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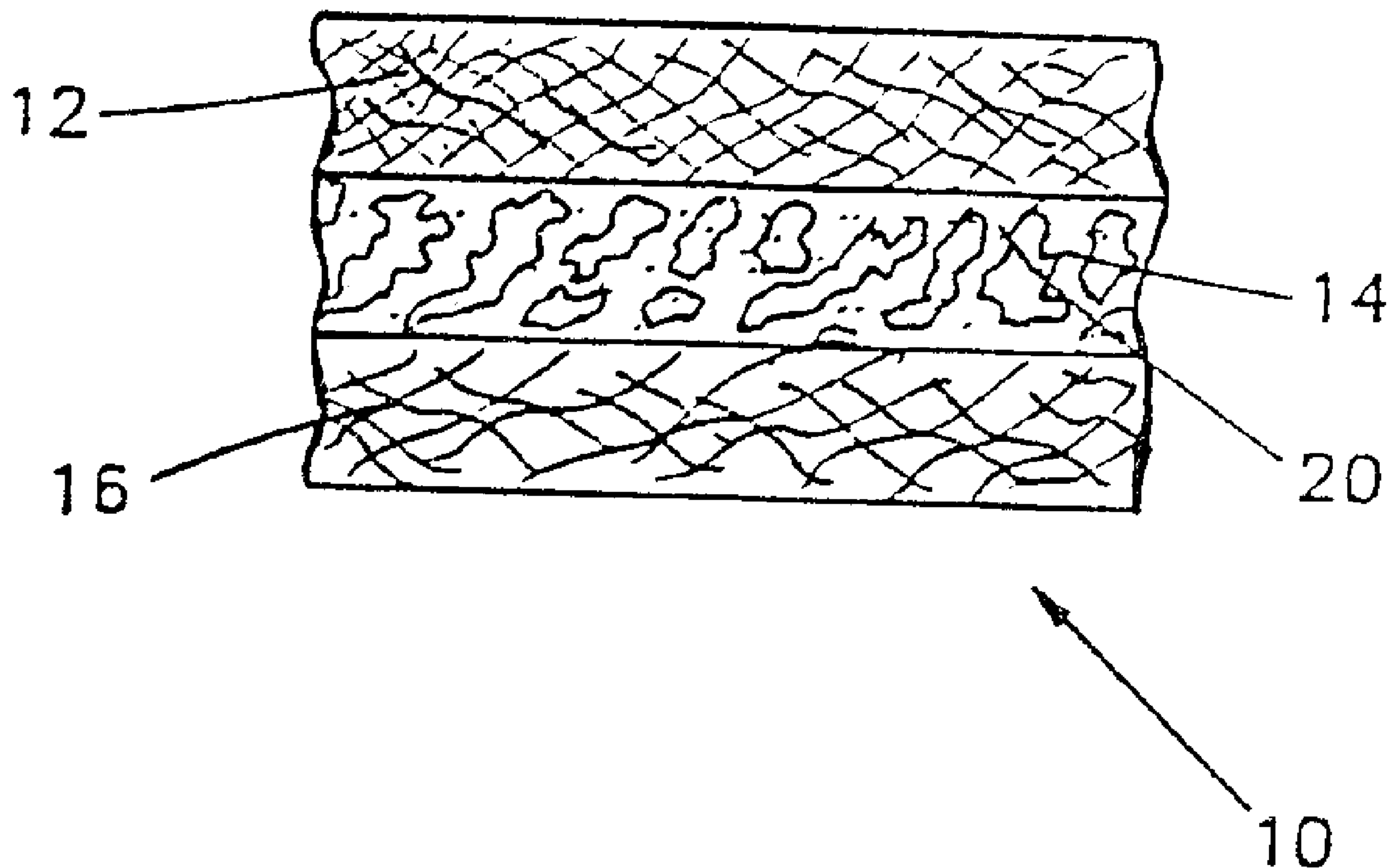
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(54) Titre : TISSU COMPOSITE ISOLANT IMPERRESPIRANT

(54) Title: BREATHABLE COMPOSITE BARRIER FABRIC



(57) Abrégé/Abstract:

A three-layered composite barrier fabric has a middle layer of a microporous polyolefin film, in particular polypropylene, and top and bottom layers of spun-bonded polyolefin webs, also preferably made of polypropylene. The three layers are secured to one another by ultrasonic point bonding at spaced-apart points. The middle layer of the composite provides a barrier to liquids such as water or blood while allowing water vapor to be transmitted therethrough. The outer layers provide for strength and overall characteristics of the fabric. The resulting fabric provides breathability by allowing transmission of vapor such as perspiration, consistent with stopping flow of liquid through the fabric. The outer layers provide effective strength and other physical properties to enable their use in protective garments.

Abstract of the Disclosure

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BREATHABLE COMPOSITE BARRIER FABRIC

Background of the Invention

This invention relates to breathable composite barrier
5 fabrics which are impervious to water-based liquids but which
allow passage of water vapor. Applications for such fabrics
exist in the field of protective garments for medical
technicians, laboratory workers, and the like where it is desired
to prevent passage of blood or other body fluids to the body of
10 the worker or from the worker to the patient while allowing
passage of water vapor. Garments with such characteristics
provide enhanced comfort for the wearer by allowing perspiration
to escape, consistent with maintaining a barrier to passage of
liquids.

15 Breathable multi-layer barrier fabrics of various
combinations of layered material are disclosed in prior art
patents. U.S. Patent No. 4,041,203, issued August 9, 1977, to
Brock et al., discloses a fabric made up of a mat of generally
discontinuous thermoplastic microfibers as a top layer and a web
20 of substantially continuous, randomly deposited polymer filaments
as a bottom layer, the layers being bonded at intermittent
discrete regions. A three-layer fabric having a mat layer on the
outside and a web layer in the middle is also disclosed. The
specific polymer materials used for the mat and the web include
25 polyolefins such as polypropylene. U.S. Patent No. 4,828,556,
issued May 9, 1989, to Braun et al., discloses a multi-layer
fabric having a first layer of porous melt-blown material, a

second layer comprised of a non-microporous film of polyvinyl alcohol, and a third layer of porous non-woven material in the form of a spun-bonded or melt-blown web. The fabric of this reference is said to be useful for absorbent articles such as
5 diapers. Numerous prior patents directed to microporous films are also disclosed and discussed in this reference. Impervious, absorbent barrier fabrics are disclosed in U.S. Patent No. 4,379,192, issued April 5, 1983, to Wahlquist et al., the fabric including layers having continuous filament webs, microfiber
10 mats, and polymeric film, the mats providing an uncompacted absorbent center layer. While numerous combinations of layers of various polymeric materials prepared in a desired physical form are disclosed in these references, the combination of an inner layer of microporous film and outer layers of spun-bonded
15 material as disclosed herein is not known by applicant to have been disclosed or suggested by the prior art.

A breathable fabric for protective garments of the type mentioned above should provide for wearer comfort by enabling passage of water vapor resulting from perspiration or humidity in
20 the environment, as well as forming a barrier to passage of liquid water or water-based liquid such as blood or other body fluids. For effectiveness in situations involving handling of a bleeding patient, the barrier should be effective at elevated pressure such as two psig to prevent the blood from being
25 projected through the fabric. In addition, strength and durability are desired in the fabric as exemplified by tensile strength of at least 30 pounds and a Mullen burst value of at least 50 psi. Other characteristics need for such fabric include

a relatively low cost obtainable by use of readily available inexpensive materials for the various layers and amenability to preparing the fabric and making garments by inexpensive methods. Also, a cloth-like texture and feel are needed to encourage
5 wearing of the garment.

Summary of the Invention

The present invention is directed to breathable composite fabrics made up of an inside layer of a film of polyolefin material in microporous form sandwiched between layers of spun-
10 bonded polyolefin webs. Desired characteristics of the fabrics in terms of vapor transmission, liquid water blockage, and necessary strength are obtained by selecting materials having specified physical properties for the respective layers. The layers are bonded to one another by ultrasonic bonding at spaced-
15 apart points.

Fabrics embodying the invention are effective for use in protective garments where stoppage of fluids such as blood is required, along with enhanced comfort and breathability of vapors produced by perspiration. The fabric may be made up of readily
20 available inexpensive materials for the respective layers, and they are readily fabricated using simple methods.

It is, therefore, an object of this invention to provide a composite fabric that is permeable to water vapor but that serves as a barrier against passage of water-based fluids.

25 Another object is to provide such a fabric that provides a barrier to passage of blood at slightly elevated pressure.

Yet another object is to provide a breathable composite

fabric that may be manufactured at low cost from readily available layer materials.

Other objects and advantages of the invention will be apparent from the following detailed description and the appended
5 claims.

Brief Description of the Drawings

Fig. 1 is a diagrammatic representation of a cross-sectional view of a multi-layer composite fabric embodying the invention.

Fig. 2 is a schematic fragmentary perspective view, with
10 portions peeled away, of the fabric of Fig. 1.

Description of the Preferred Embodiment

Referring to the drawings, there is shown a breathable composite fabric 10 made up of three layers, a top layer 12 of a spun-bonded polyolefin, a middle layer 14 of a microporous
15 polyolefin film, and a bottom layer 16 of spun-bonded polyolefin. The three layers are secured to one another by ultrasonic bonding at spaced-apart points 18 throughout the fabric surface.

Top layer 12 may comprise a spun-bonded polyolefin, with polypropylene being the preferred material. Polyethylene may also be used. The polypropylene material may have a weight of one-half to two ounces per square yard, with one ounce being particularly preferred. The spun-bonded layers provide strength to the composite fabric, along with a cloth-like surface texture which enhances its use for garments, as contrasted with film materials which have a smooth plastic surface. Spun-bonded polypropylene suitable for this purpose is available from Poly-

Bond, Inc., under the designation Poly-bond. Properties of this material are as follows: weight, 1 ounce per square yard; thickness, 7.9 mils; air permeability, 465 cubic feet air flow per square yard; Mullen burst, 43; grab strength, machine
5 direction, pounds to break, 25; cross direction, 17, elongation, percent, machine direction, 75; cross direction, 17, and trapezoidal tear strength, machine direction, 7.2 pounds; cross direction, 4.25 pounds.

The bottom layer 16 may have the same composition as top
10 layer 12, although material having a lighter weight such as 0.5 ounce per square yard may be used to reduce the overall fabric weight.

The middle layer 14 may comprise a microporous film of a polyolefin and preferably propylene. Polyethylene may also be
15 used. The polypropylene films have a microporous structure with extremely small random pores 20 extending through the film matrix, allowing vapor such as water vapor to pass through, while forming a barrier to passage of liquids. A suitable film material is available from 3M Disposable Products Division under
20 the designation, "Scotch™ microporous film." Properties of a designated film suitable for use in this invention are as follows: thickness, 1.5 mil; weight, 0.85 ounce per square yard; tensile strength at break (DPD Test Method 106), machine
25 direction, 2,000g/25mm; cross direction, 950 grams/25mm; elongation at break (DPD Test Method 106), machine direction, greater than 100 percent, cross direction, greater than 100 percent. Permeation/barrier properties include a moisture vapor transmission rate of greater than 5,000 grams per square meter at

75° F. and 50 percent relative humidity as measured by the inverted cup method; air permeability, less than 400 seconds/50 cc by Gurley Densometer® measurement and water hold-out, greater than 65 pounds per square inch as measured by Mullen burst test.

5 Other microporous films having a transmission rate of greater than 1,500 b/m²/24 hr. at 86° F. and 48 percent relative humidity as measured by ASTM E96 and water holdout greater than 50 psi are acceptable.

Composite fabrics may be prepared by forming a stacked array
10 of the respective layers and bonding them together under heat and pressure at discrete, spaced-apart sites by use of ultrasonic point bonding techniques such as pinsonic bonding. This produces a strong and durable fabric, consistent with the avoidance of creating enough fused areas to interfere with vapor transmission.

15 The invention is illustrated by the following example:

A composite three-layered fabric was prepared by providing a stacked array having a middle layer of a 1.5 mil thick layer of microporous polypropylene film and top and bottom layers of 1.0 oz./square yard spun-bonded polypropylene material and securing
20 the layers together by ultrasonic point bonding. Samples of the fabric were subjected to liquid penetration tests by being exposed to a liquid for 5 minutes at atmospheric pressure, one minute at 2 psig, and 54 minutes at atmospheric pressure. For liquid tap water (73 dynes/cm), no penetration was observed.

25 Liquid synthetic blood (40 dynes/cm) showed no penetration under the same test conditions, except for one failure out of 10 samples when exposed for 2 minutes at 2 psig, this failure resulting from an apparent pin hole. Liquid isopropyl alcohol

showed no penetration at 5 minutes under atmospheric pressure but did show penetration at 2 minutes under 2 psig.

Strength properties of samples of the fabric were determined using test methods specified in ASTM D-751. Results obtained
5 were as follows: Mullen burst (psi) 75.0; tensile test (pounds) (machine direction) 39.6; (cross direction) 39.6; trap tear (pounds) (machine direction) 23.4; (cross direction) 15.6.

Moisture vapor transmission rates through the fabric were determined by exposing a sample to 50 percent relative humidity
10 air at 86.4° F, using ASTM E96 test procedure. A transmission rate of 1973 g/m²/24 hrs. was obtained. The results obtained demonstrate effectiveness of the fabric in terms of providing a barrier to water-based liquids while allowing transmission of water vapor such as to enable breathability.

15 The above example is not to be understood as limiting the scope of the invention, which is limited only as indicated by the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:-

1. A non-woven composite fabric comprising:
a layer of microporous film having at least one film surface ultrasonically bonded to a layer of spun-bonded polyolefin, characterized in that the microporous film is polypropylene and that said film and layers are ultrasonically bonded to one another by ultrasonic point bonding at multiple spaced-apart locations;
creating a water-based liquid barrier comprised of liquid water, blood, and other bodily fluids; and
said non-woven composite fabric providing a barrier to passage of liquids while allowing water vapor to be transmitted therethrough.
2. A non-woven composite fabric according to claim 1, wherein the polypropylene microporous film has a layer of the spun-bonded polyolefin ultrasonically bonded to a top surface of the microporous film and a bottom surface of the microporous film.
3. A non-woven composite fabric according to claim 1, wherein said layers of spun-bonded polyolefin are comprised of polypropylene, said barrier to passage of liquids is a barrier to blood.
4. A non-woven composite fabric according to claim 2, wherein each layer of spun-bonded polyolefin is comprised of polypropylene.
5. A non-woven composite fabric according to claim 1, wherein said microporous film has a moisture vapor transmission rate of greater than 1,500 grams per square meter per 24 hours at 75°F (41.7°C) and 48 percent relative humidity and water hold-out greater than 65 pounds per square inch (448 kN/m²) as measured by the Mullen burst test.

6. A non-woven composite fabric according to any one of claims 2 to 4, wherein said microporous film has a moisture vapor transmission rate of greater than 1,500 grams per square meter per 24 hours at 75°F (41.7°C) and 48 percent relative humidity and water hold-out greater than 65 pounds per square inch (448 kN/m²) as measured by the Mullen burst test.

7. A non-woven composite fabric according to claim 1, wherein said spun-bonded layers have a grab strength in machine direction of at least 25 pounds (11.3kg) to break, cross direction of at least 17 pounds (7.7kg) to break, and an elongation value of at least 75 percent machine direction and at least 17, cross direction.

8. A non-woven composite fabric according to any one of claims 2 to 5, wherein said spun-bonded layers have a grab strength in machine direction of at least 25 pounds (11.3kg) to break, cross direction of at least 17 pounds (7.7kg) to break, and an elongation value of at least 75 percent machine direction and at least 17, cross direction.

9. A non-woven composite fabric according to claim 5, wherein said microporous film has a thickness of 1.5 mil (0.15cm).

10. A non-woven composite fabric according to claim 7, wherein said spun-bonded layers have a weight of 1 ounce per square yard (33.9 g/m²).

11. A breathable composite barrier fabric comprising:

a middle layer of a microporous film of polypropylene having a moisture vapor transmission rate of at least 5,000 grams per square meter at 75°F and 50 percent relative humidity and an air permeability of less than 400 seconds/50 cc and a water hold-out of greater than 65 pounds per square inch;

top and bottom layers of spun-bonded polypropylene having a weight of one ounce per square yard, a thickness of 7.9 mils, and an air permeability of 465 cubic feet air flow per square yard; and

said layers being joined to one another by ultrasonic point bonding at spaced-apart locations.

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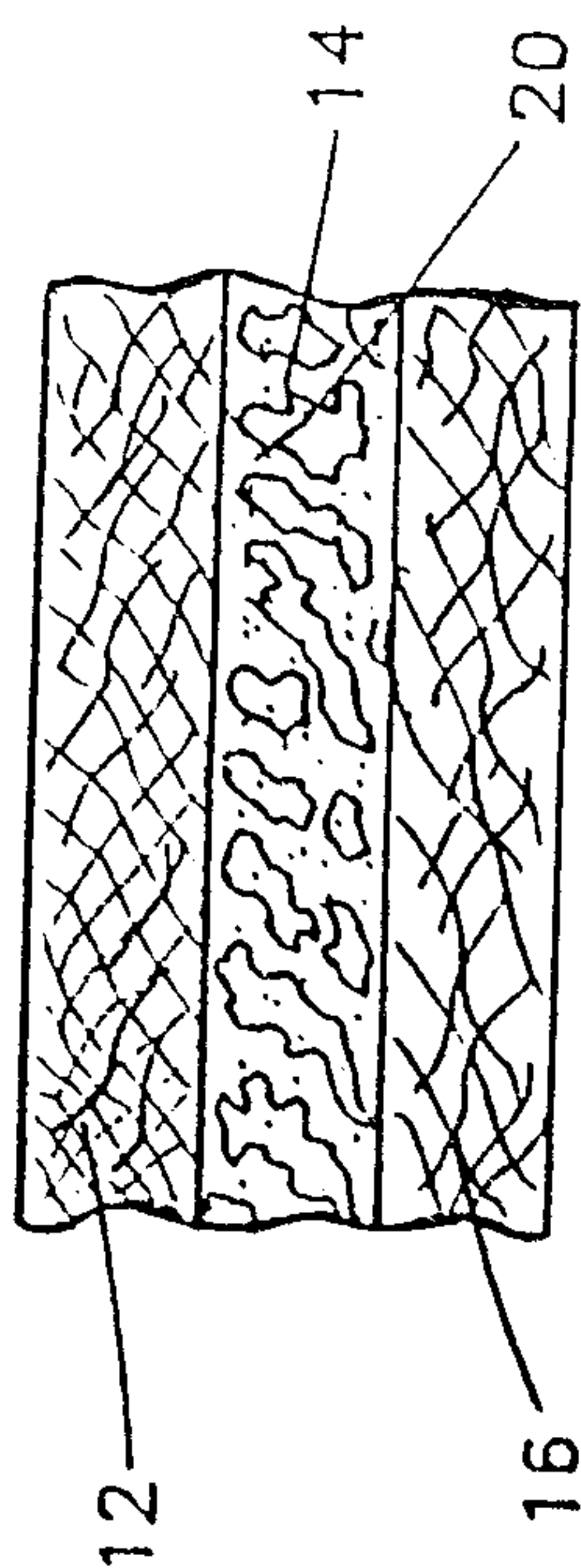


FIG. 1

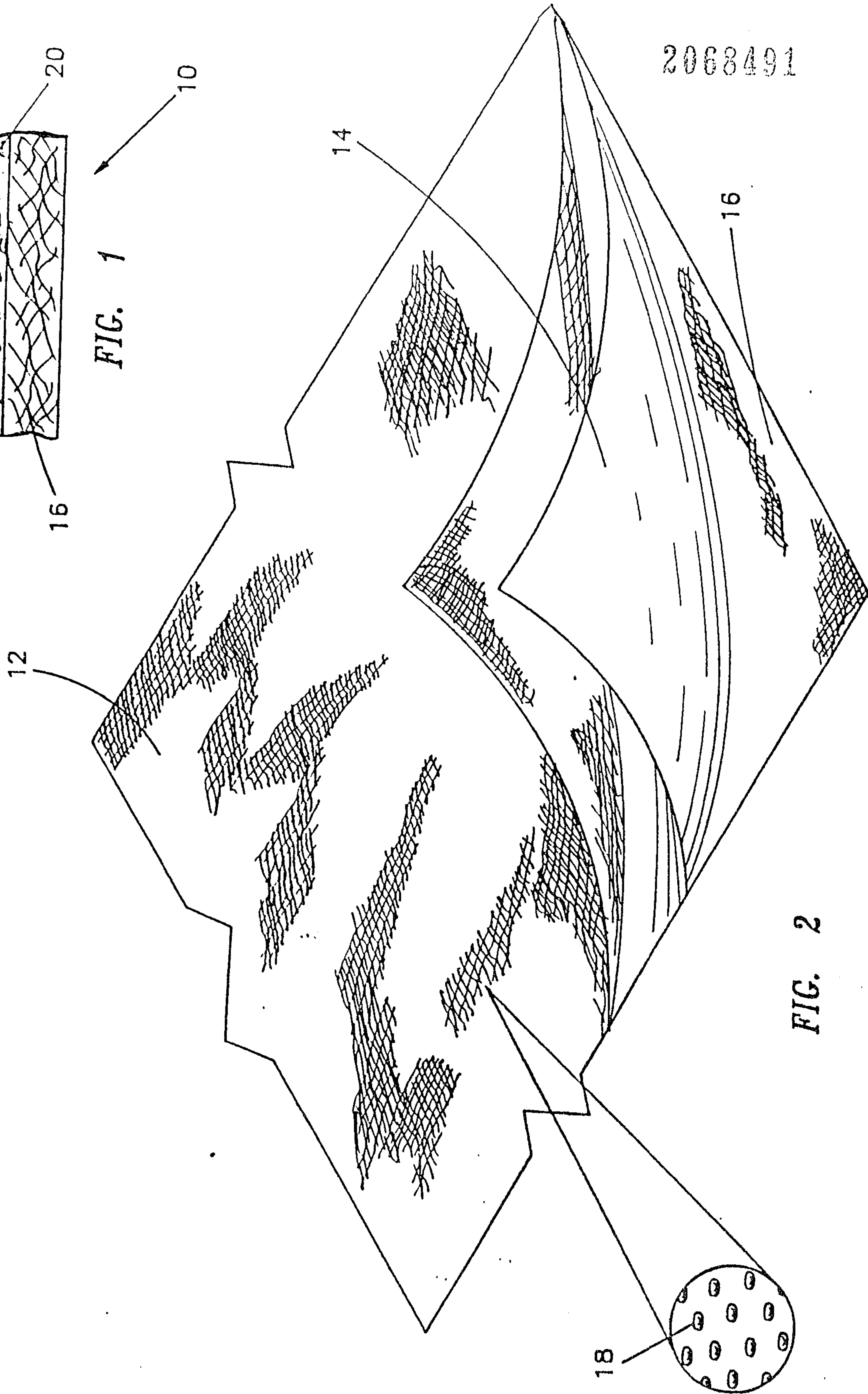


FIG. 2

