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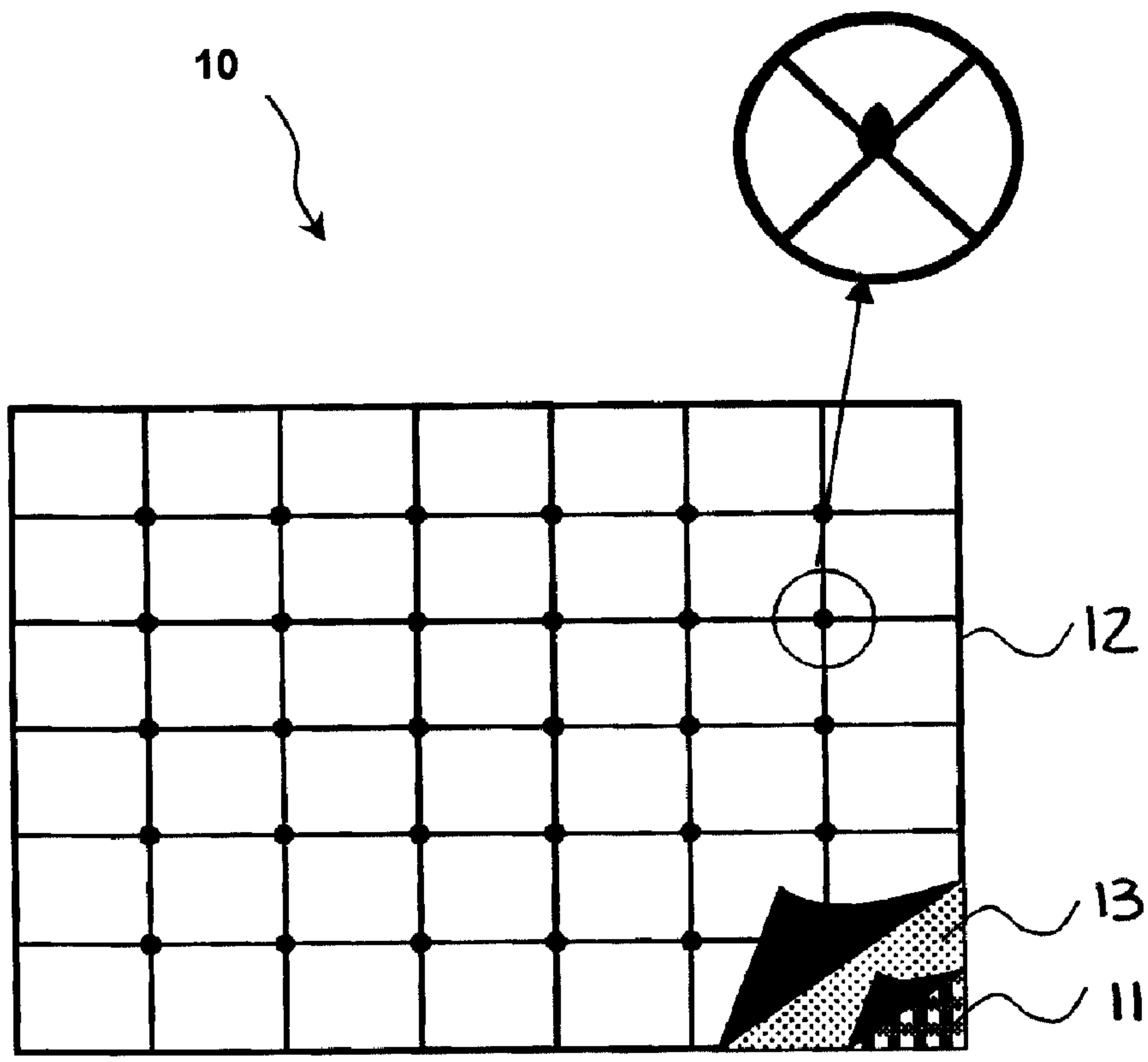
(54) Titre : MATERIAU EN FEUILLE MULTICOUCHE ANTIDERAPANT
(54) Title: MULTILAYER SLIP RESISTANT SHEET MATERIAL



(57) Abrégé/Abstract:
There is provided a sheet material having a walking surface with high slip-resistance in dry, wet, or dusty conditions. The sheet material has a flexible structural layer laminated to a polymeric mesh layer which has protruding nodes to impart a high coefficient of friction. The sheet material may be used as an underlayment. The high coefficient of friction of the sheet material provides a roofing underlayment which is safe to walk upon in dry, wet or dusty conditions, and on steeply sloped surfaces.

Abstract of Disclosure

There is provided a sheet material having a walking surface with high slip-resistance in dry, wet, or dusty conditions. The sheet material has a flexible structural layer laminated to a polymeric mesh layer which has protruding nodes to impart a high coefficient of friction. The sheet material may be used as an underlayment. The high coefficient of friction of the sheet material provides a roofing underlayment which is safe to walk upon in dry, wet or dusty conditions, and on steeply sloped surfaces.

Multilayer Slip Resistant Sheet Material

Technical Field of the Invention

The invention relates to sheet materials. In particular, the invention relates to roofing underlayments.

Background of the invention

In both residential and commercial roofing applications, a primary roof covering material provides the main water protection barrier. Whether the primary covering is composition shingles, metal panels or shingles, concrete or clay tiles, wood shakes, or slate, it is the function of the primary roofing material to protect the building interior from water ingress.

In some circumstances, whether due to primary roofing material design, installation practices, or accidental breach of the primary roofing material, water can penetrate the primary roofing material. To protect the building interior in these circumstances, it is common to use a secondary water shedding device called a roofing underlayment which acts as a temporary water shedding device.

A variety of roofing underlayment products are commonly used. The two major classes are mechanically attached and self-adhered underlayments, the latter commonly referred to as "peel and stick".

It is desirable that a roofing underlayment provide a surface which has a sufficiently high coefficient of friction to be safe for an applicator to walk upon. Underlayments should be easily affixable to a roofing surface, for example by nailing or adhesion. They should ideally be impermeable to moisture. High tensile and tear strengths are also desirable. Underlayments should be light in weight to facilitate ease of transport and application, and should be able to withstand prolonged exposure to sunlight, air and water.

A common mechanically attached roofing underlayment product used in the United States and Europe is bituminous asphalt-based felt, commonly referred to as felt. Typically, this is comprised of organic paper felt saturated with asphaltic resins to produce a continuous sheeting material which is subsequently processed into short rolls for application.

Such felts generally demonstrate good resistance to water ingress and good walkability in dry and wet roof conditions. Disadvantages include very low tensile and tear strengths, relatively high weight per unit surface area, a propensity to dry and crack over time, extreme lack of resistance to ultraviolet (UV) exposure, high likelihood of wind blow off, and a propensity to absorb water causing buckling and wrinkling, thus preventing the application of direct primary roofing materials such as composition shingles.

As felts have very low tensile and tear strengths, their use is generally confined to roofing applications where the roofing underlayment is attached directly to a solid, continuous roofing deck, rather than in spaced sheathing applications where open spaces characterize the roof structure. Use of felts in spaced sheathing roofs would endanger the applicator should the applicator walk over a section of the roof structure covered only by felt.

In climatic regions where ice damming or prolonged exposure to water is prevalent, it is common to employ thick rubberized asphalt-based underlayments in the valleys, eaves, and seams of the roof. These underlayments are generally applied not by mechanical means, but by adhesives exposed by removing release liners from the bottom surface of the underlayment.

In Europe, it is common in roofing design to utilize spaced sheathing rather than solid decking prior to application of the primary roof covering materials. To address the safety issue of an applicator falling through rafters, several products have been marketed with high tensile and tear strengths which are specifically designed to prevent applicator breach during application.

These materials are generally high strength woven hybrids with other laminates or coatings, or reinforced non-woven polymeric synthetic materials, rather than asphaltic felts. They are generally lightweight, thin, have high tensile, tear and burst strengths, and are superior to felts in UV resistance and resistance to drying and cracking over time.

The major drawback of such underlayments is their low coefficient of friction on the walking surface in dry or wet conditions. This problem limits the commercial attractiveness of such products in high pitch roofs or in climates characterized by frequent and sporadic wet or humid conditions. It has limited these products to spaced sheathing applications where safety and tensile strength are more important than walkability.

In many markets, such as the US and Canada, building design is characterized by roofing structures possessing solid decking substrates onto which is applied roofing underlayment and, ultimately, the primary roofing material. As the decking surface provides a safe walking medium for the roof applicator, underlayment walkability, that is, the ability to permit applicators to walk upon the underlayment without slipping, becomes more important than tensile strength. Any roofing underlayment which does not provide walking safety under dry and wet conditions will be unsafe for use without special precautions, and will be severely limited in commercial market penetration.

Examples of such synthetic underlayments include RoofGuard™ and RoofTOPGuard II™ produced by Rosenlew of Finland. These are produced using woven tape technology as a reinforcement, and are 2-sided polymer coated for encapsulating the porous woven substructure. RoofGuard™ utilizes smooth, high coefficient of friction polymers to improve walkability in dry conditions. However, it suffers dramatic reduction in coefficient of friction in wet conditions.

In RoofTOPGuard II™ the walking surface has been replaced by a polypropylene spun bond non-woven layer. This surface provides a slight improvement in walkability in some wet surface conditions. However, it does not provide safety in highly pitched roofs and very wet conditions. The non-woven material also has a tendency to peal or suffer surface fiber tears under foot load, and does not readily absorb or displace water when walked upon. Therefore, this product is limited in its ability to compete with felt roofing underlayments under wet conditions.

TRIFLEX 30™, produced by Flexia Corporation of Canada is of spun bond polypropylene construction, with a polypropylene layer coating both sides. The surface is relatively smooth and void of any surface texture properties which would provide high coefficient of friction properties under wet or dusty conditions.

There are other examples of underlayment products, notably in the self-adhered or "peel and stick" bituminous membrane market, which possess various surface designs aimed at improving walkability under wet conditions. Grace Construction Products produces various rubberized asphalt self-adhered products, including Select™ and Ultra™, having either a grainy polymer film laminate surface or an embossed polymer adhesive pattern as a surface layer. Neither product, however, works well under wet or dusty conditions.

POLYGLASS produces Polystick P™ and Polystick MU™ self-adhered underlayment with polymer corrugated film laminated and non-woven fabric surfaces. Neither of these products works very well in wet conditions, as there is no mechanism to generate high normal and shear forces underneath walking load to resist slippage.

Additional mechanical and self-adhering membrane roofing underlayment products are shown in Table 1, in which "M" refers to mechanically applied underlayments and "SA" to self-adhered underlayments. All of the abovementioned materials, as well as all materials in Table 1 were tested in simulated test roof pitches ranging from a 4:12 pitch to a 12:12 pitch under extremely wet surface conditions. All materials were found to possess surfaces that become highly slippery and unsafe to walk upon when coated with water.

Table 1 – Roofing underlayment products

Supplier	Type	Trade Name	Surface Layer Type
MFM Building Products	SA	Ice Buster™	silver, embossed polymer film
MFM Building Products	SA	Wind & Water Seal™	black, grainy polymer film
TAMKO	SA	TW Tile and Metal™	blistered surfaced film
Miradri	SA	WIP 200™	black, embossed polymer film

Supplier	Type	Trade Name	Surface Layer Type
Lafarge	M	Divoroll Top™	black, non woven fibers
Dupont	M	Tyvek Solid™	white, tan, pitted spun bonded
Daltex	M	RoofShield™	grey, embossed non woven fibers

Wiercinski, in US patent number 5,687,517, describes a roofing underlayment with corrugated ridges in the machine direction to achieve slip resistance in installation on a sloped roof. The surface layer is comprised of oriented, corrugated film laminated onto substrate. These ridges are comprised of polymer materials having a low coefficient of friction under dry or wet conditions. These ridges do not provide sufficient shear and normal force resistance under loading, as the individual ridges lack rigidity and bend over. Such an underlayment does not function well under wet conditions.

Strait, in US patent number 6,308,482, describes a reinforced roofing underlayment with a tensile strength sufficient to resist tearing when exposed to tensile loads from various directions. He further discloses provision of a slip resistive polypropylene sheet on the outer surface of the roofing underlayment.

Neither of the above patents discloses satisfactory slip resistance under wet, humid or dusty conditions at high roof pitches between 4:12 (a vertical rise of 4 units over a horizontal distance of 12 units) and 12:12. Neither discloses an invention in which the bottom layer is slip resistive to avoid slippage between the underlayment and the deck during installation, nor they combine high tensile strength and slip resistivity on both sides of the underlayment.

One method in the prior art of achieving a high coefficient of friction under wet conditions is by embedding extremely hard, granular, inorganic particles into the surface of asphalt bituminous underlayments.

Polymer underlayments are produced by various forms of polymeric extrusion, lamination, or thermal calendaring. In extrusion coating methods, it is normal to use specially surfaced chilling rolls to quench the molten polymer to solidify the product and reduce thermal damage of the reinforcement. The use of hard inorganic particles would severely damage processing equipment, and also significantly increase the mass per unit area of the resulting underlayment, limiting the advantages inherent of lightweight synthetic polymer underlayments.

Adding hard particles to the throat of an extruder to produce granular coatings would not be feasible as it would damage the processing equipment. Particles would be unable to pass through normal filtration media or narrow die slits. Furthermore, adhesion between inorganic particles and thin thermoplastic coatings is generally very poor, permitting the particles to dislodge from the underlayment surface.

The use of specialty inorganic particle coatings could improve bonding to the underlayment surface, but would add technical complexity and cost. Also, hard inorganic particles may tear and gouge the relatively soft surface layers of the polymer underlayment if freed from the surface and walked upon, thereby permitting water penetration of the underlayment.

Summary of Invention

In one of its aspects, there is provided a sheet material having a top surface mesh layer with interconnected strands and protruding nodes at strand junctions, the mesh layer having a high coefficient of friction, good walkability on sloped surfaces and exceptional slip resistance in dry, wet, or dusty conditions.

In another aspect, there is provided a roofing underlayment having a top surface noded mesh layer with a high coefficient of friction in dry, wet or dusty conditions. The underlayment has a structural layer with high tensile and tear strengths and a bottom surface with a sufficient coefficient of friction to avoid slippage between the underlayment and the deck to which the underlayment may be applied.

The underlayment may be lightly coloured to reflect solar radiation, thereby reducing heat absorption of radiant energy transfer into the roof attic space. The underlayment may be treated to increase UV resistance, thereby allowing extended exposure to the elements without damaging the underlayment. Mold inhibitors may be added to inhibit mold growth on the underlayment and immediate surrounding roof area. Fire retardant compounds may also be added to the underlayment to increase its fire resistance.

In another aspect, the nodded mesh layer may be laminated to molten rubberized asphalt to produce a self-adhering bituminous membrane roofing underlayment possessing a mesh layer surface that is highly walkable in wet conditions.

Other aspects of the invention will be appreciated by reference to the description of the preferred embodiment which follows, and to the claims.

Brief Description of Drawings

The present invention will be better understood from the following description in conjunction with the accompanying drawings in which:

Figure 1 is top view of the mesh layer of the invention showing the interlaced strands and nodes of the mesh.

Figure 2 is a cross-sectional view of one embodiment of a roofing underlayment according to the invention showing an EVA coating.

Figure 3 is a cross-sectional view of a second embodiment of a roofing underlayment showing a structural layer laminated to a slip-resistive EVA film.

Figure 4 is a cross-sectional view of a third embodiment of a roofing underlayment showing a peel and stick treatment.

Figure 5 is a cross-sectional view of a fourth embodiment of a roofing underlayment showing a self-adhered bituminous rubberized asphalt layer.

Detailed Description of the Preferred Embodiments

The invention provides a polymeric multi-layer sheet material that provides a high coefficient of friction in dry, wet or dusty surface conditions. The sheet material may be used for a variety of applications, including as a roofing underlayment, as an industrial wrapping material, and as a fabric. The high coefficient of friction is achieved through the use of a polymer mesh material, laminated onto the walking surface of a coated woven structural layer or rubberized asphalt, such that the mesh provides a secure surface for walking even under dusty or wet conditions.

The sheet material of the present invention is characterized by a structural layer having high tensile and tear strengths, coated with thermoplastic resins. A thermoplastic mesh possessing nodular characteristics and preferably coated on both sides with a tacky coating to provide an enhanced high coefficient of friction in dry, wet or dusty conditions, is laminated to the upper surface, and becomes the walking surface in underlayment applications.

Referring to figure **1**, the multilayer slip resistant sheet material **10** has a nodded mesh layer 12 having interconnected strands and protruding nodes at the junctions of the strands. The nodes are significantly thicker than the strand links, thus providing the key nodular characteristics. The mesh layer is laminated by a synthetic resin lamination layer **13** to a structural layer **11.** The structural layer is preferably a woven or non-woven scrim of synthetic polymer resin tapes, but other materials are possible.

The sheet material may be used in a roofing underlayment. Referring now to figure **2**, a roofing underlayment **20** has a structural layer **11,** preferably a woven scrim made of synthetic polymer resin tapes, to provide tensile strength. Typical tensile strengths of the structural layer range from 80 to 160 pound feet per inch in the machine direction and 40 to 80 pound feet per inch in the cross direction.

A mesh layer **12** is laminated to the upper surface of the structural layer by a synthetic resin lamination layer **13**. The mesh layer **12** has nodes protruding from its upper surface, and may be treated with a tacky coating such as ethylene vinyl acetate ("EVA") which provides an improved coefficient of friction to the surface.

The laminating layer **13** may be comprised of tacky polymers or a polyolefin blend comprising low-density polyethylene. The underlayment **20** also may be coated on its lower surface with a tacky non-slip polymeric resin coating **14**. Both the laminating layer **13** and the coating **14** provide a membrane to prevent moisture passing through the sheet material. One or more of the layers may be treated with additives to increase UV resistance, retard fire, reduce heat absorption or reduce mold creation. Typically, the underlayment **20** weighs between 100 and 300 grams per square meter and has a thickness of about 4 to 16 millimeters.

The unusually high coefficient of friction in wet conditions is achieved by a combination of oriented, stiff, laminated mesh strands having high tensile and shear strengths, and a unique high coefficient of friction polymer coated nodular surface on the mesh material. Water and dust covering the underlayment surface predominantly reside in the spaces between nodes and strands, and not on the nodes. As water and dust accumulates, they will flow over the strands and reside in the spacing pockets between the strands without covering the nodes.

A roofing installer walking on the nodded mesh surface will transmit the walking load primarily onto the nodes, which are generally free of water and dust. The high strength, oriented nodes have very high normal and shear force resistance in all directions, therefore a high coefficient of friction results under various walking scenarios of pitch, angle and load.

While the mesh layer nodes possess a high coefficient of friction even in dry conditions, a polymer surface coating such as EVA copolymer may be applied to the mesh to increase the coefficient of friction. An example of such a mesh is Thermanet™, produced by Conwed Plastics of Minneapolis. The mesh layer may be coated on both sides with EVA, which will reduce the incidence of delamination of the mesh layer from the structural layer.

The mesh design (nodes/inch), mesh polymer type, node characteristics of shape and size, and weight (lbs/ft2) of the mesh layer may be selected to optimize foot traction and coating layer securement. If the node density is too high, the surface becomes effectively smooth, and does not provide slip resistance. If the node density is too low, the mesh does not provide sufficient traction under wet characteristics.

The structural layer may be comprised of woven polyethylene or polypropylene, another high strength reinforced substrate such as polyethylene terephthalate (PET), or a glass fiber mat or similar structural layer of non-woven construction. Other materials are also possible.

The use of a nodular mesh material provides the benefits of hard, inorganic particles under wet conditions, but is more compatible with polymer underlayment manufacturing processes than is addition of inorganic particle coatings.

Referring to figure **3**, roofing underlayment **30** has a mesh layer **12** laminated by a first synthetic lamination layer **13** to the upper surface of a structural layer **11**. A non-slip tacky film **15** is laminated by a second synthetic layer **16** to the lower surface of the structural layer. Addition of the non-slip tacky film **15** and associated lamination layer **16** increases the mass of the underlayment by 10 to 60 grams per square meter and the thickness by 0.03 to 0.13 millimeters.

As wet conditions generally are not found on the deck side of the underlayment, it is not necessary to laminate the mesh layer to the bottom surface of the underlayment. Sufficient coefficient of friction between the underlayment and the deck is achieved by application of tacky coatings such as EVA to the lower surface of the underlayment. It is important to provide a high coefficient of friction between underlayment bottom and the deck surface, as applicators are likely to walk over the underlayment before it is secured. Any slippage between underlayment and deck may cause accidents. The use coatings such as EVA, increase the coefficient of friction between the deck and the bottom of the underlayment to render the underlayment secure until the underlayment is fully secured by roofing nails or staples.

The sheet material may be a light colour such as white or grey to provide reflection of solar radiation. This provides the sheet material with less heat absorption, which results in a cooler roof, lower attic temperatures, and a cooler working surface for applicators. The sheet material is lightweight for faster installation and lower volume to inventory and handle.

An example of the invention claimed herein is a synthetic roofing underlayment, comprised of a woven tape structural layer of polyethylene or polypropylene, extrusion coated with low-density polypropylene on the top surface, and simultaneously laminated onto the top surface a thermoplastic noded mesh material such as Conwed Plastics Thermanet™ 750012-018 (4.5 lbs/1000 ft2, 3.5 x 3.5 strands/inch, 39 x 36 lbf/3" tensile strength) coated on both sides by EVA. The oriented strands are typically approximately 1.5 mm in thickness, whereas the node junctions are approximately 5 mm in thickness, thus providing a nodular characteristic for enhanced shear load bearing. The bottom surface of the underlayment is coated with EVA, either by direct extrusion or EVA film lamination. EVA grades are preferably at least 18% EVA commoner, such as Dupont Elvax or similar. The woven structural layer provides high strength and light weight for ease of application, and resistance to tearing and wind blow off. The underlayment is free of buckling and wrinkling characteristic common in organic asphalt felts.

The structural layer, lamination layer, coatings, and mesh layer may be UV stabilized to provide for exposure resistance during applications where the underlayment has been installed to dry-in the roof, but application of the primary roofing material is delayed. This scenario is very common in tile and metal roofing applications.

Because of the unique surface, the present invention may be used where safe walkability in extreme conditions or on pitched surfaces, such as decking.

Further, the inner surface of this product can be treated with adhesives backed by a release liner that protects the adhesive and prevents the product from sticking to itself. During application, the release liner is easily removed to aid in positioning of sheets and to maintain proper line, allowing the product to stick to the installation surface and eliminating the need for mechanical fasteners which puncture the underlayment, thereby generating opportunities for water penetration.

Referring to figure **4**, in roofing underlayment **40**, a mesh layer **12** is laminated by a synthetic lamination layer **13** to the top surface of the structural layer **11**. The bottom surface of the structural layer is coated with a thin layer of adhesive **17**, and the adhesive layer is backed by a removable release paper layer **18**.

An alternate embodiment provides a mesh layer laminated to molten rubberized asphalt to produce a self-adhering underlayment exhibiting good walkability under wet conditions. Typically, a polymer such as Kraton™ (Shell Chemicals) rubber is emulsified within an asphalt matrix to produce a highly elastic core sealing membrane layer which is laminated to an outer film surface, and the bottom surface is coated with an adhesive to which is attached a release liner.

Referring to figure **5**, in underlayment **50** a mesh layer **12** is attached to the upper surface of a bituminous rubberized asphalt layer **19** 40 to 60 millimeters thick. The lower surface of the asphalt layer is coated with a thin layer of adhesive **20**, which is covered by a removable release paper layer **21**. Underlayments having an adhesive layer and release paper are commonly known as "peel and stick" underlayments.

The roofing underlayment of the present has high tensile and tear strengths, exhibits a high coefficient of friction in dry wet or dusty conditions, and is lightweight, permitting fast installation and reducing the number of rolls of underlayment to inventory and handle.

The synthetic polymer construction of the present invention is free from wrinkling and buckling caused by water absorption. Such water effects are common with asphalt felts, and can interfere with primary roof covering installation.

The sheet material of the present invention has been evaluated and passed by an external lab in accordance with International Conference of Building Officials Evaluation Services ("ICBO-ES") Acceptance Criteria for AC 188 & AC 48 (section 4.7 accelerated aging and section 4.8 ultraviolet exposure), ASTM D226 (pliability), ASTM D1970 (tensile testing and nail penetration), and ASTM D4869 (liquid water transmission).

Several field application tests were conducted with various roofing underlayment samples attached to solid decking roofing substrates to simulate dry and wet conditions under various roof pitches. The results of these tests demonstrated the vastly superior walkability properties of the proposed mesh-surfaced invention product over the above mentioned "smooth" underlayments.

For example, in one test the mesh-surfaced invention comprising a woven polyethylene structural layer with an EVA film laminated to the bottom surface and a ConWed 2-sided EVA Thermanet (3.5 x 3.5, 4.5 #/MSF) mesh layer laminated to the top walking surface was attached to a roof pitch of 8:12. Alongside this material was attached the same structural layer having merely a smooth EVA film walking surface.

Water was poured from above equally onto both materials to provide a wet surface simulation. Subsequently, various roofing professionals with various shoe types, and with proper safety precautions, proceeded to attempt to walk upwards on these wet surfaces. Only on the mesh covered woven underlayment sample was it possible to walk repeatedly up and down the pitch under wet conditions. For the smooth surfaced sample, immediate slippage resulted.

In an attempt to provide a more scientifically-based and standardized measurement of walkability, the COF of the invention and various other roofing underlayments was tested utilizing a sophisticated COF customized test method that more accurately simulates roof walking physics.

During the tests, the COF of the roof underlayment of the invention was tested relative to three competing underlayments: 30# felt, Triflex 30 and RoofTopGuard II, using an NBS-Sigler Pendulum Impact Tester according to Federal Test Standards NBS7121 and NBS501. The underlayments were tested under dry and wet conditions on a flat surface, a pitch of 18.4 degrees, and a pitch of 45 degrees.

Result of COF tests performed on the mesh surface sheet material against products that have common application is provided in Tables 2 and 3 below.

Table 2 – Comparative improvement in COF under dry conditions

Test Condition	**COF Improvement Mesh Surface vs. 30# felt**	**COF Improvement Mesh Surface vs. Triflex 30**	**COF Improvement Mesh Surface vs. RTG II**
COF dry Flat	16%	8%	14%
COF dry 4/12 pitch	17%	9%	15%
COF dry 12/12 pitch	15%	10%	21%

Table 3 - Comparative improvement in COF under wet conditions

Test Condition	COF Improvement Mesh Surface vs. 30# felt	COF Improvement Mesh Surface vs. Triflex 30	COF Improvement Mesh Surface vs. RTG II
COF wet Flat	24%	44%	18%
COF wet 4/12 pitch	23%	43%	16%
COF wet 12/12 pitch	23%	39%	14%

It will be appreciated by those skilled in the art that other variations of the preferred embodiment may also be practiced without departing from the scope of the invention.

WHAT IS CLAIMED IS:

1. A sheet material comprising:

a flexible structural layer;

a lamination layer affixed to the upper surface of the structural layer; and

a mesh layer connected to the lamination layer, the mesh layer having interconnecting strands and protruding nodes at the junctions of the strands.

2. The sheet material of claim 1 wherein the mesh layer is treated with a tacky coating.

3. The sheet material of claim 2 wherein the tacky coating is ethylene vinyl acetate.

4. The sheet material of claim 1 wherein the lamination layer is comprised of a polyolefin.

5. The sheet material of claim 4 wherein the polyolefin is low-density polyethylene.

6. The sheet material of claim 4 wherein the polyolefin is polypropylene.

7. The sheet material of claim 1 wherein the lamination layer is comprised of a blend of polyolefins.

8. The sheet material of claim 1 wherein the lamination layer is comprised of polymers having a high coefficient of friction.

9. The sheet material of claim 1 wherein the structural layer is comprised of woven polyolefin tapes.

10. The sheet material of claim 1 wherein the lamination layer carries ultraviolet stabilizers.

11. The sheet material of claim 1 wherein the lamination layer is lightly coloured to reflect at least 25 % of incident light.

12. The sheet material of claim 1 wherein one or more of the layers carries a mold inhibitor.

13. The sheet material of claim 1 wherein one or more of the layers carries a fire retardant additive.

14. The sheet material of claim 1 for use as an underlayment.

15. The sheet material of claim 1 for use as an industrial coating.

16. The sheet material of claim 1 for use as a fabric.

17. A roof underlayment, comprising:

a flexible structural layer;

a high coefficient of friction coating on the lower surface of the structural layer;

a lamination layer affixed to the upper surface of the structural layer; and a mesh layer connected to the lamination layer, the mesh layer having interconnecting strands and protruding nodes at the junctions of the strands.

18. The roof underlayment of claim 17 wherein the mesh layer is treated with a tacky coating.

19. The roof underlayment of claim 18 wherein the tacky coating is ethylene vinyl acetate.

20. The roof underlayment of claim 17 wherein the lamination layer is comprised of a polyolefin.

21. The roof underlayment of claim 20 wherein the polyolefin is low-density polyethylene.

22. The roof underlayment of claim 20 wherein the polyolefin is polypropylene.

23. The roof underlayment of claim 17 wherein the lamination layer is comprised of a blend of polyolefins.

24. The roof underlayment of claim 17 wherein the lamination layer is comprised of polymers having a high coefficient of friction.

25. The roof underlayment of claim 17 wherein the structural layer is comprised of woven polyolefin tapes.

26. The roof underlayment of claim 17 wherein the structural layer is comprised of a non-woven polyolefin.

27. The roof underlayment of claim 26 wherein the non-woven polyolefin comprises a spun bond polyolefin.

28. The roof underlayment of claim 17 wherein the structural layer comprises a woven high strength reinforced substrate.

29. The roof underlayment of claim 28 wherein the substrate is selected from the group comprising polyethylene terephthalate, nylon and glass.

30. The roof underlayment of claim 17 wherein the structural layer is comprised of a non-woven high strength reinforced substrate.

31. The roof underlayment of claim 30 wherein the substrate is selected from the group comprising polyethylene terephthalate, nylon and glass.

32. The roof underlayment of claim 17 wherein the coating comprises ethyl vinyl acetate.

33. The roof underlayment of claim 17 wherein one or more of the layers carries ultraviolet stabilizers.

34. The roof underlayment of claim 17 wherein the lamination layer is lightly coloured to reflect at least 25% of incident light.

35. The roof underlayment of claim 17 wherein one or more of the layers carries a mold inhibitor.

36. The roof underlayment of claim 17 wherein one or more of the layers carries a fire retardant additive.

37. A roof underlayment, comprising:

a flexible structural layer;

a first lamination layer affixed to the upper surface of the structural layer;

a mesh layer connected to the first lamination layer, the mesh layer having interconnected strands and protruding nodes at the junctions of the strands;

a second lamination layer affixed to the lower surface of the structural layer; and

a prefabricated, high coefficient of friction film affixed to the lower surface of the second lamination layer.

38. The roof underlayment of claim 37 wherein the mesh layer is treated with a tacky coating.

39. The roof underlayment of claim 38 wherein the tacky coating is ethylene vinyl acetate.

40. The roof underlayment of claim 37 wherein the first and second lamination layers are comprised of a polyolefin.

41. The roof underlayment of claim 40 wherein the polyolefin is low-density polyethylene.

42. The roof underlayment of claim 40 wherein the polyolefin is polypropylene

43. The roof underlayment of claim 37 wherein the first and second lamination layers are comprised of a blend of polyolefins.

44. The roof underlayment of claim 37 wherein the first and second lamination layers are comprised of tacky polymers.

45. The roof underlayment of claim 37 wherein the structural layer is comprised of woven polyolefin tapes.

46. The roof underlayment of claim 37 wherein the structural layer is comprised of a non-woven polyolefin.

47. The roof underlayment of claim 46 wherein the non-woven polyolefin comprises a spun bond polyolefin.

48. The roof underlayment of claim 37 wherein the structural layer comprises a woven high strength reinforced substrate.

49. The roof underlayment of claim 48 wherein the substrate is selected from the group comprising polyethylene terephthalate, nylon and glass.

50. The roof underlayment of claim 37 wherein the structural layer is comprised of a non-woven high strength reinforced substrate.

51. The roof underlayment of claim 50 wherein the substrate is selected from the group comprising polyethylene terephthalate, nylon and glass.

52. The roof underlayment of claim 37 wherein the film comprises ethyl vinyl acetate.

53. The roof underlayment of claim 37 wherein one or more of the layers carries ultraviolet stabilizers.

54. The roof underlayment of claim 37 wherein the first lamination layer is lightly coloured to reflect at least 25% of incident light.

55. The roof underlayment of claim 37 wherein one or more of the layers carries a mold inhibitor.

56. The roof underlayment of claim 37 wherein one or more of the layers carries a fire retardant additive.

57. A roof underlayment, comprising:

a mesh layer having interconnected strands and protruding nodes at the junctions of the strands;

a bituminous rubberized asphalt layer affixed to the mesh layer;

an adhesive layer affixed to the lower surface of the asphalt layer; and

a release sheet releasably attached to the lower surface of the adhesive layer.

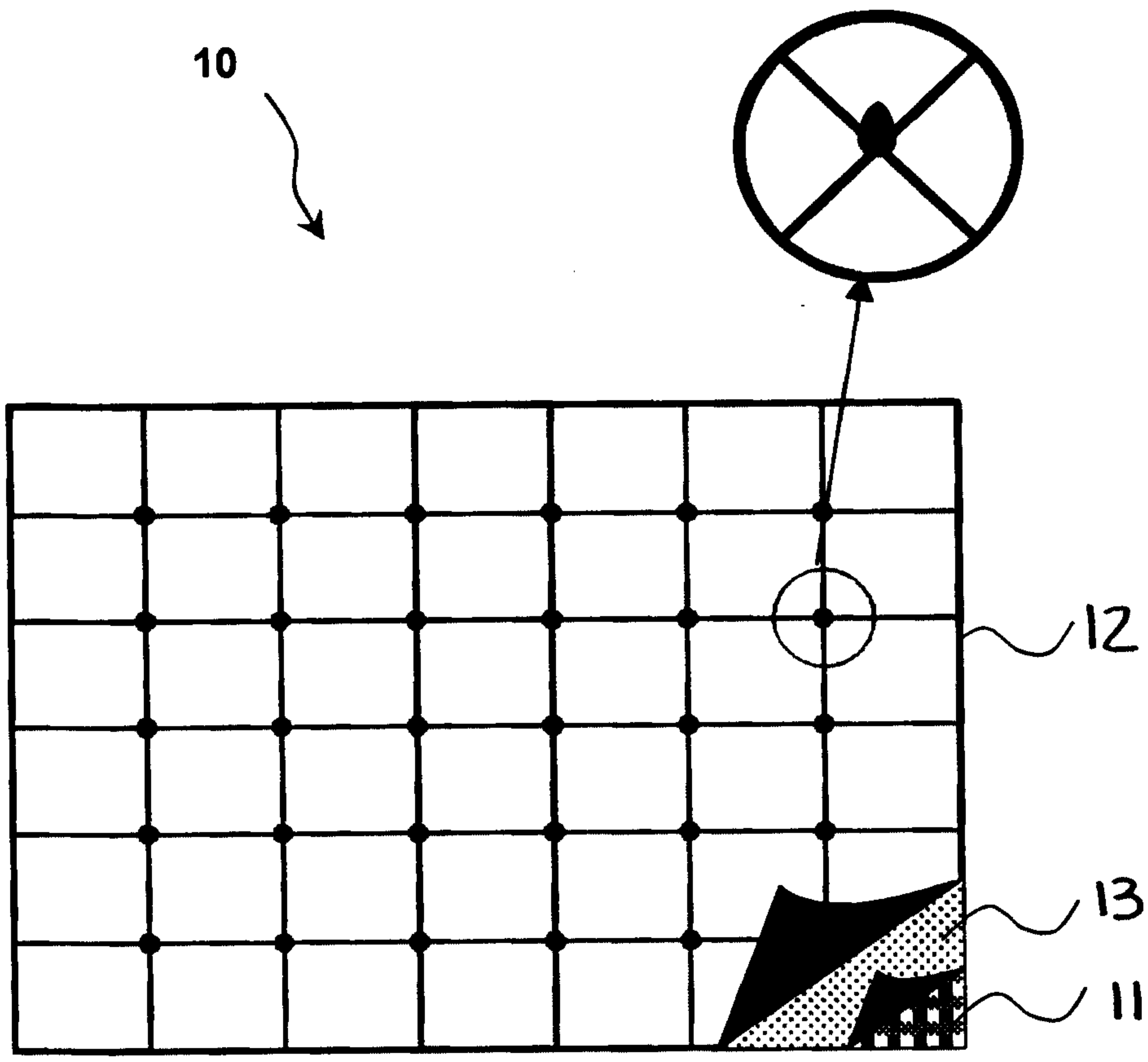


Fig 1

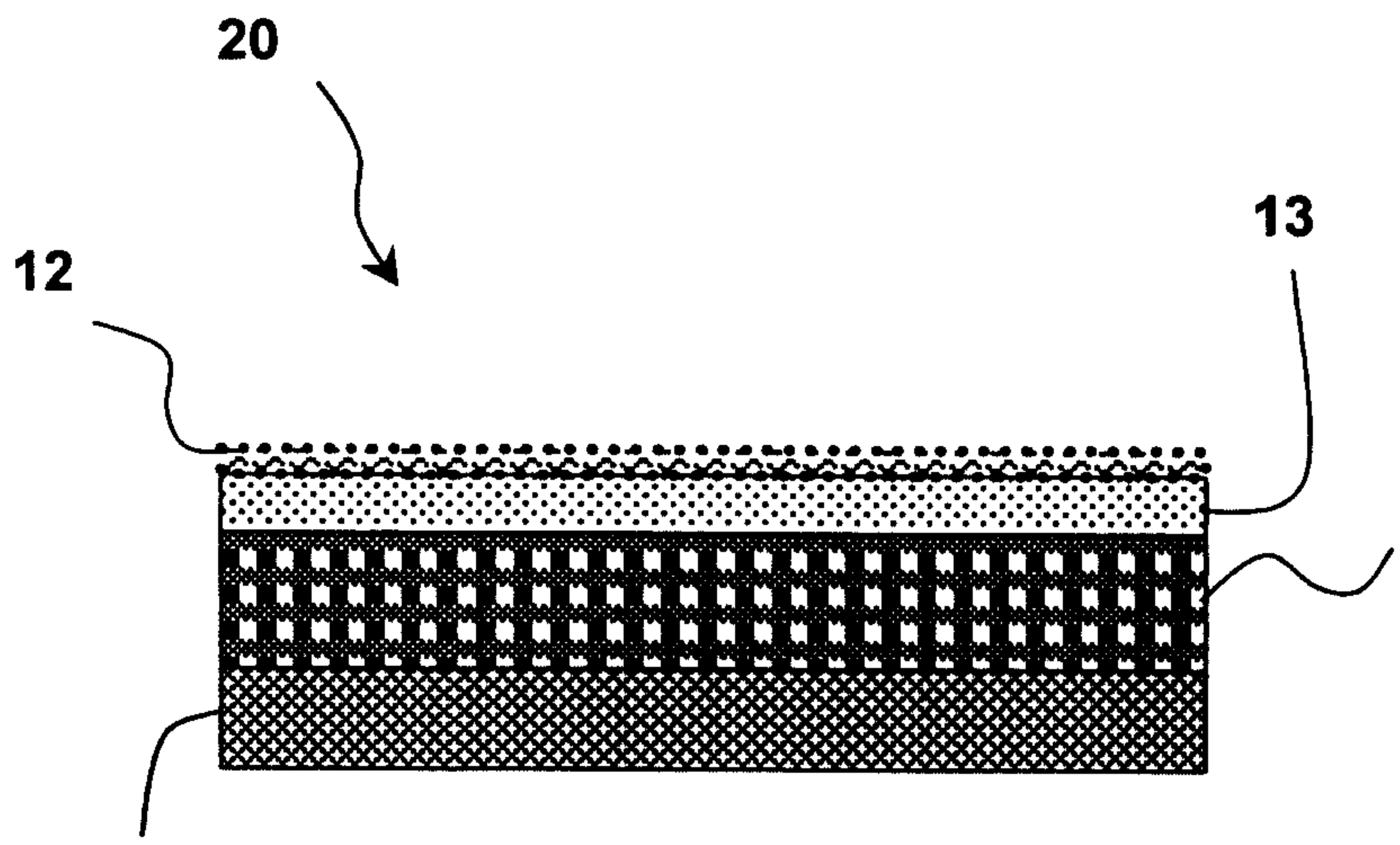


Fig 2

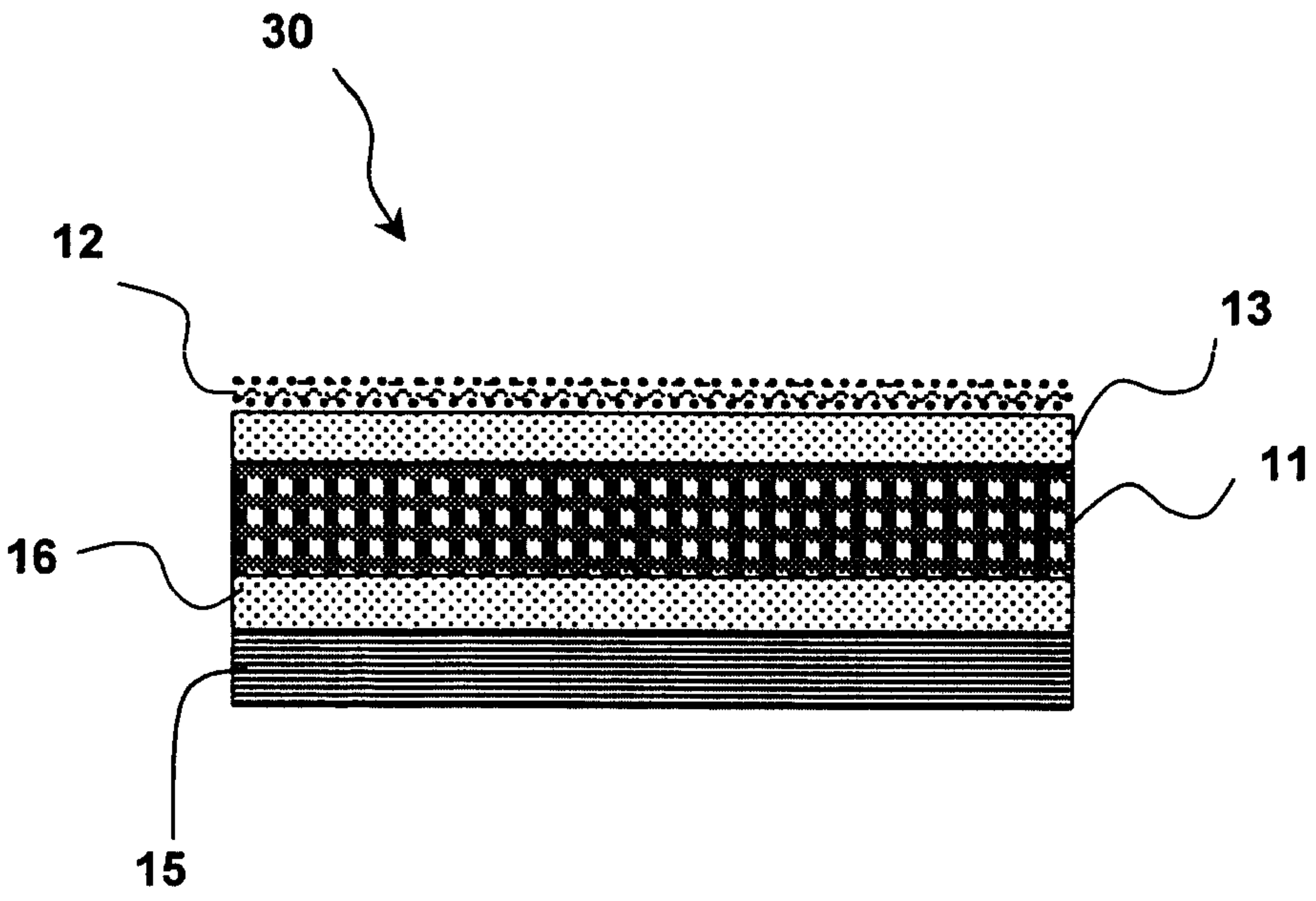


Fig 3

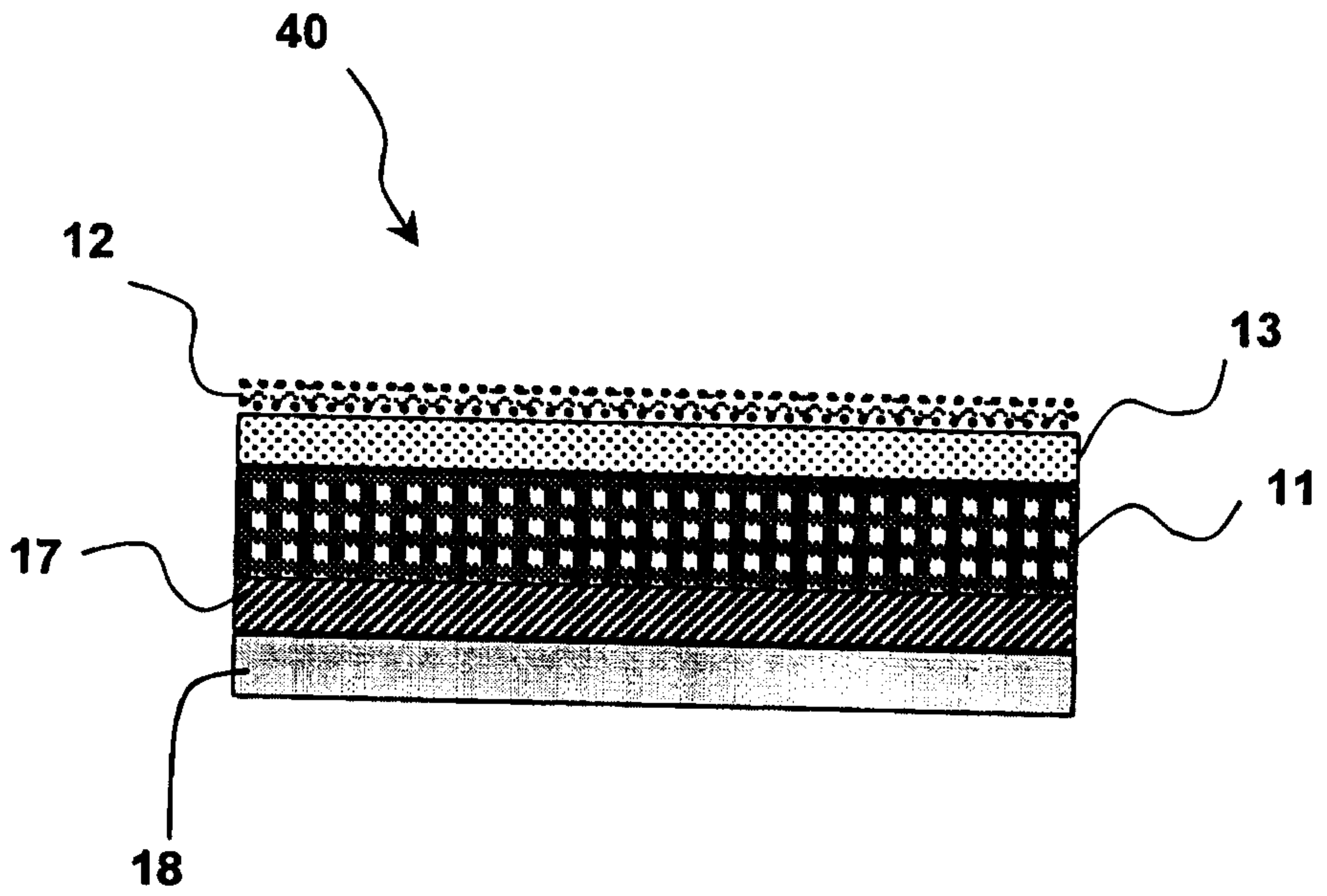


Fig 4

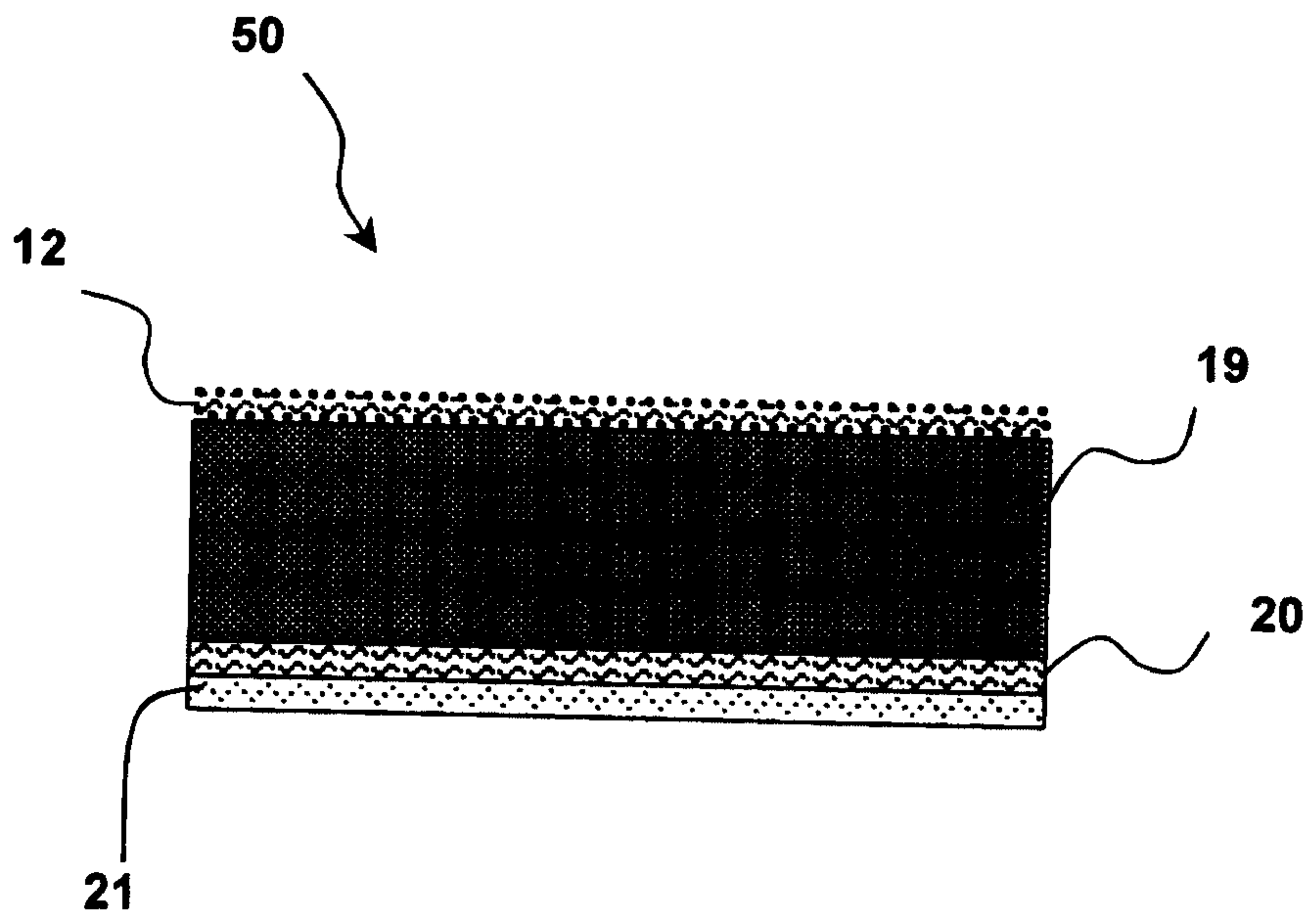
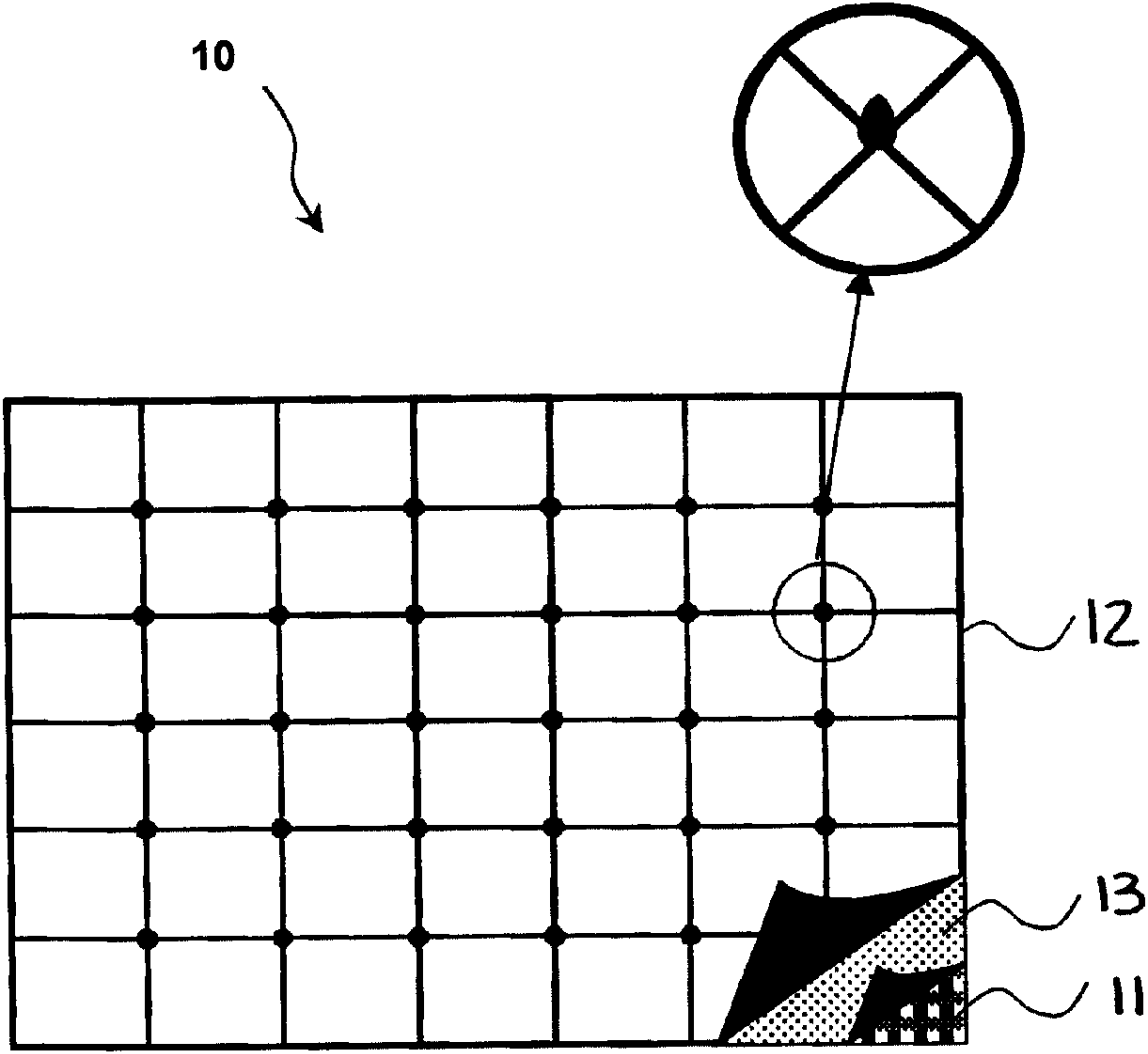


Fig 5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