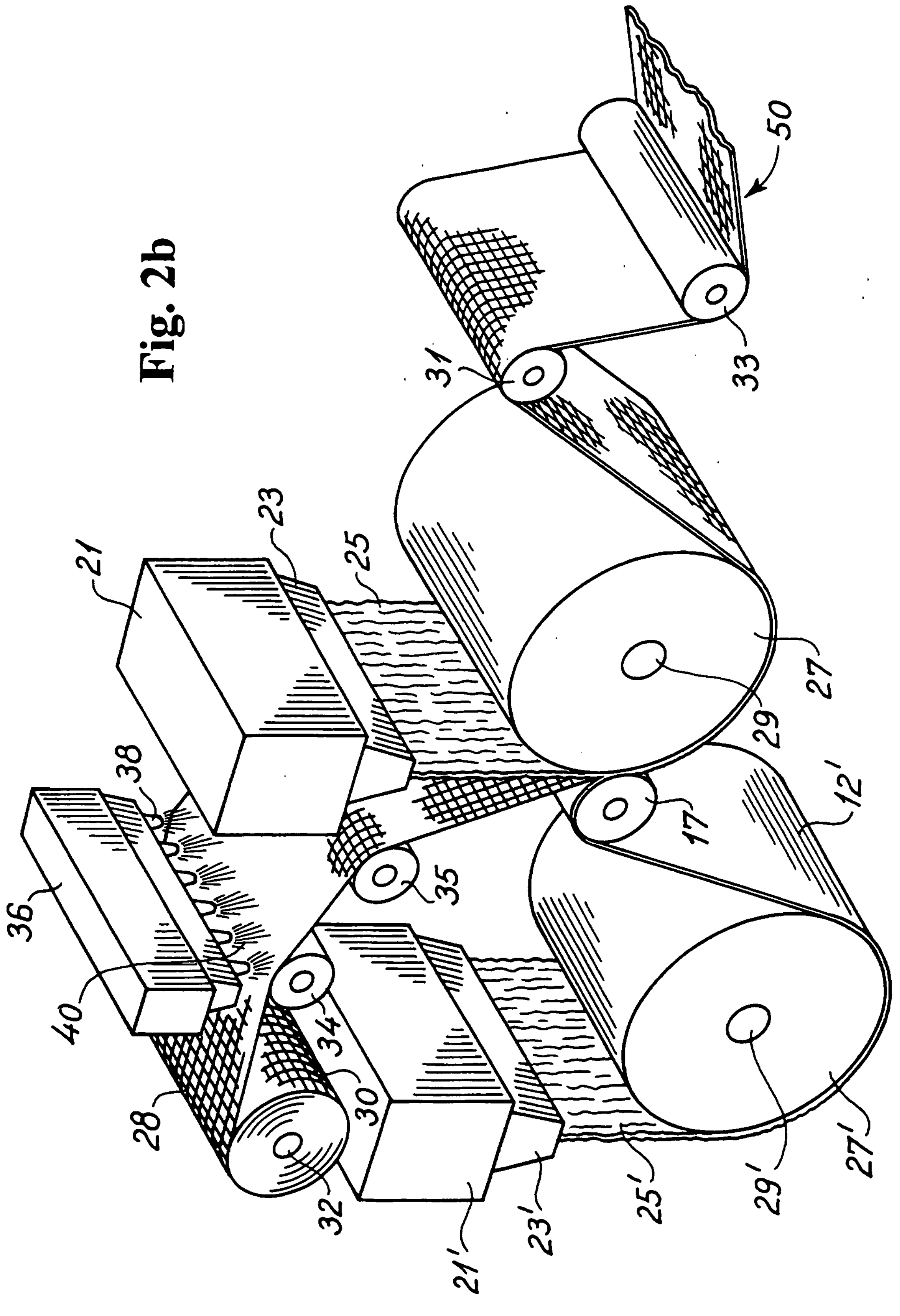


Fig. 2b

Fig. 3

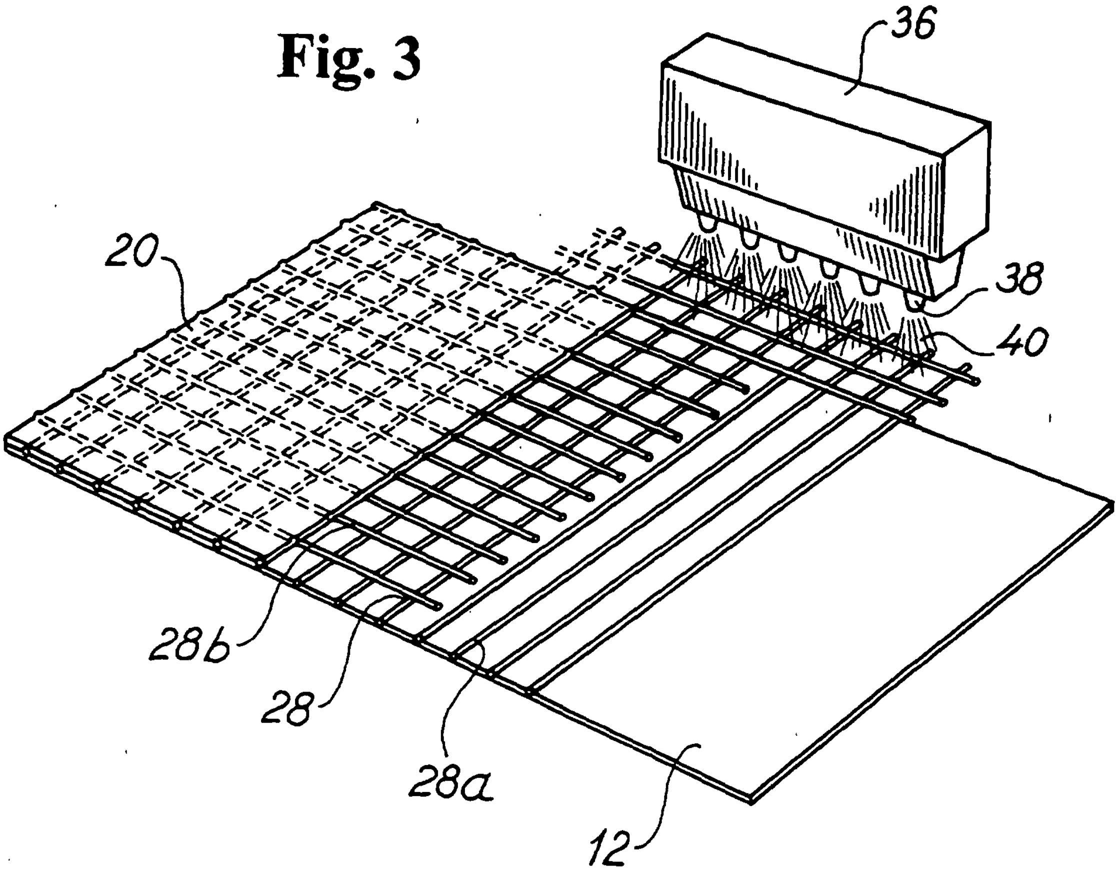


Fig. 4

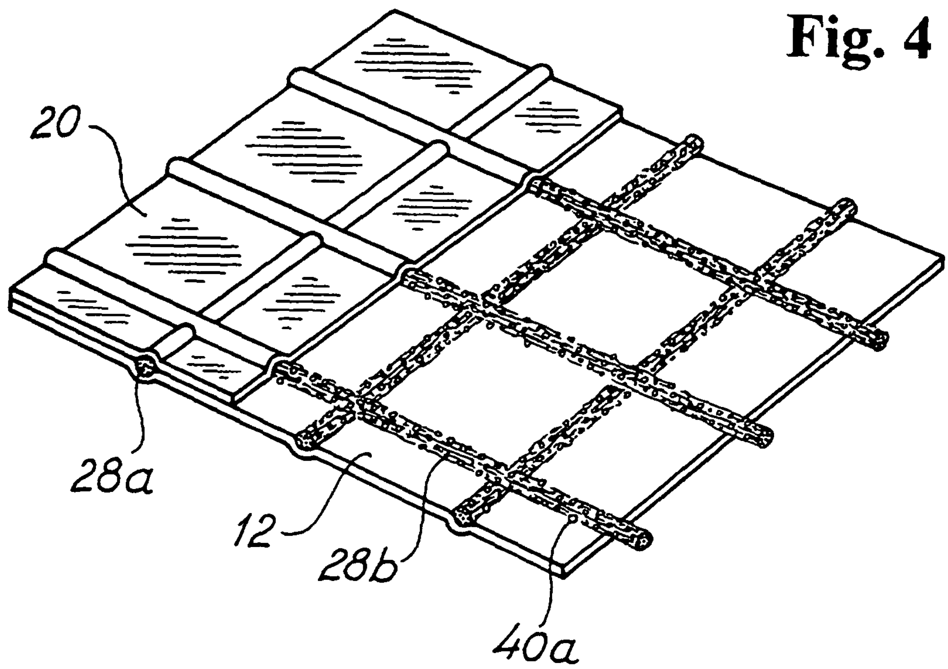


Fig. 5

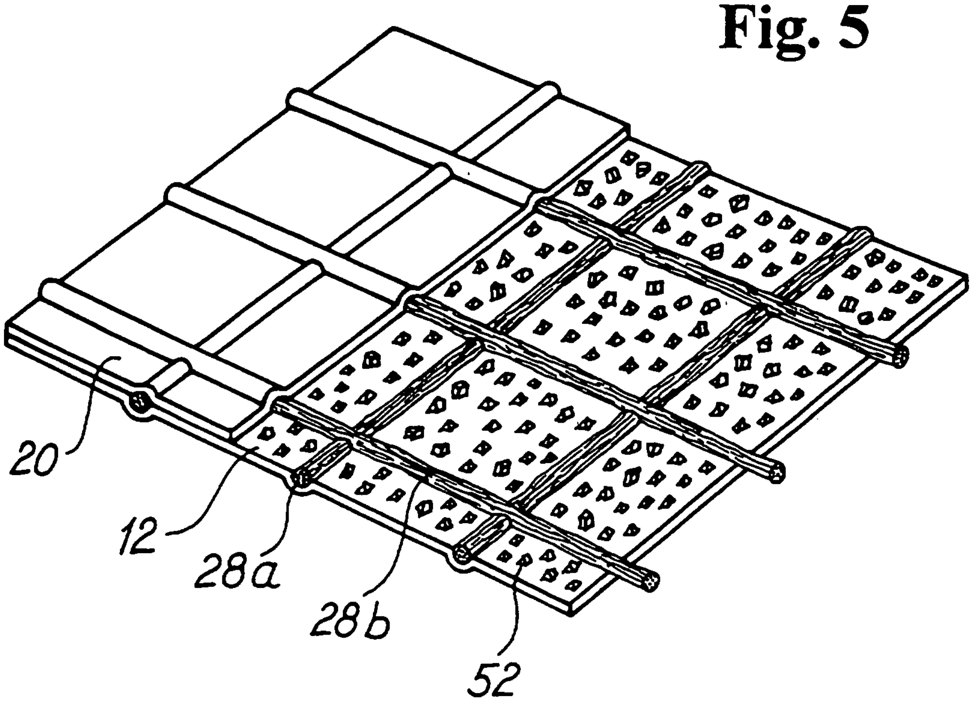
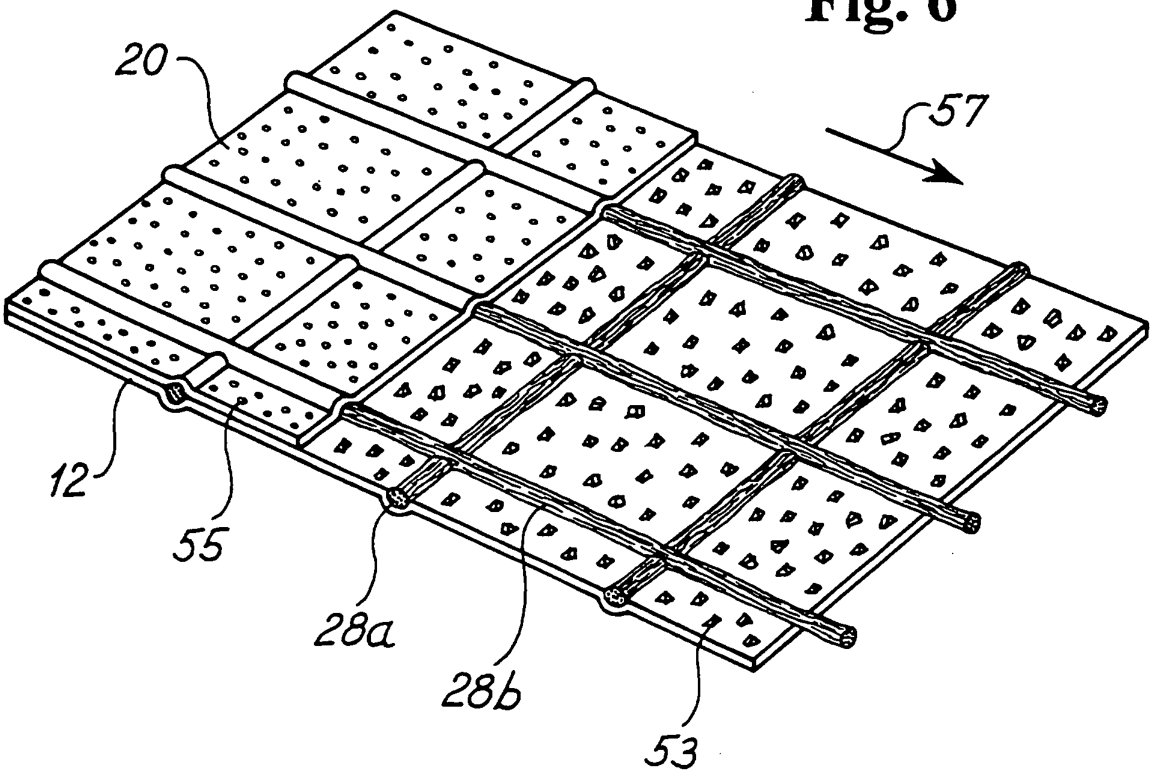


Fig. 6



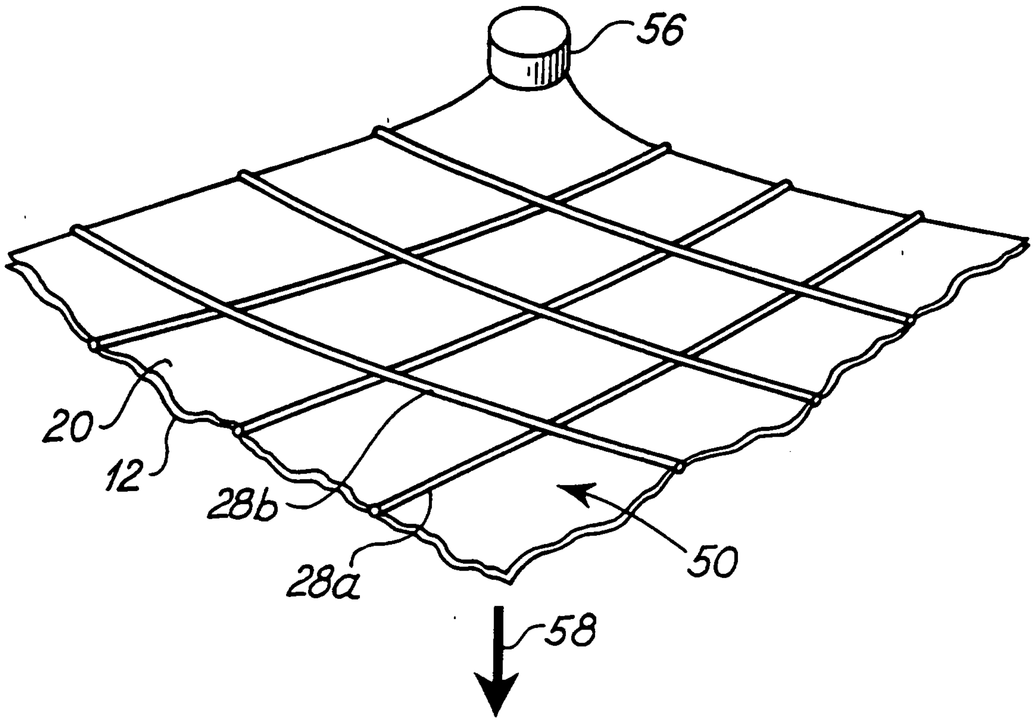


Fig. 7

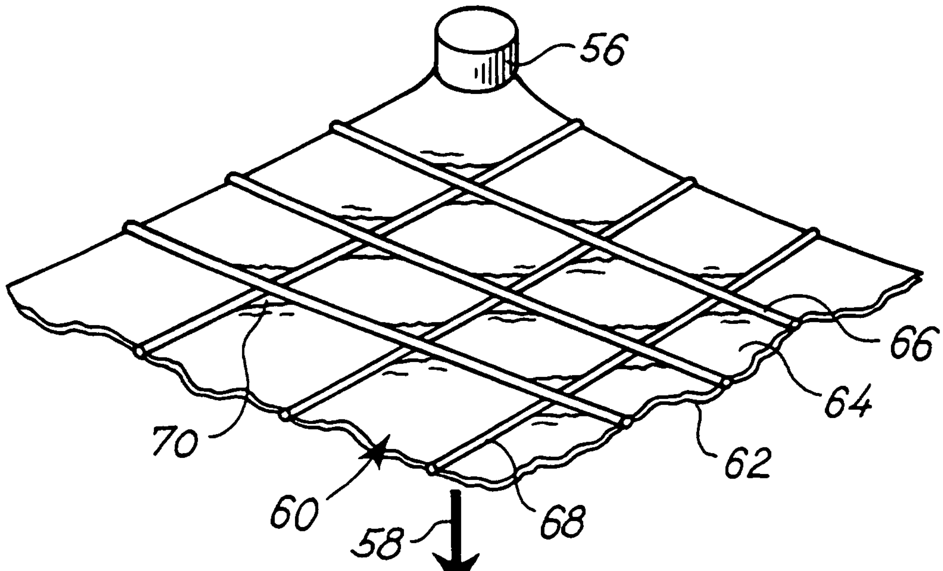


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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