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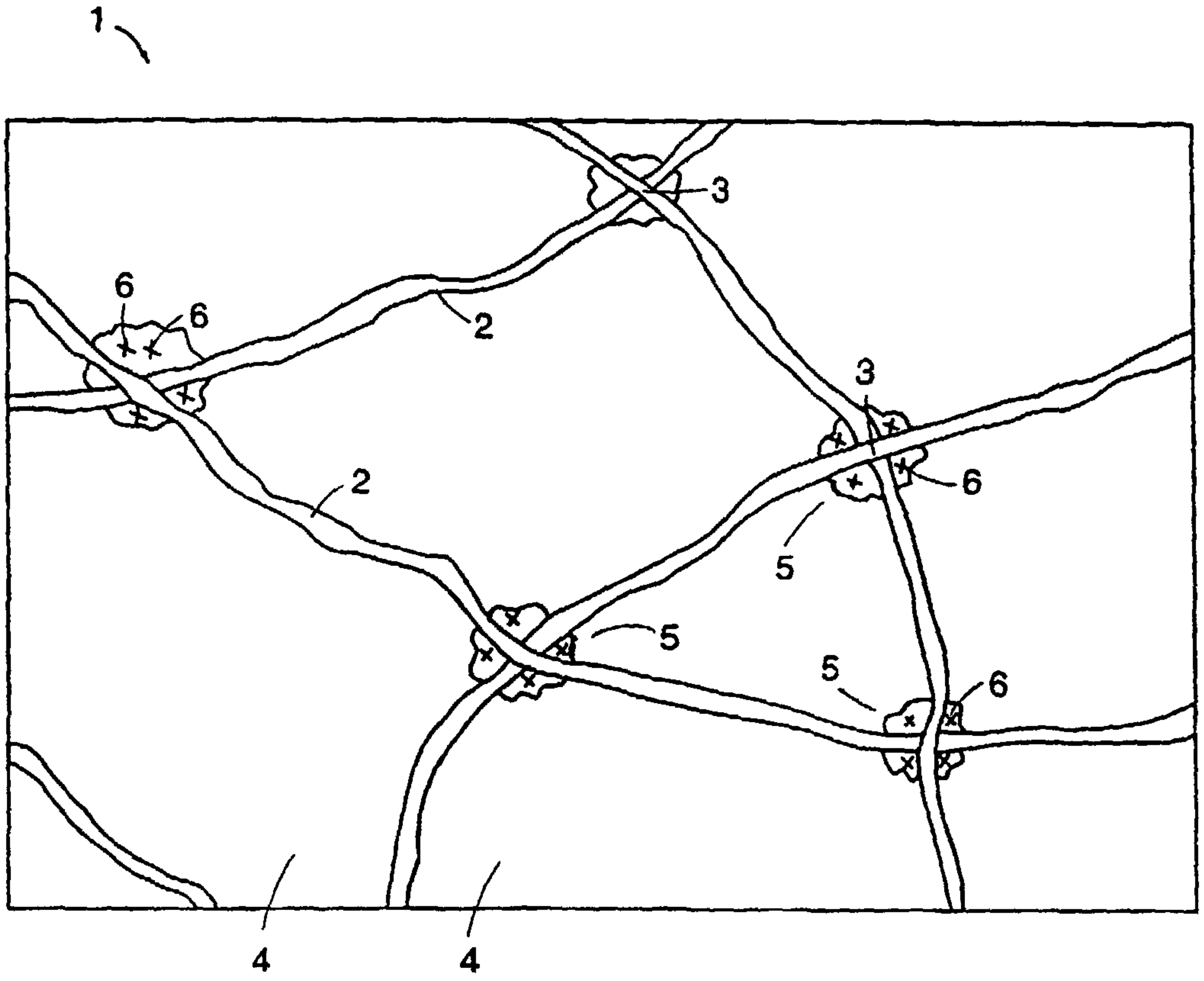

(57) **Abrégé/Abstract:**

A nonwoven textile having reversible enhanced thermal control properties, the material comprising: a bat or web bonded by polymeric binder containing thermal control material within the interior of the bat or web, wherein the thermal control material is dispersed throughout the interior of the polymeric binder, and wherein the thermal control material is substantially entirely within the interior of the nonwoven textile.

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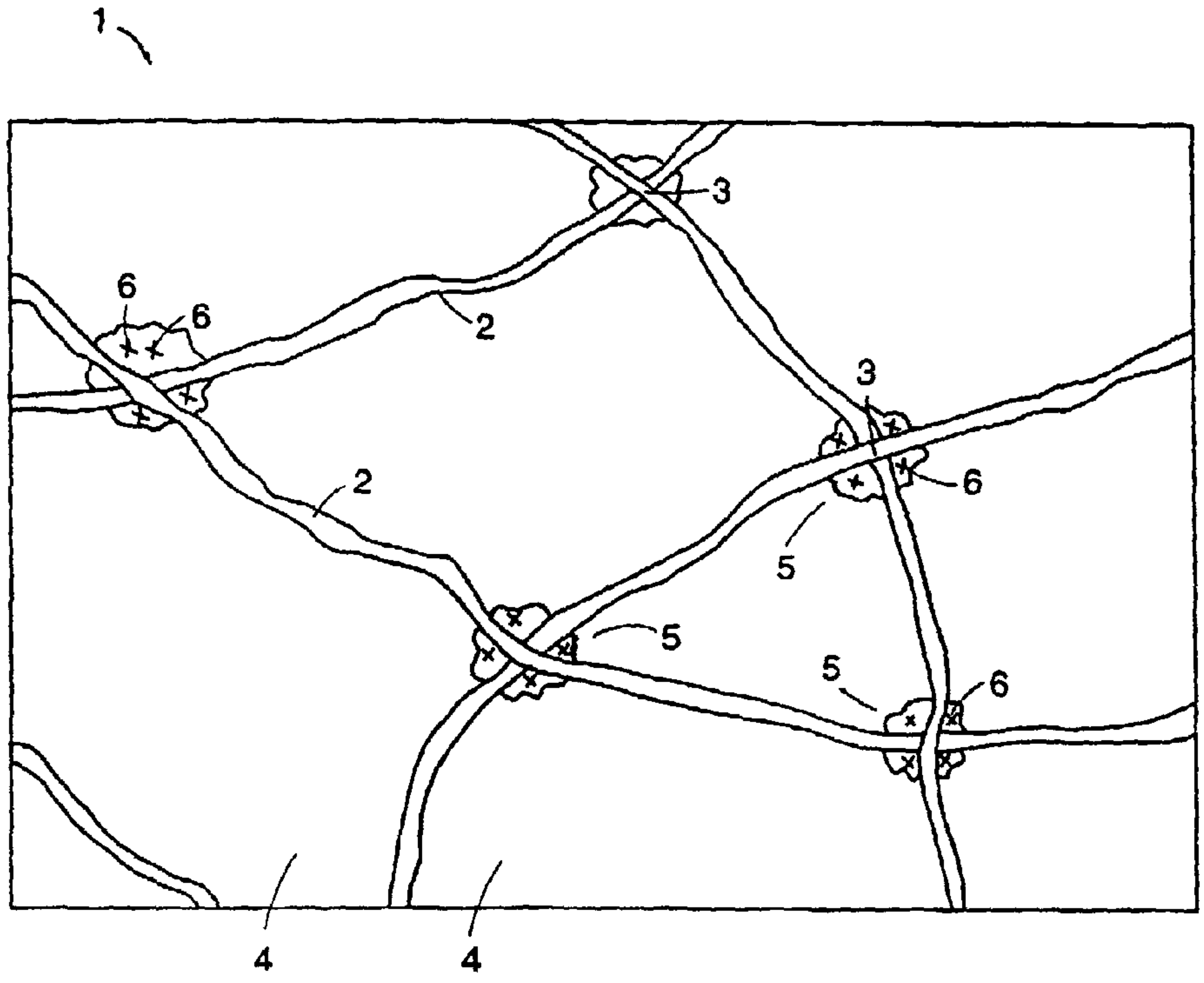

(57) Abstract: A nonwoven textile having reversible enhanced thermal control properties, the material comprising: a bat or web bonded by polymeric binder containing thermal control material within the interior of the bat or web, wherein the thermal control material is dispersed throughout the interior of the polymeric binder, and wherein the thermal control material is substantially entirely within the interior of the nonwoven textile.

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THERMAL CONTROL NONWOVEN MATERIAL

Field of the Invention

This invention relates to nonwoven materials useful as components of garments that protect against cold or hot environmental conditions. More particularly, the invention relates to articles that employ phase change materials to absorb and release heat. For example, the invention relates to shoe insoles and lining materials for maintaining the thermal climate in an enclosed shoe.

Background of the Invention

Fibrous products coated with phase change material are known. For example, publications and patents including the following disclose these and related products: United States Patent No. 6,077,597 to Pause, which discloses a three layer insulating system. The first layer is a flexible substrate treated with a coating in which are dispersed microspheres containing a phase change material. The second layer is a mat of fibers in which are dispersed microspheres containing a phase change material. The third layer is a flexible substrate. United States Patent No. 4,939,020 to Takashima et al. discloses a non-woven fabric with a coating composition comprising a vinyl polymer, heat-expandable microcapsules, and a thiocyanate compound. United States Patent Nos. 5,722,482 and 6,004,662 to Buckley discloses flexible composite material containing phase change material. PCT application WO 95/34609 to Gateway Technologies discloses fabric coatings including phase change material dispersed throughout a polymer binder, surfactant, dispersant, antifoam agents and thickener. United States Patent No. 5,366,801, and EP application 611,330 B1 to Bryant et al. disclose articles including fabric and fiber base material coated with polymeric binder and microcapsules. United States Patent No. 4,756,958 to Bryant et al. discloses fiber with integral microspheres filled with phase change material.

Summary of the Invention

The invention results from the discovery that novel combinations and configurations of materials can be used to create nonwoven thermal control textiles providing protection against either hot or cold conditions. The nonwoven textile can be a multiple-use article, suitable for incorporation as an interlining into garments such as jackets, pants, shirts, overalls, hats, scarves, and the like, as well as in footwear such as shoes and boots. For example, a shoe insole or lining can be created that helps to maintain the thermal climate within the shoe more effectively than with conventional materials or methods. The nonwoven can be used as linings in suitcases, and bags. The nonwoven can be used to produce medical garb.

"Nonwoven" as used herein in its customary sense, refers to fabric that, in contrast to woven or knitted fabric, comprises bonded continuous or staple fiber. The term "shoe," as used herein, is to be understood as denoting outer footwear generally.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, suitable methods and materials are described below. All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety. In case of conflict, the present specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting.

Other features and advantages of the invention will be apparent from the following detailed description, and from the claims.

Brief Description of the Drawing

Fig. 1 is a schematic illustration of a nonwoven web material according to a particular embodiment of the invention.

Fig. 2 is a schematic illustration of a nonwoven web material according to another particular embodiment of the invention.

Detailed Description

The thermal control nonwoven material has a polymeric binder dispersed throughout its interior, and thermal control material dispersed throughout the interior of the binder. The binder in the nonwoven may be a continuous filling or it may be discontinuous, as will be explained. The thermal control nonwoven material according to this invention has the ability to protect against hot or cold environments, by virtue of the absorption and/or release of heat from the thermal control material.

The nonwoven textiles can be made up of a wide variety of substances. For example, the nonwoven can be formed from cellulosic, polyolefin (for example, polyethylene, polypropylene and the like), polyesters, polyamides (for example, nylon), bi-component materials or mixtures of the above, and even inorganic fibers. These fibers can be of lengths between about 0.3 and about 7 cm, depending on the method of web formation and bonding desired, alternatively, the fibers can be longer, including a fiber or fibers prepared by continuous extrusion of a melted polymer via spunbond/meltblown technology. Fibers can range from about 0.5 to about 30 denier.

Nonwoven textiles are prepared in two distinct steps: the first step is formation of a loose bat or web, and the second is bonding of the bat or web, for example by binder, or physical fusion of the bat or web at its junctions, or entanglement of the bat or web to create a nonwoven.

Web formation can be carried out according to any of the methods known in the art. For example, the web can be made by a dry-laid process, in which rotating rollers having fine teeth along their circumferences are used to card individual fibers into a substantially parallel-laid, or unidirectional, web. Such unidirectional webs can be combined by crosslapping, in which individual unidirectional webs are built up at an angle to each other. For a further example, the web can be made by a wet-laid process, in which fibers are dispersed in water and passed over a belt screen. The water is extracted through the screen, and the resulting web is formed on the belt. This method produces a dense, uniform and strong web. Random-laid (isotropic) webs can be created by air deposition, which involves blowing fibers randomly onto a screen. In another embodiment, fibers can be laid randomly onto a preformed nonwoven scrim, which takes the place of a screen. For example, fibers could be blown onto a preformed web having binder with thermal control material dispersed within the binder, to form a bi-layered product with one layer having thermal control properties, and another layer without such properties. For example, such a product could be made with one layer of approximately 200 g/m2 of nonwoven including thermal control material, and another layer of approximately 200-800 g/m2 of nonwoven having been blown onto the thermal control nonwoven.

Random-laid webs can be created also by melt-blowing processes, where fibers are directly spun from a polymer, drawn and torn to varying lengths by the air stream, and deposited to form a substrate. Alternatively, spunbonding can be used to create virtually endless fibers from granules of raw material. The fibers are stretched by (heated air) and laid into a web. These processes produce nonwoven fabrics in a single, continuous process.

For insole constructions, the nonwoven can take a number of forms. The type of material used depends on the required end use of the material. For an insole material, the non-woven fabric preferably comprises a stiff, rigid board, formed, for example, from a blend of polyester fibers with a range of decitex values with a stiff polymer binder. For a cushion-type insole, the nonwoven fabric preferably comprises, for example, a blend of coarse polyester fibers having a decitex value of about 6, with a soft, resilient polymer binder to give a material having a resilient and open structure.

After formation of the web, and in some embodiments, after any eventual slight prebonding of the web (to be described below), the web is submerged in a bath containing a suspension or dispersion of polymeric binder and thermal control material. According to the processes described herein, a nonwoven is created in which the web is bonded to itself by binder, at least at points of intersection. In some embodiments, the web is substantially continuously filled with polymeric binder, while in other embodiments, the polymeric binder is present substantially at the web junctions, and the interstices are substantially filled with a gas, such as air. Binders useful in fabrics of this invention are solids at temperatures of fabric use, preferably resulting in nonwoven which are washable and dry cleanable. If a solvent is used, the binder can have a high melting point. If not dissolved, however, suitable binders generally flow below the softening point of the base material of the web. Some suitable binders are polymeric materials. Particularly useful are polymer dispersions or emulsions which are able to form adhesive and/or cohesive bonds within the web, for example by crosslinking to itself, or by crosslinking to the web itself. Examples of polymeric binders, include acrylics and polyacrylics, methacrylics and polymethacrylics, polyurethanes, nitrile rubbers, styrene/butadiene copolymers, chloroprene rubbers, polyvinyl alcohols, or ethylene/vinyl acetate copolymers, and mixtures thereof.

Latex binders can also be used, including water-based latex blends. Advantageously, the latex binder comprises a stiff styrene/butadiene rubber latex. Preferably the binder includes a thickener, for example ammonia and an acrylic latex that reacts with the thickener (for example, ammonia) to thicken the mixture. For example, a suitable latex binder comprises a blend of 75% by weight of Applied Polymers S30R and 25% by weight of Synthomer™ 7050. This blend can be thickened with ammonia and an acrylic latex such as, for example, Viscalex™ HV30, manufactured by Allied Colloids.

Examples of thermal control materials include phase-change materials, such as those discussed below.

This submersion step is carried out to the extent necessary to allow substantially complete penetration of the suspension or dispersion into the web. The bath can be heated, in order to effect fusion of the fibers at points of intersection. The web is then dried to remove any solvent (i.e. water), resulting in a nonwoven textile having binder and thermal control material in the interstices of the web material. Alternatively or additionally, the web can be passed through rollers, which can be heated or not heated. Warmed or hot air can also be used to dry the web. In some embodiments, the interstices of the resulting web are substantially filled with binder and thermal control material.

A preferred embodiment of the invention has the binder located almost entirely at points where the web intersects itself, leaving the remainder of the interstices filled with gas, typically air, which imparts thermal insulative properties to the material. Turning to Figs. 1 and 2, there is shown a portion of nonwoven 1 comprising web material 2, having junctions 3, and interstices or voids 4. Dispersed throughout the web and located at junctions of fibers of the web material are areas of binder 5, having thermal control material 6 dispersed throughout. The remainder of the web does not contain binder, in some embodiments. The binder acts as the bonding agent of the web to itself as well as the bonding agent of the thermal control material to each other and to the web, thus forming a bonded nonwoven with thermal control material dispersed therein.

Nonwoven textiles according to such embodiments can be prepared by utilizing the surface tension of the binder, and the relative affinities of the binder for the web and for itself. A binder which shows excessive self-affinity will not be prone to bind to the web at all, while a binder which shows excessive affinity for the web will not form islands or globules at the web's intersection points. The rate at which any solvent is removed from a binder can also affect the extent to which binder forms islands or globules at the web intersections. Excessively rapid solvent removal may not allow the binder to migrate to the web junctions. It is within the ordinary level of skill of one in the art to select a solvent removal rate which is well matched to the affinity properties of the binder.

In other embodiments, the web is substantially entirely filled with binder, the binder having thermal control material dispersed throughout it. Embodiments in which the web is filled can also call for relatively flexible binder material, or can call for relatively rigid binder material, depending on the application.

The viscosity of the binder can be modulated to produce nonwoven fabric having binder coagulated at the interstices of the web. In such embodiments, the binder coagulates at the interstices of the web, as shown in Fig. 1 and Fig. 2.

The bonding of the web is carried out preferably immediately after web formation, by submersion of the web into binder bath containing the thermal control material. Alternatively slight prebonding processes including binder spray-bonding, thermal bonding processes, needling processes and water-jet bonding processes may be carried out prior to the submersion of the web into the binder bath and final bonding of the nonwoven. These processes can impart various qualities to the finished product, as recognized by those of skill in the art. For example, needling or water-jet bonding can be used to produce relatively dense and stiff nonwovens, as well as relatively light and voluminous nonwovens, depending on the needling or water-jet density and pressure. In some embodiments, a preferred web can be a non-woven needle felt. In another example, spunbonded webs can be submerged in the above-described chemical bath subsequent to their bonding.

The thermal control materials that can be included in the textiles are those suitable for protection against cold and/or heat. Particularly useful thermal control materials include phase change materials. Phase change materials that are encapsulated, particularly microencapsulated, are useful in the invention. Microcapsules suitable for the present invention may contain a wide variety of materials. The choice of materials is limited only by the conditions for processing of the textiles disclosed herein. Microcapsules suitable for the present invention have diameters ranging from 15.0 to 2,000 microns. Preferably, the microcapsules have diameters of from 15 to 500 microns. Most preferably, the microcapsules have diameters of from 15 to 200 microns. Phase change materials are well suited for inclusion in microcapsules, wherein the microcapsules have a diameter of the same order as, or greater than, the diameter of the material making up the nonwoven.

Phase change materials are designed to utilize latent heat absorption associated with a reversible phase change transition, such as a solid-liquid transition. Certain phase change materials also absorb or emit heat upon solid-solid phase transitions. Thus, the material can be used as an absorber of heat to protect an object from additional heat, because a quantity of thermal energy will be absorbed by the phase change material before its temperature can rise. The phase change material can also be preheated and used as a barrier to cold, as a larger quantity of heat must be removed from the phase change material before its temperature can begin to drop. The phase change materials which are preferred for the present invention utilize a reversible solid-liquid transition.

Phase change materials store thermal energy in the form of a physical change of state as the core material within the microcapsules melts or freezes or undergoes a solid-solid transition. These materials will absorb or emit heat at a constant temperature (their phase change temperature) before changing phase. Thus, the material can be used as an absorber of heat to protect an object from additional heat as a quantity of thermal energy will be absorbed by the phase change material before its temperature can rise. The phase change material can also be preheated and used as a barrier to cold, as a larger quantity of heat must be removed from the phase change material before its temperature can begin to drop. In order to maintain the ability of the phase change materials to recycle between solid and liquid phases, it is important to prevent dispersal of the phase change materials throughout the solvent (or carrier fluid) when they are in the liquid form. An approach which has found success is encapsulation of the phase change materials within a thin membrane or shell. Such thin membranes or shells should desirably not significantly impede heat transfer into or out of the capsules. The capsules can desirably also be small enough to present a relatively high surface area. This makes rapid heat transfer to and from the carrier fluid possible. Such capsules are known as microcapsule. Microcapsule range in size from about 10 to about 50 microns and are formed according to conventional methods well known to those with skill in the art. Heat transfer across the microcapsule material into its interior should be efficient for maximum utility in the present invention.

The composition of the phase change material is modified to obtain optimum thermal properties for a given temperature range. For example, the melting point for a series of paraffinic hydrocarbons (normal, straight chain hydrocarbons of formula CnH2n+2) is directly related to the number of carbon atoms as shown in the following table.

Table 1. Hydrocarbon Phase Transition Temperatures

Compound Name	Carbons	Melting Point (°C)
n-decane	10	-32
n-undecane	11	-26
n-dodecane	12	-11
n-tridecane	13	-5.5
n-tetradecane	14	5.9
n-pentadecane	15	10.0
n-hexadecane	16	18.2
n-heptadecane	17	22.0
n-octadecane	18	28.2
n-nonadecane	19	32.1
n-eicosane	20	36.8
n-heneicosane	21	40.5
n-docosane	22	44.4
n-tricosane	23	47.6
n-tetracosane	24	50.9
n-pentacosane	25	53.7
n-hexacosane	26	56.4
n-heptacosane	27	59.0
n-octacosane	28	61.4
n-nonacosane	29	63.4
n-triacontane	30	65.4
n-hentriacontane	31	68.0
n-dotriacontane	32	70.0
n-tritriacontane	33	71.0
n-tetratriacontane	34	72.9
n-hexatriacontane	36	76.1

In addition to the hydrocarbons listed here, other paraffinic hydrocarbons having a greater (or lesser) number of carbon atoms having a higher (or lower) melting point can also be employed in practicing the invention. Additionally, plastic crystals such as 2,2-dimethyl-1,3-propanediol (DMP) and 2-hydroxymethyl-2-methyl-1,3-propanediol (HMP) and the like are also contemplated for use as the temperature stabilizing means. When plastic crystals absorb thermal energy, the molecular structure is modified without leaving the solid phase.

Combinations of any phase change materials can also be utilized. Microencapsulated phase change material (MicroPCM) is desirably distributed homogeneously throughout the polymeric binder. In some embodiments, the MicroPCM can be predispersed in water using a dispersing agent, for example, Dispex™ A40 before being mixed with latex binder. According to such embodiments, it is preferable that the phase change material is dispersed in the water at between about 30% and about 60% by weight of the solid material to the water, or preferably between about 40% and 45%. When a water/MicroPCM mixture is desirably made, preferably, the water/MicroPCM mixture is mixed with the latex binder to give a ratio of MicroPCM to rubber or between about 0.5 and 2 to 1. Preferably, the dry binder to base nonwoven material ratio is between about 0.3:1 and 3:1. The preferred ratio depends on the required properties of the finished product. For a cushion insole, the ratio is preferably between about 0.3 and 0.5 to 1. For a lining material, the ratio is preferably about 1:1 and for a stiff insole, the ratio is preferably about 2.5:1. Optionally, the binder mix may include a coloring agent.

Examples of phase change materials are paraffinic hydrocarbons, namely normal (straight-chain) hydrocarbons represented by the formula CnH2n+2, wherein n can range from 10 to 30. Preferred paraffinic hydrocarbons are those in which n ranges from 13 to 28. Other compounds which are suitable for phase change materials are 2,2-dimethyl-1,3-propanediol (DMP), 2-hydroxymethyl-2-methyl-1,3-propanediol (HMP) and similar compounds. Also useful are fatty esters such as methyl palmitate. Preferred phase change materials are paraffinic hydrocarbons.

The thermal control properties can be made reversible for the textiles disclosed herein by providing for regeneration of the phase change material. During warming, for example, the phase change material gradually melts; during cooling, the phase change material gradually freezes. One way to regenerate the phase change material is to place the nonwoven in an environment having a temperature which restores the phase change material to the appropriate phase for the protection desired.

For most embodiments, the melting point or activation temperature of the phase change material is in the range of from about 15 to about 55°C (60 to 130°F), advantageously in the range 26 to 38°C (80 to 100°F). For most applications the activation temperature is preferably about 28°C (83°F). Advantageously, different grades of phase change material can be used for different applications. For example, it may be advantageous to have a higher activation temperature for shoe insoles of about 35°C (95°F), and a lower activation temperature of about 28°C (83°F) for upper or tongue areas of shoes. The variations in activation temperature can be selected to allow for the physical differences in the skin from the bottom of the foot to the top of the foot.

The specifications of thermal control materials as discussed herein can vary according to the uses to which they are put. The weight of the web can be from about 15 to about 1000 g/m2, preferably from about 40 to about 700 g/m2, or from about 50 to about 150 g/m2.

For example, when used as an interlining or as insulative materials for garments or footwear, the weight of the fibrous web can range from about 15 to about 200 g/m2, preferably from about 50 to about 160 g/m2. Such a web can be loaded with from about 5 to about 600 g/m2 of binder and phase change material, preferably from about 50 to about 450 g/m2 of binder and phase change material. The thickness of the nonwoven can range from about 0.5 mm up to about 20 mm when used as an interlining, or for garments and footwear. Preferably for a shoe insole or lining material, the initial thickness is between about 0.5 and 5mm, whereas for a cushion insole, the initial thickness is between about 5 and 15mm.

The invention further provides a method of manufacturing a shoe insole or lining material comprising the steps of 1) mixing a microencapsulated phase change material comprising a material having reversible thermal energy storage properties encapsulated in microcapsules of a retaining polymer and having an activation temperature of around body temperature (where body temperature is normal physiological skin temperature), with a liquid polymer binder; 2) impregnating a non-woven base material with the binder mixture; and 3) drying the impregnated material. Preferably the method further includes the step of pre-dispersing the microencapsulated phase change material in water before mixing with the liquid polymer binder. Preferably, the microencapsulated phase change material is pre-dispersed in water using a dispersing agent such as Dispex™ A40. Preferably, the method further includes the step of adding a thickening agent to the binder mix. It has been found that increasing the velocity of the mix improves stability, reduces separation of filtering out of the microcapsules during impregnation and results in a much better appearance of the finished material. Preferably, the impregnated material is dried at about 120°C. Preferably, the method includes the further step of curing the polymer binder material. Advantageously, the curing step is carried out at about 140°C. Preferably, the method includes the further step of finishing the material, for example, by calendaring the material to the required gauge, sueding the surface of the nonwoven lining and the application of adhesive or barrier coatings to aid the shoe-making process.

The invention further provides a shoe insole, comprising a nonwoven base material, a polymer binder, and a microencapsulated phase change material dispersed within the binder, wherein the phase change material comprises a material having reversible thermal energy storage properties encapsulated in microcapsules of a retaining polymer and the phase change material has an activation temperature of around body temperature.

The invention will be further described in the following examples, which do not limit the scope of the invention described in the claims.

Examples

Example 1. Preparation of a Nonwoven

A bat or web having a weight of 50 g/m² was carded from a mixture of 100% polyester fibers including fibers with 1.7 dtex and a length of 38 mm and 3.3 dtex and a length of 38 mm. The bat was submerged into a binder bath and dried in a dryer at 160°C, so that the resulting product had a weight of 111 g/m² containing 61 g/m² binder and phase change material. Thus, the product had 15 g/m² of dry mass of a self crosslinking acrylate binder with a glass temperature Tg= - 10°C and 46 g/m² phase change material (Thermasorb® 83 Frisby Technologies) wherein the weight ratio of binder to phase change material was 1 : 3.1 and the weight ratio of bat or web to binder plus phase change material is 1 : 1.2.

Example 2. Preparation of a Further Nonwoven

A bat or web having a weight of 110 g/m² was made from a mixture of 50% polyesterfibers with 1.7 dtex and a length of 38 mm and 50% polyamide 6.6 fibers with 3.3 dtex and a length of 38 mm was prebonded by needle punching. The bat was submerged into a binder bath and dried in a dryer at 165°C so that the resulting product had a weight of 289 g/m² and contained 179 g/m² binder and phase change material. Thus, the product had 30 g/m² in the dry mass of a self crosslinking acrylate binder with glass temperature Tg= - 32°C and 149 g/m² phase change material (Thermasorb® 83 Frisby Technologies) wherein the weight ratio of binder to phase change material is 1 : 4.9 and the weight ratio of bat or web to binder plus phase change material is 1 : 1.6.

Example 3. Preparation of Yet a Further Nonwoven

A bat or web having a weight of 75 g/m² was made from a mixture of 90% polyesterfibers with 1.7 dtex and a length of 50 mm and 10% of a bicomponent fiber including polyamide 6.6 and polyamide 6 with 3.3 dtex and a length of 50 mm was prebonded by thermal bonding in a vacuum oven at 205°C. The bat was submerged into a binder bath as in Example 2 and dried in a dryer at 165°C so that the resulting product had a weight of 237 g/m² wherein the weight ratio of binder to phase change material is 1 : 4.9 and the weight ratio of bat or web to binder plus phase change material is 1 : 2.2.

Example 4. Preparation of a Nonwoven Suitable for Use as a Shoe Insole Material

A non-woven needle felt of a blend of polyester fibers suitable for use as a shoe insole, such as for example the felt designated T90 as manufactured by Texon (UK) Limited, was impregnated with a water-based latex binder. The binder comprised the following composition by weight:

Thermasorb™ microcapsules	90	)	pre-dispersion
Dispex™ A40	0.9	)	solid content
Water	109	)	of 45%
Applied Polymers S30R	100		
Synthomer™ 7050	33		
Coloring agent	15		
Ammonia	1.5		
10% Viscalex™ HV30	25		

This gives a Thermasorb™ to rubber content of 1.25:1 and a solids content of 43.2%.

A mat of polyester needle felt 40 cm x 14 cm and having a thickness of 4.0mm was impregnated with the binder mixture with a ratio of dry binder to felt of 1.70:1. The resulting impregnated material was dried at 120°C and cured at 140°C. The final material had a weight of 1850g/m2and gauge of 4.2mm and a Thermasorb™ content of 22% or 400g/m2. This material could provide an energy storage capability of about 49 to 50 joules per gram, which can provide a cooling or warming effect when used as a shoe insole.

Example 5. Preparation of a Nonwoven Suitable for Use as a Cushion Shoe Insole Material

A non-woven needle felt of coarse polyester fibers suitable for use as a cushion insole for a shoe, such as for example the felt designated T100 as manufactured by Texon (UK) Limited, was impregnated with a water-based latex binder. The binder comprised the following composition by weight:

Thermasorb™ microcapsules	90	)	pre-dispersion
Dispex™ A40	0.9	)	solid content
Water	109	)	of 45%
Latex 2890	200		
Coloring agent	15		
Ammonia	1.5		
10% Viscalex™ HV30	25		

This gives a Thermasorb™ to rubber content of 1.13:1 and a solids content of 38.5%.

A mat of felt 40 cm x 14 cm and having a thickness of 4.0mm was impregnated with the binder mixture with a ratio of dry binder to felt of 1.50:1. The resulting impregnated material was dried at 120°C and cured are 140°C. The final material had a weight of 900g/m2 and gauge of 4.0mm and a Thermasorb™ content of 23% or 200g/m2. This material could provide an energy storage capability of about 57 to 58 joules per gram, which can provide a cooling or warming effect when used as a shoe insole. Test results on samples prepared according to examples 4 and 5 indicate that the shoe insole and lining materials according to the invention provide a noticeable cooling or warming effect when used within a shoe.

Other Embodiments

It is to be understood that while the invention has been described in conjunction with the detailed description thereof, the forgoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims.

What is claimed is:

1. A nonwoven textile having reversible enhanced thermal control properties, the material comprising: a nonwoven bat or web bonded by polymeric binder containing encapsulated thermal control material within the interior of the bat or web, wherein the thermal control material is dispersed within the interior of the polymeric binder, and wherein the thermal control material is substantially entirely within the interior of the nonwoven bat or web.

2. The nonwoven textile of claim 1, wherein the textile is a shoe insole or lining.

3. The shoe insole or lining of claim 2, wherein the polymeric binder is applied in liquid form and then solidified.

4. The nonwoven textile of claim 1, wherein the nonwoven material is a polyolefin, polyester, polyamide, bicomponents hereof or polyacrylate or cellulosic or mixtures thereof.

5. The nonwoven textile of claim 1, wherein the weight ratio of bat or web to binder and thermal control material together is from about 1 : 0.5 to about 1:3.

6. The nonwoven textile of claim 1, wherein the weight ratio of binder to thermal control material is from about 1 : 0.5 to about 1: 6.

7. The nonwoven textile of claim 1, wherein the thermal control material comprises microcapsules of a phase change material.

8. The textile of claim 7, wherein the diameter of the microcapsules is not substantially smaller than the diameter of the material of the bat or web.

9. The nonwoven textile of claim 7, wherein the phase-change material comprises a hydrocarbon.

10. The nonwoven textile of claim 7, wherein the phase-change material undergoes a change in phase from about 43 to about 175°F.

11. The nonwoven textile of claim 10, wherein the phase-change material undergoes a change in phase from about 75 to about 95°F.

12. The nonwoven textile of claim 10, wherein the phase-change material undergoes a change in phase around body temperature.

13. The nonwoven textile of claim 1, wherein the thermal control material comprises at least two phase-change materials undergoing changes in phase at at least two different temperatures.

14. The nonwoven textile of claim 1, wherein the nonwoven material comprises a bat or web having junctions where the web contacts itself.

15. The nonwoven textile of claim 14, wherein the polymeric binder is located at the junctions of the web.

16. The nonwoven textile of claim 1, wherein the nonwoven has a weight of from about 15 to about 200 g/m2.

17. The nonwoven textile of claim 16, wherein the nonwoven has a weight of from about 50 to about 150 g/m2.

18. The nonwoven textile of claim 1, wherein the polymeric binder comprises a latex binder.

19. The nonwoven textile of claim 18, wherein the polymeric binder comprises a water-based latex blend.

20. The nonwoven textile of claim 1, wherein the bat or web comprises a non-woven needle felt.

21. The nonwoven textile of claim 20, wherein the latex binder comprises a styrene butadiene rubber latex.

22. The nonwoven textile of claim 1, wherein the polymeric binder further comprises a thickener.

23. The nonwoven textile of claim 22, wherein the thickener comprises ammonia and an acrylic latex that reacts with the ammonia.

24. An interlining comprising the nonwoven textile according to claim 1.

25. A garment comprising the interlining according to claim 24.

26. A footwear component comprising the nonwoven textile according to claim 1.

27. A method of making a nonwoven textile, wherein the nonwoven textile comprises a web having junctions, the method comprising fixing the web at its junctions by a binder, the binder comprising thermal control material.

28. A method of protecting against hot temperature, the method comprising providing a textile according to claim 7, wherein the phase change material is in a solid phase, and wherein the phase change material undergoes a phase change at a temperature below the hot temperature.

29. A method of protecting against cold temperature, the method comprising providing a textile according to claim 7, wherein the phase change material is in a liquid phase, and wherein the phase change material undergoes a phase change at a temperature above the cold temperature.

30. The method of claim 27, wherein the thermal control material is dispersed in water before being mixed with the binder.

31. The method of claim 30, wherein the thermal control material is dispersed in water at between about 30% and 60% by weight of solid material to water.

32. The method of claim 31, wherein the thermal control material is dispersed in water at between about 40% and 45% by weight of solid material to water.

33. The method of claim 30, wherein the water/thermal control material is mixed with the binder to give a ratio of thermal control material to binder solids of between about 0.5 and 2 to 1.

34. The method of claim 30, wherein the binder to web ratio is between about 0.3:1 and 3:1 by weight.

35. A method of manufacturing a shoe insole or lining material comprising:

mixing a microencapsulated phase change material comprising a material having reversible thermal energy storage properties encapsulated in microcapsules of a retaining polymer and having an activation temperature of around body temperature, with a liquid polymer binder;

impregnating a nonwoven base material with the binder mixture; and

drying the impregnated material.

36. The method of claim 35, further including dispersing the microencapsulated phase change material in water before mixing with the liquid polymer binder.

37. The method of claim 36, wherein the microencapsulated phase change material is dispersed in water using a dispersing agent.

38. The method of claim 35, further including adding a thickening agent to the binder mixture.

39. The method of claim 35, further including drying the impregnated material at about 120°C.

40. The method of claim 35, further including curing the material.

41. The method of claim 35 including finishing the material.

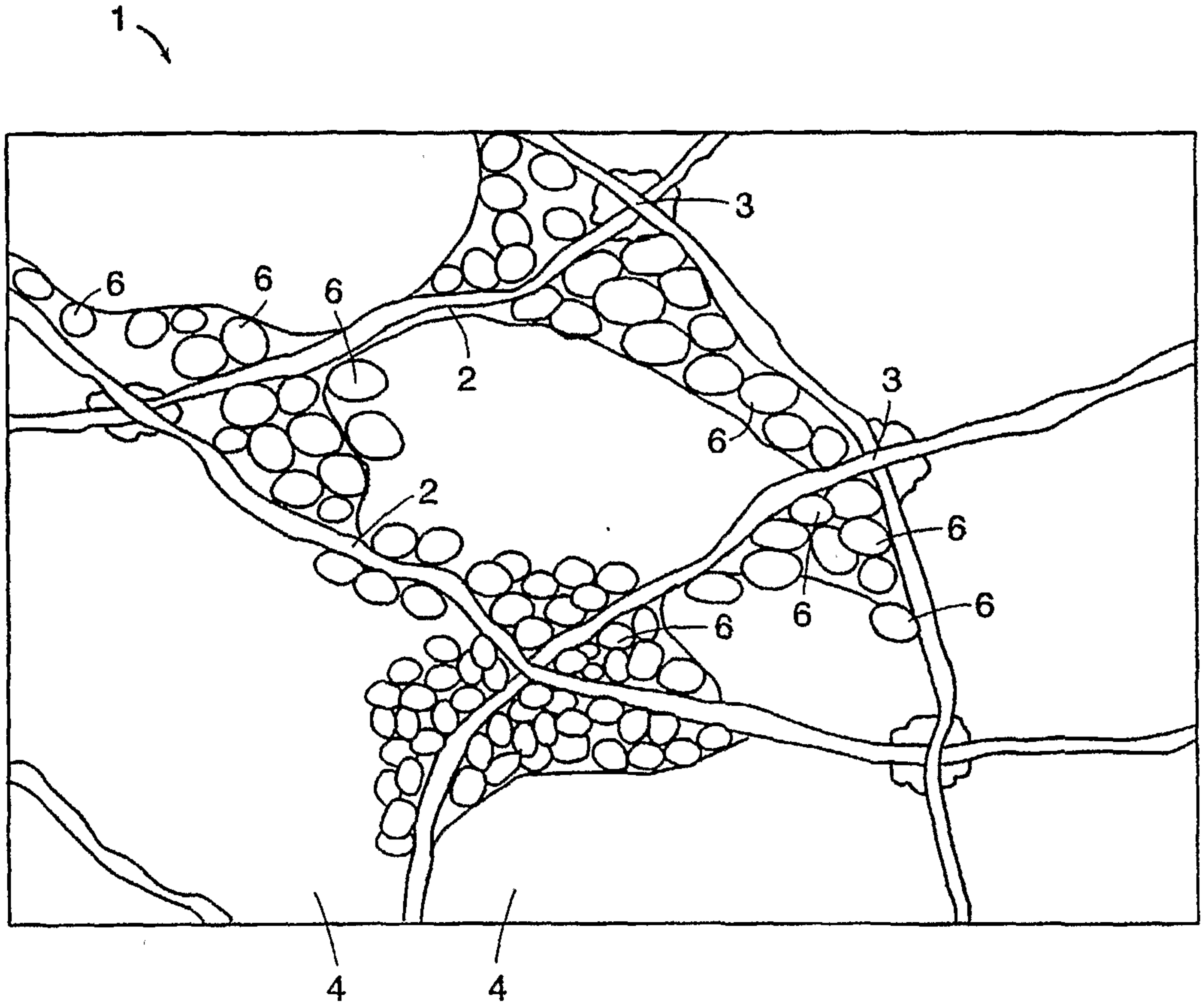


FIG. 1

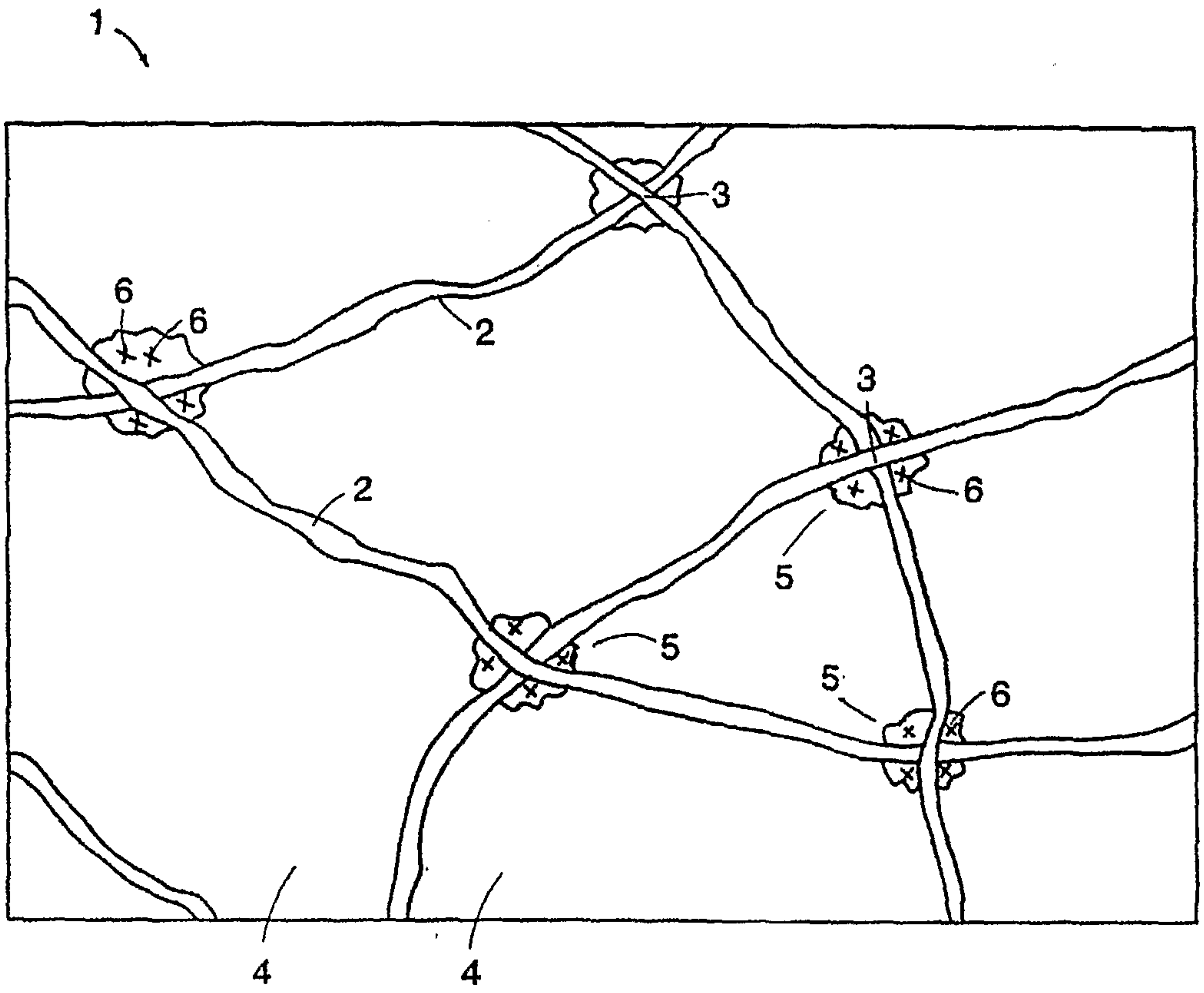
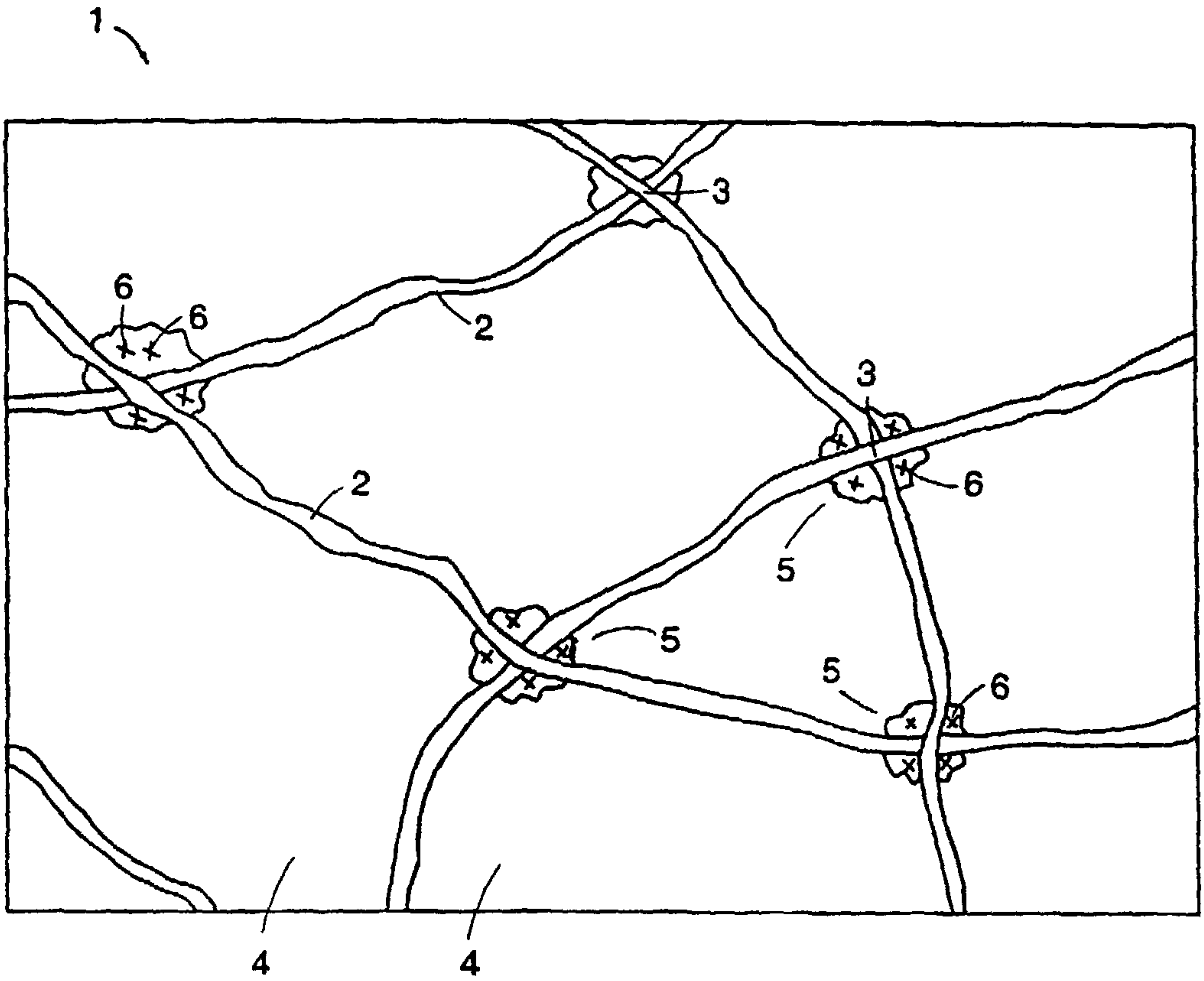


FIG. 2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