OPIC
OFFICE DE LA PROPRIÉTÉ INTELLECTUELLE DU CANADA

CIPO
CANADIAN INTELLECTUAL PROPERTY OFFICE

(12) (19) (CA) **Demande-Application**

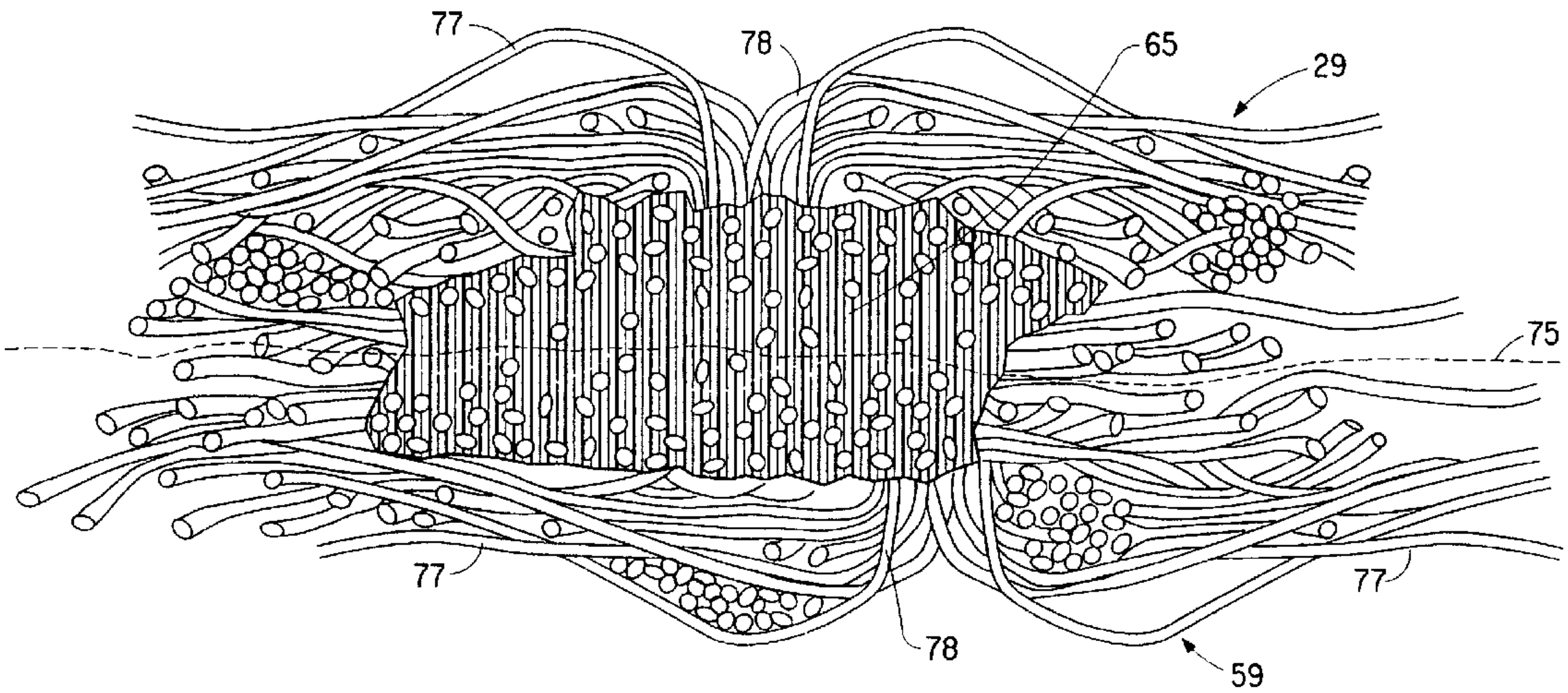
(21) (A1) **2,304,963**
(86) 1998/11/02
(87) 1999/05/14

(72) CRUISE, CHARLES CLAYTON, US
(72) PETERSON, ROBERT HOWE, US
(72) SUMMERS, JAMES THOMAS, US
(71) E.I. DU PONT DE NEMOURS AND COMPANY, US

(51) Int.Cl.^{6} D04H 13/00, D04H 1/66, D04H 1/62, D06M 17/04, A47L 13/16, B32B 5/06
(30) 1997/11/05 (60/064,506) US

(54) **STRUCTURES DE TISSU ABSORBANTES, SOLIDES A FILAMENTS ENTREMELES**

(54) **DURABLE, ABSORBENT SPUNLACED FABRIC STRUCTURES**



(57) L'invention concerne la production de tissus non tissés résistants au lavage en machine et à d'autres utilisations à l'état humide ou énergiques ou à des applications sollicitant fortement le tissu. Ces tissus comprennent deux couches de tissu liées l'une à l'autre en des points rapprochés, le liage comprenant des fibres des deux tissus intimement mêlées au liant. Ces tissus conservent les qualités d'un tissu non-tissé à filaments entremêlés, notamment un faible coût et des qualités de confort, d'aptitude au drapage, de douceur, d'absorption, de perméabilité à l'air etc. tout en présentant une durabilité comparable aux tissus traditionnels réalisés par tricot ou tissage.

(57) This invention relates to making nonwoven fabrics which are durable for machine washing and durable for other wet and hard use or abusive applications. The inventive fabrics comprise two layers of fabric sheet bonded together at closely spaced locations where the bonding includes fibers from both fabrics thoroughly involved with the binder. The inventive fabrics retain the qualities of a spunlaced nonwoven fabric which include low cost, comfort, drapability, softness, absorbency, breathability and others while having the durability comparable to traditional knitted or woven fabrics.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **D04H 13/00, 1/62, 1/66, B32B 5/06, D06M 17/04, A47L 13/16**	**A1**	**(11) International Publication Number:** **WO 99/23291** **(43) International Publication Date:** 14 May 1999 (14.05.99)

(21) International Application Number: PCT/US98/23196

(22) International Filing Date: 2 November 1998 (02.11.98)

(30) Priority Data:
60/064,506 5 November 1997 (05.11.97) US

(71) Applicant: E.I. DU PONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US).

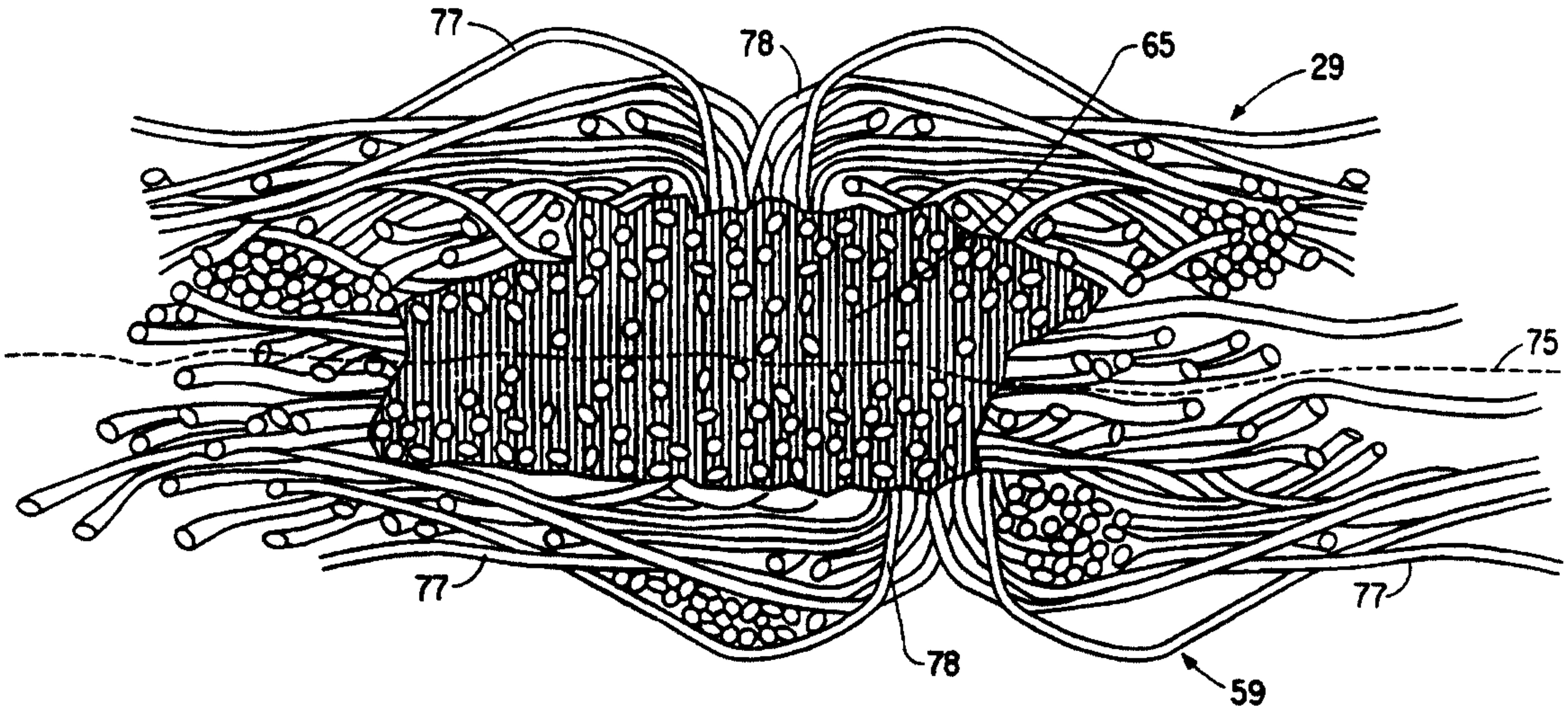
(72) Inventors: CRUISE, Charles, Clayton; 4948 Ranier Drive, Old Hickory, TN 37138 (US). PETERSON, Robert, Howe; 102 Blue Ridge Trace, Hendersonville, TN 37075 (US). SUMMERS, James, Thomas; 1066 Hillview Drive, Hendersonville, TN 37075 (US).

(74) Agent: STRICKLAND, Frederick, D.; E.I. du Pont de Nemours and Company, Legal Patent Records Center, 1007 Market Street, Wilmington, DE 19898 (US).

(81) Designated States: CA, JP, KR, MX, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: DURABLE, ABSORBENT SPUNLACED FABRIC STRUCTURES



(57) Abstract

This invention relates to making nonwoven fabrics which are durable for machine washing and durable for other wet and hard use or abusive applications. The inventive fabrics comprise two layers of fabric sheet bonded together at closely spaced locations where the bonding includes fibers from both fabrics thoroughly involved with the binder. The inventive fabrics retain the qualities of a spunlaced nonwoven fabric which include low cost, comfort, drapability, softness, absorbency, breathability and others while having the durability comparable to traditional knitted or woven fabrics.

DURABLE, ABSORBENT SPUNLACED FABRIC STRUCTURES

Field of the Invention

This invention relates to spunlaced fabrics and particularly to spunlaced fabrics suitable for durable uses and reuses. The invention more particularly relates to chamois-type materials.

Background of the Invention

E. I. du Pont de Nemours and Company (DuPont) has been making and selling Sontara® spunlaced fabrics for a number of years. Such spunlaced fabrics have a multitude of uses such as medical gowns and drapes, absorbent wipers and durables such as window shades and interlinings for apparel. Sontara® spunlaced fabrics are successfully marketed because of their low cost in use and valuable attributes such as texture, softness, comfort, drapability and absorbency.

Spunlaced fabrics are made by hydroentangling webs of fibers with high energy water jets as basically described in Evans et al. US Patent No. 3,485,706. The webs may be made of a variety of fibers such as polyester, cellulose (rayon, cotton and wood pulp), acrylic, and other fibers as well as some blends of fibers. The fabrics may be further modified to include antistatic and antimicrobial properties, etc. by incorporation of appropriate additive materials into the fiber or fiber webs. However, one limitation of spunlaced fabrics and nonwovens in general is durability through multiple launderings. Thus, spunlaced fabrics have not been acceptable for most uses in apparel and garments except for single use garments such as medical gowns and limited use protective apparel.

Hydroentangling creates an impressively strong fabric at much lower cost than weaving and knitting. Unfortunately, the cyclic working in a typical washer ravages the entangled fibers and effectively destroys the fabric for its intended purpose as fibers are disentangled. After a single laundering, the fabric may tend to have a noticeably poorer appearance such as a pilling or "worn" look or possibly may be destroyed. Within a few launderings, ordinary spunlaced fabrics are almost always useless for their intended purpose. The fabric has the appearance that it has been shredded.

In one approach to create durability in spunlaced fabrics, DuPont has addressed this problem by a stitch pattern introducing thread into the fabric forming a stitchbond structure. The filament or staple yarns are "knit" in a dense pattern into the fabrics and are quite resistant to the cyclic tensioning or working of the fabric. Thus, the laundered stitchbond fabric does not suffer as much of the damages seen with the ordinary un-reinforced spunlaced fabrics. The stitched structure has proven to be reasonably satisfactory in performance for durable and reusable mattress covers and withstands many hundreds of launderings. However, there are aesthetic and cost considerations of the stitched appearance that could make such a solution unattractive.

Others have attempted to create a durable nonwoven by adding bonding agents to the fabrics. The bonding agents tend to make the resulting fabrics quite stiff. Actually, it seems to take more bonding agent to make the fabrics durable than it does to make them stiff. Clearly, stiffness is not a desirable quality for a number of uses such as for apparel and home furnishings. A second problem with binders is that they often extend to the surface which creates a couple of undesirable consequences. The binders tend to be very hard after they are cured and any place that it extends through to the surface will be noticeable to the touch. It would likely be quite irritating for example to a human wearing clothing made from such material. The second problem is that the binders often do not respond to dyes and printing like the fibers in the fabric. As such, the binder becomes noticeable and unsightly.

Clearly, it would be very desirable to be able to make and use nonwoven fabrics that are durable to withstand numerous launderings or similar abuse while having the qualities available from spunlaced fabrics.

Further, it is widely known that chamois is a material used for its absorbency and softness. Natural chamois is made from treated animal skins. There are also many artificial chamois-type materials, but none providing very high durability with excellent absorbency.

Summary of the Invention

It has now been found that a durable fabric may be formed by bonding two layers of fabric together to form a composite fabric structure having the feel and appearance of a conventional spunlaced fabric sheet, but with significantly improved durability. The composite fabric structure comprises two layers of fabric bonded together such that the bonding is done with discrete bonding points between the layers and relatively closely spaced to one another. In particular, the bonds encompass portions of fibers from both layers of fabric without substantially penetrating through to the outer surface of at least one of the layers of fabric.

Yet a further aspect of this invention is to provide an inexpensive yet durable and effective alternate to natural chamois and other artificial chamois materials.

Brief Description of the Drawings

The invention will be more easily understood by a detailed explanation of the invention including drawings. Accordingly, drawings which are particularly suited for explaining the invention are attached herewith; however, it should be understood that such drawings are for explanation only and are not necessarily to scale. The drawings are briefly described as follows:

Figure 1 shows a highly schematic arrangement of the manufacturing process for making the fabric of the present invention;

Figure 2 is an enlarged fragmentary perspective view of the calender rolls for forming the composite fabric of the present invention;

Figure 3 is an enlarged fragmentary top view of the scrim used to create the bonds in the composite fabric;

Figure 4 is a fragmentary perspective view similar to Figure 2 showing a second arrangement for forming the composite fabric structure of the present invention; and

Figure 5 is a cross sectional view of the composite fabric of the present invention showing a single bonding point.

Figure 6 is a set of photographs showing the composite fabric material at high magnifications before further processing.

Figure 7 is a set of photographs showing the composite fabric material at high magnifications after further processing.

Detailed Description of the Preferred Embodiments

Referring now to Figure 1 of the drawings, the equipment for making the composite fabrics of the present invention is generally indicated by the number 10. Figure 1 is a highly schematic drawing intended to convey the general understanding of the equipment and process while not overloading the drawing with detail.

The preferred process essentially comprises three generally separate steps which are shown in sequence in Figure 1. The first step is the creation of two separate hydroentangled sheets by first and second fabric forming lines generally indicated by the reference numbers 20 and 30 at the upper and lower portions of the drawing. The process of forming hydroentangled sheets is generally described in Zafiroglu et al., US Patent No. 3,797,074 and Evans et al., US Patent No. 3,485,706 and which are incorporated herein by reference. Focusing on the second fabric forming line 30, the process comprises feeding a batt of fiber 32 to an airlay 35. The airlay 35 includes a toothed disperser roll 36 that rotates at high speed relative to the feed rate of the batt 32. The fiber is pulled out of the batt 32 by the disperser roll 36 and fed into an air flow in the nozzle 37. The fiber is collected on a consolidation screen belt 41. The fiber on the belt 41, now generally referred to as a web, is carried onto a second belt 42 suited for supporting the web under a series of high energy water jets generally indicated by the number 45. The high energy water jets entangle the fibers forming a fabric. Typically, the fabrics are subjected to hydroentangling from the underside by conveyance around a roll 49 so as to be impinged by a second series of high energy water jets 50. The fabric is thereafter dried by suitable equipment such as the steam heated rolls 54 and 55 to produced a base fabric 59.

Both the first and second fabric lines 20 and 30 are essentially similar, producing base fabrics 29 and 59, respectively. It is preferred that the base fabrics are collected on a roll at the end of each line 20 and 30 so that production rates of each line 20, 30 and the composite assembly line 60 (described below) may be optimized and the lines can be operated independently for maximum up time.

Turning now to the process of combining the layers of fabrics together, a composite assembly line in the middle of Figure 1 is generally indicated by the number 60. The base fabric 59 is provided into the composite assembly line 60 and a mesh bonding layer 61 of a thermoplastic netting is provided thereon from a supply roll 62. The mesh bonding layer 61 is illustrated in Figure 3 and comprises a very fine netting like material with dots 63 at the interconnections of thermoplastic material. The fine strands 64 of thermoplastic material hold the mesh bonding layer together and effectively dictates the spacing of the bonding points of the composite fabric 99 or netting together. In the preferred arrangement, the dots 63 are smaller than a millimeter in diameter and about one (1) millimeter from adjacent dots 63. The fine strands 64 are quite small, being a few microns in thickness. Such materials are utilized commercially in medical and automotive products and are available from Smith and Nephew, Ltd. and Applied Extrusion Technologies, as well as other sources.

The second base fabric 29 is laid over top of the mesh bonding layer 61 forming a sandwich with fabrics 29 and 59 on the top and bottom thereof. The sandwich is then subjected to calendering between calender rolls 71 and 72 under controlled temperature, pressure and speed to melt the thermoplastic material in the mesh bonding layer 61. By surface tension of the molten thermoplastic material, the dots 63 of the mesh bonding layer 61 form discrete globules 65 (see Figure 5) of binder such that the fine connecting strands 64 between the dots 63 are severed and the material therein largely retracts into the globules 65. At the same time the pressure of the calender rolls 71 and 72 force a substantial portion of the fibers of the base fabrics into the globules such that the binder encases or encompasses a plurality of the fibers in each of the base fabrics at some point.

Referring now particularly to Figure 5, the construction of the composite fabric may be more clearly understood. A dotted line 75 is provided to show the interface between the two layers of base fabric 29 and 59. Each of the base fabrics are made up of a great number of individual fibers 77. The fibers are randomly arranged in the fabrics 29 and 59, however, it is generally known that the fibers preferentially lay flat in the web prior to hydroentangling. The fibers are described as having an X-Y orientation. After the fabric has been hydroentangled, some of the fibers are pushed through the fabric to have a Z component extending up and down in the fabric. The Z component fibers are tangled into and with the X-Y fibers which continue to comprise a majority of the fibers, forming the stable and strong hydroentangled fabric. As seen in Figure 5, some fibers 78 have a portion which extend in the Z direction though the fiber is longer than the Z direction thickness of the fabric. Thus, the fibers are not necessarily entirely vertically or Z oriented. It should also be seen that some of the Z fibers 78 are also enmeshed or encompassed into the globule 65 of binder. It is believed that this interaction of Z fibers 78 being caught and held by the globules 65 of adhesive provides the strongest contribution toward durability that hydroentangled fabrics have not possessed until this time. However, the durability benefits may not be entirely the enmeshing of the Z direction fibers but more simply the enmeshing of so many fibers. Certainly, it is believed that enmeshing Z direction fibers into the globules forms the most durable fabrics, but it may be within the scope of the invention simply to have at least one nonwoven fabric having a plurality, closely spaced, but discrete bonding points where the bonds includes enmeshing or encompassing fibers in the nonwoven fabric.

Several other observations about the globules and fibers 77 and 78 worth discussing are that the globule 65 is within the fabric and does not extend to the surface. Thus, the composite fabric surface retains the softness and appearance characteristics of the base fabric constituted by fibers 77. Secondly, the globule 65 preferably encase or surround on at least half of the surface of fibers 77 that are at least one fiber thickness from the boundary between the two base fabrics. In the drawing and in the preferred embodiment, fibers 77 several fiber thicknesses from the boundary are encased in the globules 65 of binder. This deep fiber bonding is a result of the substantial pressure employed by the calender rolls. The extent of involvement of the fibers in the globules may also be described as the percentage of the thickness of each base fabric which is involved with the globules 65. For example, it is preferred that the globules not extend through 100% of the base fabric because this would mean that the adhesive extends to the surface of the composite fabric. However, 80% to 90% penetration may be quite acceptable. At the other end, it is preferred that about 10% or more of the base fabric is involved in the globule although the scope of the invention is related to the amount that makes the composite fabric durable.

A further observation is that it is also important that the connections between adjacent globules are substantially broken or nonexistent. The inventive fabrics tend to exhibit harsher qualities after calendering and before washing. Once the inventive fabric is laundered, it expands in thickness after being tightly compressed and exhibits softness and drapability qualities comparable to conventional spunlaced fabrics. If the globules were substantially interconnected, they would tend to make the composite fabric stiffer. The discrete bonding points do not make a continuous film layer in the middle of the fabric but are in discrete globules that neither connect with each other nor penetrate to the surface of the fabric. The surface layers, while hydroentangled enough to interconnect the filaments and maintain surface integrity and strength are, nonetheless free to move enough to give a soft, drapable, flexible material, particularly after washing or mechanical action.

It should be noted that the two base fabrics may be similar or quite different. The base fabrics may differ in basis weight or in fiber composition, construction or a combination of differences. The potential binders for the base layers of fabric may be polyethylene, polyamide, polyester, polypropylene and polyvinyl alcohol as well as other potential adhesives. It is preferred that the adhesives be in a thermoplastic state so that the globules may be controlled while being pressed by calender rolls or other arrangement for compressing the base fabrics together.

While it is preferred that the binder be applied in the form of a mesh bonding layer 61, it has been found that it may be applied directly to the underlying base fabric. Referring to Figure 4, there is shown a simple series of adhesive applicators 80 which apply a small amount of binder to the fabric 59. The small amount of binder are called drops and form globule type bonds in a manner similar to the dots of the mesh bonding layer 61. The arrangement of the drops may not be as uniformly distributed as the dots are in a mesh, however it is believed that the distribution may be close enough to obtain satisfactory lamination while maintaining discrete bonding points or positions to provide the other desirable characteristics.

The size of the globules is preferably selected or defined so that the adhesive encompasses fibers from both layers of fabric but does not "bleed" through to either surface of the durable fabric. The term globule is meant to describe the adhesive material in the fabric although it is probably not spherical. Actually, the globules are quite amorphous being generally flatter and wider because of the nip pressure. It is noted that in some applications where one side of the fabric may be concealed or shielded, the adhesive may be permitted to extend to the surface of that side. However, it is suggested that one of the qualities of the inventive fabric is that the adhesive is not very perceptible at the surface of either side. Thus, the upper limit on the size of the globules is probably limited by the thickness of the fabric and the lower limit is related to the ability to get the adhesive to encompass fibers in each of the fabric layers. In most cases the globules will be less than 2 millimeters in diameter and often less than a single millimeter.

Another consideration of the dots or globules is the spacing. It is believed that the best results when the globules are spaced close to one another. However, it is recognized that a suitable composite fabric may be formed having greater durability than ordinary nonwoven fabrics when the globules are spaced considerably further apart than is preferred. For example, it may be suitable to space the globules so that there is a four to five millimeter spacing between the globules and perhaps greater spacing is possible. However, such spacing may suggest or require large globules that will penetrate substantially through the thickness of the fabric. Thus, the fabric layers may be quite thick in such circumstances or the adhesive may extend to the surface. In the preferred arrangement, the spacing is about 2 millimeters or less and more preferably about one millimeter or less.

The activation of the adhesive requires a balance of several considerations. For example, the speed at which the fabrics may be run through the nip will depend on the melting temperature of the adhesive, the temperature of the heated roll, and the pressure at the nip. Other factors may affect the bonding including hardness of the pressure roll, the diameter of the rolls. The adhesive in the dots or globules is preferably activated by a heated roller regardless of how the dots are applied to the fabrics.

Another option with the system to perhaps speed the manufacturing process would be to preheat one or both fabrics so that the calender rolls do not have to heat the fabric from ambient temperature. The calender rolls 71 and 72 are arranged so that the lower roll 72 is heated by hot oil or other source of heat and the upper roll 71 provides pressure down onto the heated roll 72. Thus, it is preferred to heat the upper base fabric 29 which is furthest remote from the heated roll. However, the preheaters may be placed in a variety of potential locations as indicated by the numbers 82, 83, 84, and 85 or in any combination that is found acceptable. It has been found that preheating the mesh bonding layer 61 has not been very satisfactory as it tends to melt unevenly and without the two fabrics to hold the dots in place could leave portions without the globules or bonds.

It should also be noted that hydroentangling is not the only nonwoven technology that would benefit by the present invention. Needle punched fabrics which have Z fiber direction arranged by a physical needle punched into a web of randomly oriented fiber also work well within the scope of the present invention.

It should also be noted that in some cases it may be desirable under the present invention to bond a nonwoven, a woven, a knit fabric or material made in accordance with technology other than spunlaced or needle punched technology. For example, it may be desired to have a lightweight knitted fabric combined with a low cost, heavier weight spunlaced fabric as backing for thickness or softness. By securing the woven to the nonwoven such that discrete globules of adhesive encase sufficient portions of the fibers from the spunlaced or needle punched nonwoven fabric, the resulting fabric will be durable to multiple launderings.

The following is a more detailed description of a sample of the inventive fabric: A layer of meltable thermoplastic web or mesh such as Delnet® meltable polyethylene web (weight range of 0.2-1.0 oz/yd^2 or 6.8-33.9 g/m^2 with a preferred range of 0.3-0.5 oz/yd^2 or 10.2-17.0 g/m^2) is laid between two layers of spunlaced fabric. The fabric layers should be at least 0.6 oz/yd^2 (20.3 g/m^2) up to about 5 oz/yd^2 (170 g/m^2) for the heated roll contact fabric of up to 8 oz/yd^2 (271 g/m^2) for the "non-preheated" fabric. The preferred range is about 0.9-4.0 oz/yd^2 (30.5-136 g/m^2). The two fabric layers may consist of cellulosics like rayon or lyocell or thermoplastics like polyester or polyamide or blends as desired to create specific sets of properties. A preferred blend has been lyocell and Microsafe™ acetate which gives a permanently antimicrobial absorbent comfort layer.

The adhesive mesh layer must be sufficiently lower melting than the surface layers to enable reasonable process speeds at a temperature that will not damage the surface layers. It can be, but is not limited to, a condensation polymer or copolymer such as polyamides or polyesters or an addition polymer such as polyethylene or vinyl copolymers. Scrim and surface layer polymers can be selected for reasonable surface energy compatibility to ensure proper adhesion, but with good physical interlock, it is not necessary. It is conceivable to form the globules of the present invention using a punctured or apertured film that under the application of heat would cause discrete bonding points to form. There are probably other techniques that could be used to form the globules.

The surface fabrics are preferably needled such as by hydroentangling or needle punch, to impart a significant amount of "Z" directionality to the fabrics so that many fibers in the layer are present on both surfaces and fastening them on the inside surface of the layer with the scrim polymer provides stability for the outside surface. Other means of web forming for nonwovens result in almost all of the fibers being in the plane of the fabric and not available to hold the outside to the inside.

Bonding is preferably achieved by use of a heated pressure calender. The preferred temperature range is from a low of 300 degrees F

(149 degrees C) to enable reasonable process speed to a high of about 450 degrees F (232 degrees C) for thermoplastics like polyesters to about 550 degrees F (288 degrees C) for cellulosics, such as lyocell. Pressures should be sufficient to extrude the molten scrim polymer into the surface layers to an extent that will encapsulate a reasonable number of fibers but will not exude to the surface.

In order to make a chamois-type material, the durable material as made from lyocell nonwoven fabrics is further treated to provide the desired properties. Photographs of the "as-made" laminate in Figure 6 show very little fibrillation at 100x and 250x magnifications. Washing of the material would have been thought to impart absorbency and softness by increasing fibrillation but even after four wash cycles there was little effect on the average fiber size. However, when the as-made fabric was finished by jet dyeing, Beck (rope) dyeing, rotary or paddle dyeing with either a direct-type or reactive dye after alkaline scouring there was an extensive amount of fibrillation on the surface. This is shown in the set of photographs in Figure 7. Moreover, after the dyed fabric was washed about twenty times the fibrillation appeared even more extensive and the fabric was still stable. The fibers which are roughly 10 micrometers in diameter produce fibrils of about one-half micrometer diameter. The reason that the lyocell fiber fibrillates as a result of heat, alkali and transverse stress is probably well explained in the literature with Courtauld's work on lyocell. Alkali swelling of cellulosic fiber is well known. Courtauld currently makes a lyocell fiber that is alleged to be easier to fibrillate; but different from the lyocell used in the examples herein which is known to be difficult to fibrillate.

A significant feature of this product appears to be the presence of microfibers in great numbers which are well anchored in the fabric structure but free enough in most of their length and particularly at the surface of the fabric to act as an outstanding absorbent article. This one structure could be the starting point for several products that would benefit from the several microfibers not being tied up in yarns. Some concepts include the chamois-type materials, glass cleaner, etc. With some modification, the substrate of a super-suede type fabric in which the fibrils are further fastened by resin such as a polyurethane and raised by brushing or sanding can be achieved. Such materials would have application as non-disposable, yet relatively inexpensive, wearing apparel.

It was noted that in processing the material that it is important to understand the impact of moisture content. For example, fabric having low levels of moisture content contributed to easier heating and bonding. Because of the high heat of vaporization of water, fabrics having relatively high moisture content respond to a slightly higher preheat condition to allow processing comparable to those fabrics with low moisture levels.

Measurements made on the items thus produced included basis weight, thickness, and surface stability rating after washing. Surface stability was measured by a taber, and Scott internal bond was used to measure resistance to delamination. A taber is an abrasive wheel and Scott internal bond uses adhesively bonded attachments and measures the energy required to separate the bonding.

An important variable affecting surface stability of the inventive materials after temperature, pressure and speed were optimized and as measured by rating after washes and taber was the arrangement in the unwind area. The best stability was attained by use of a take off which resulted in the top surfaces of the fabric as made in the spunlaced operation being adjacent to the adhesive layer. This was true for both the first and second layers under lamination. The least favorable arrangement for stability was when the bottom surfaces of the spunlaced fabrics were turned to the inside of the lamination. And, one top layer and one bottom layer in (or out) in the lamination gave intermediate results. The explanation of why the top of the spunlaced fabric should go to the inside of the laminate is not obvious but may be explained after the fact without being held to any specific theory. The top encounters the first water jets, so fibers oriented in the direction of the z-axis may be more abundant. However, the bottom is needled last and encounters more needling energy. Even though the top appears denser (i.e., more stable), from observation the bottom gives the more stable outside surface in the laminated fabric. Speed, pressure and temperature of the hot roll are also relevant to stability.

In the examples, the unwind was configured to provide the optimum top to top lamination and the string up before the hot roll was made to give some preheat on top and bottom of the ingoing laminate. Also, a 180 degree wrap on the hot roll before the nip and a 180 degree wrap on the chill roll exiting the nip was employed. With the preferred unwind and string up, and the small temperature and pressure ranges chosen, the items could be made readily with sufficient stability.

EXAMPLES

The example inventive fabrics have been prepared essentially as described below.

The chamois-type fabric was made from two layers of spunlaced style 8630 bonded with a layer of Delnet 530 according to the process disclosed in US Patent Application 08/642,649 and finished by dyeing in a jet dyer or Beck dyer with a direct dye. The 8630 is a 1.25 denier per filament lyocell having a basis weight of 2.3 oz/yd^2 and 40 mesh needled. Comparable products can be obtained by paddle or rotary dyeing after alkaline scouring using either direct or reactive dyes..

Natural (real) chamois is made by oil tanning leather splits. Typical artificial chamois is made by polymer treating woven or nonwoven cloth.

Description of Test Methods Used

Basis Weight, Thickness and Tensile (Grab Strength and Elongation) measurements are based on ASTM D1117 measurement methods.

The Absorbent Capacity and Rate are measured using a Gravimetric Absorbency Tester (GAT), which is available from M&K Systems, wherein the fabric is under an approximately 350 kg per square meter load. In essence, the GAT measures the amount of liquid (gat abs) and rate (gat rate) at which it is absorbed through an orifice in the equipment. The T1/2 time is the time for the fabric to take up half of its total uptake of water. The rate at T1/2 is the slope of the absorption curve at time T1/2.

Intrinsic absorbency (int abs) is a measurement of the amount of water the fabric will absorb as a percentage of the weight of the fabric. Samples of the fabric are fully immersed in water and allowed to drain for approximately one minute. The difference in the dry and wet weight of the sample is divided by the dry weight of the sample and then multiplied by 100 so as to be expressed as a percentage. Wick Rate is measured by the INDA STM 10.1 method.

When used as a chamois-type fabric the inventive product works very well and exceeds most other products in some aspects. Table I compares the laminated and finished inventive product against natural chamois and two artificial products.

TABLE I

Property	Units	2x8630	Real	"Ultra"***	"The Absorber"***
basis wt.(dry)	oz/yd^2	6.17	7.31	8.76	8.49
basis wt. (conditioned)*	"	14.2	15.0	13.2	15.8
gat abs.	%	156	**	159	179
T1/2	sec.	6.4	**	9.8	21.6
gat rate	g/g/s	0.13	**	0.09	0.04
int abs	%	164	154	200	228
wick rate	sec/in	3.8	46.4	5.6	11.6

*conditioned by wetting out and squeezing, other measurements were made on conditioned samples

**excessive time for lateral transport

***Distributed by EMGEE Cleaning Tools, Clearhill, IL

Clearly, the inventive fabrics are of comparable or better absorbency and faster wick rate than natural chamois and other artificial chamois-type materials. The inventive fabrics retain the qualities of a spunlaced nonwoven fabric which include low cost, comfort, drapability, softness, absorbency, breathability among others while having the durability of knitted or woven materials. Additionally, laminates consisting of more than two base fabric layers are possible.

The foregoing description and drawings were intended to explain and describe the invention so as to contribute to the public base of knowledge. In exchange for this contribution of knowledge and understanding, exclusive rights are sought and should be respected. The scope of such exclusive rights should not be limited or narrowed in any way by the particular details and preferred arrangements that may have been shown. Clearly, the scope of any patent rights granted on this application should be measured and determined by the claims that follow.

WE CLAIM:

1. A process of forming an absorbent, durable fabric comprising the steps of:

providing a first layer of fabric comprising fibers wherein at least a portion of the fibers have a Z component orientation

providing a second layer of fabric comprising fibers wherein at least a portion of the fibers have a Z component orientation;

positioning adhesive material onto one of the first or second layer;

overlying one layer of fabric over the other to form a sandwich with the adhesive material between the first and second layers; and

activating the adhesive material to form discrete globules encompassing fibers in each of said layers together such that portions of the Z component fibers are substantially surrounded by some of the globules,

dyeing the durable fabric with one of either a direct dye or a reactive dye,

washing the durable fabric under alkaline conditions to increase fibrillation.

2. The process according to Claim 1 wherein the step of activating the adhesive material comprises heating.

3. The process according to Claim 1 wherein the step of activating further comprises pressing the fabric layers together while the adhesive material is being heated.

4. The process according to Claim 1 wherein the step of positioning adhesive material comprises laying a mesh comprising interconnected points of adhesive with fine portions connecting the points in a network.

5. The process according to Claim 1 wherein the step of positioning adhesive material comprises depositing small drops of adhesive material on one layer.

6. The process according to Claim 1 wherein the step of activating the adhesive material comprises passing the sandwich through a heated calender to heat and compress the fabric layers into the melting adhesive material.

7. The process according to Claim 6 further comprising preheating at least one of said fabric layers prior to the heated calender.

8. The process according to Claim 1 wherein the first fabric layer is a nonwoven hydroentangled fabric sheet.

9. The process according to Claim 1 wherein the second fabric layer is a nonwoven hydroentangled fabric sheet.

10. A durable absorbent material made by the process of either of Claims 1-9.

11. The durable absorbent material of Claim 10 wherein the fibers of the first layer and the fibers of the second layer are lyocell.

12. A chamois-type material made from the material of either Claim 10 or 11.

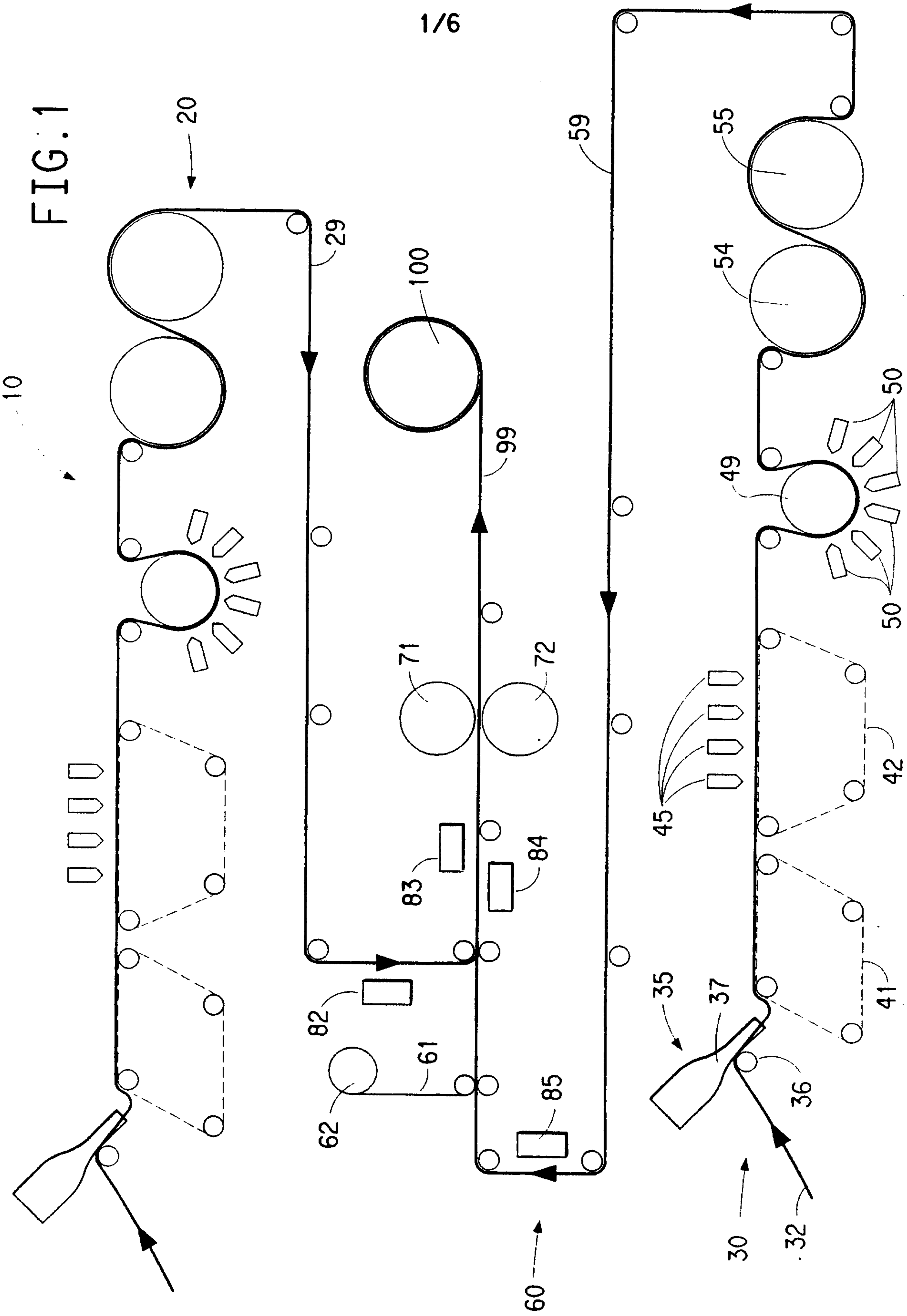

10
20
29
100
99
59
55
54
50
49
50
71
72
45
42
83
84
41
35
37
82
61
36
85
62
30
32
60

FIG. 1

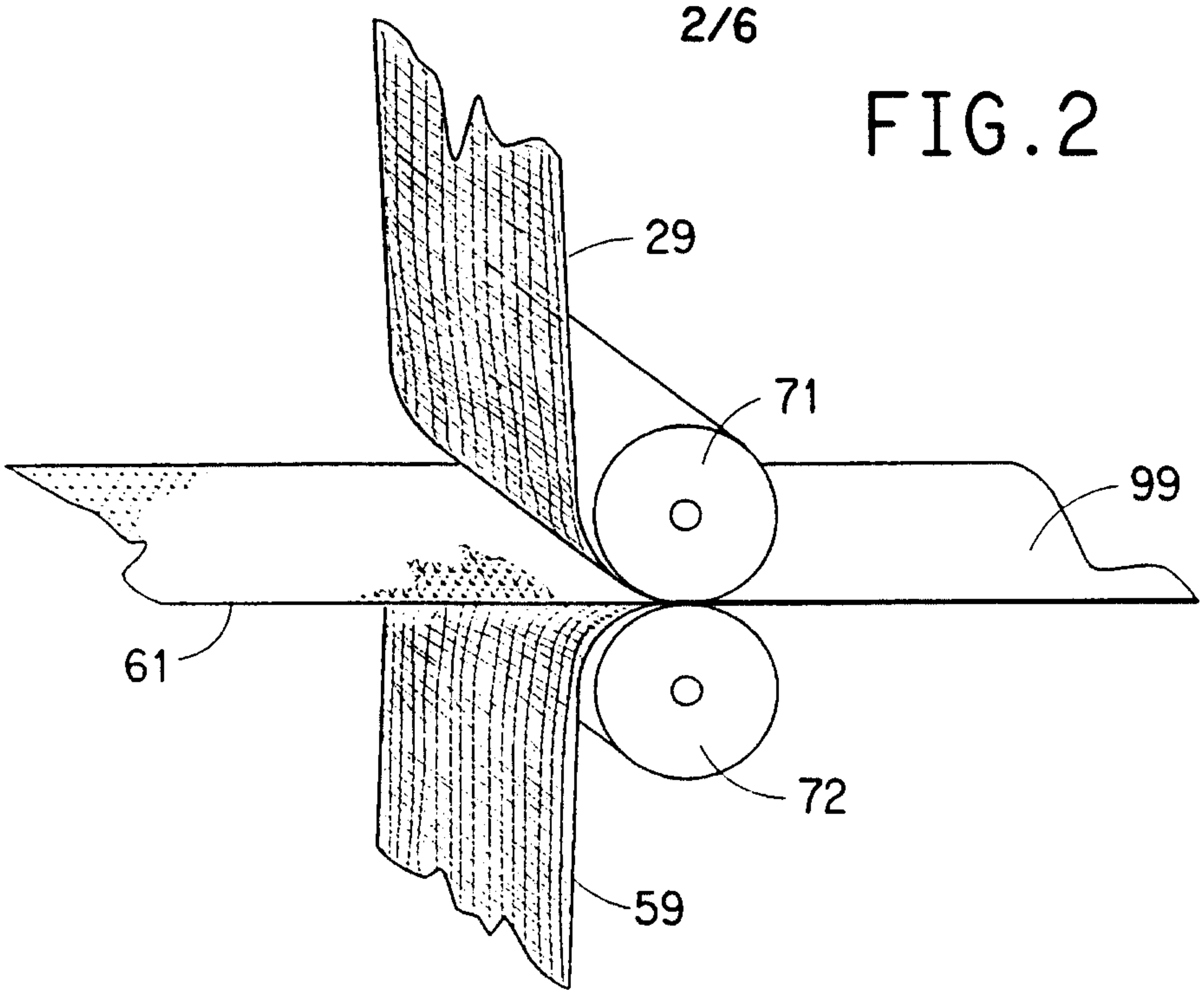


FIG.2

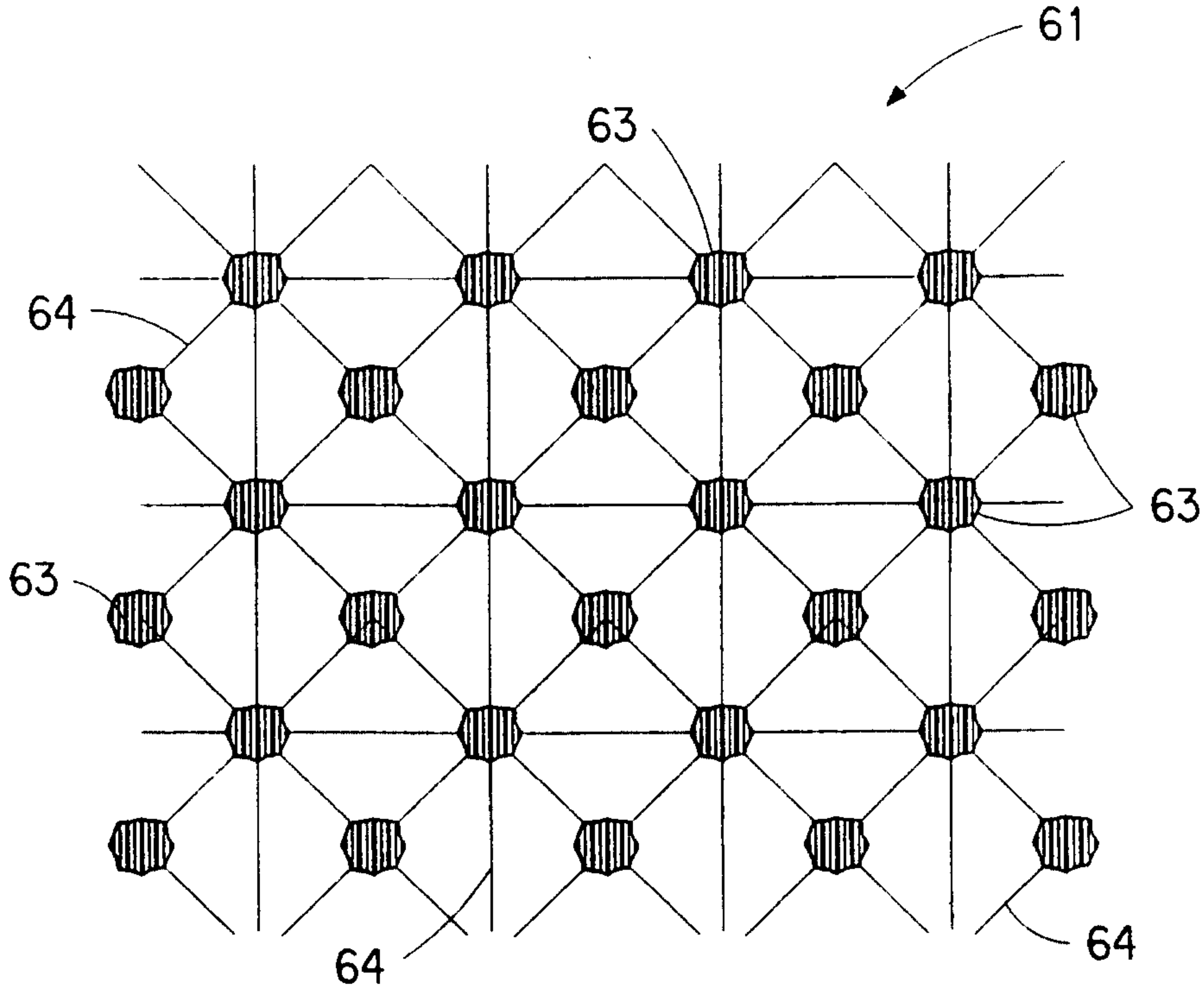


FIG.3

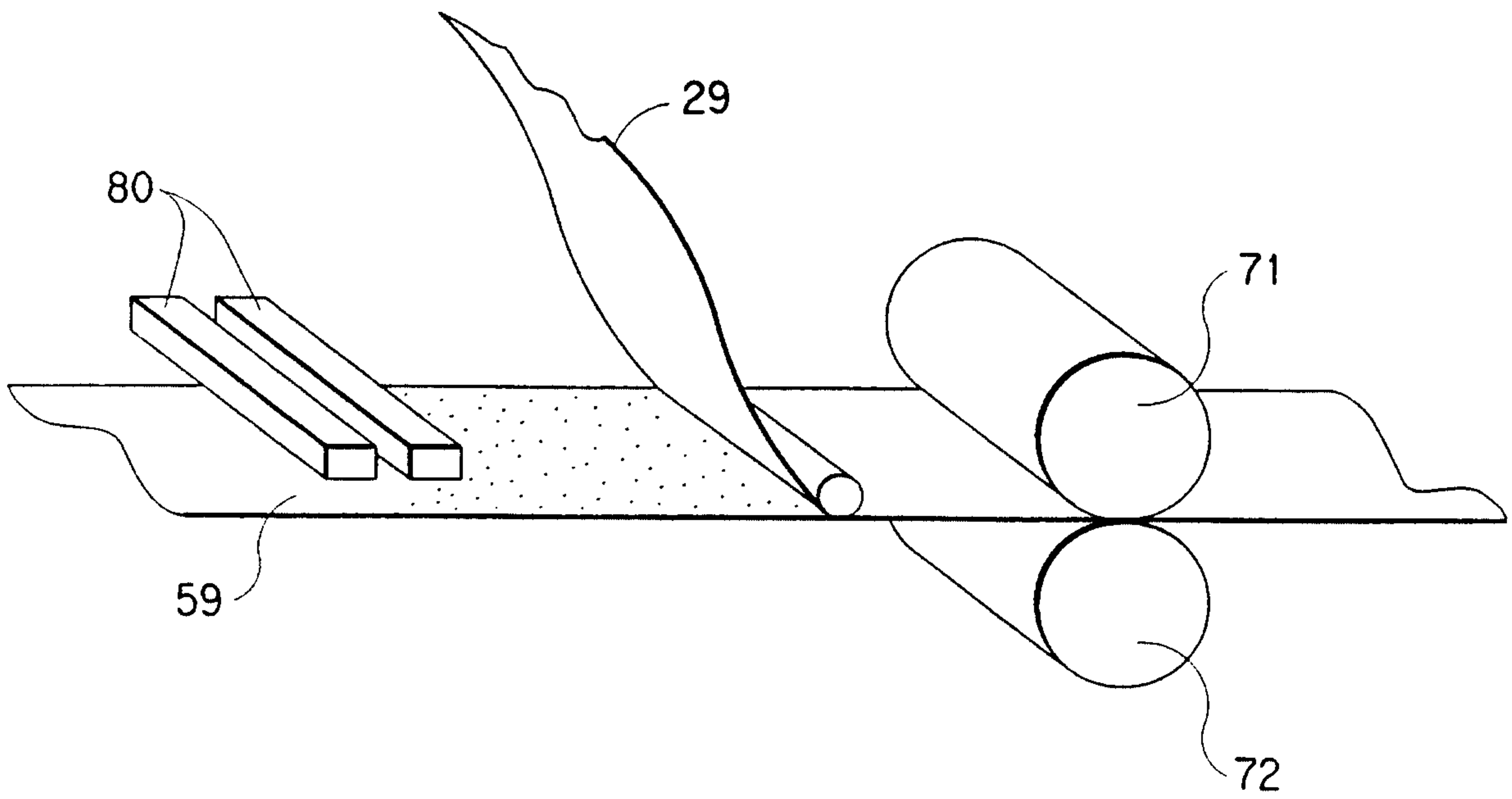


FIG.4

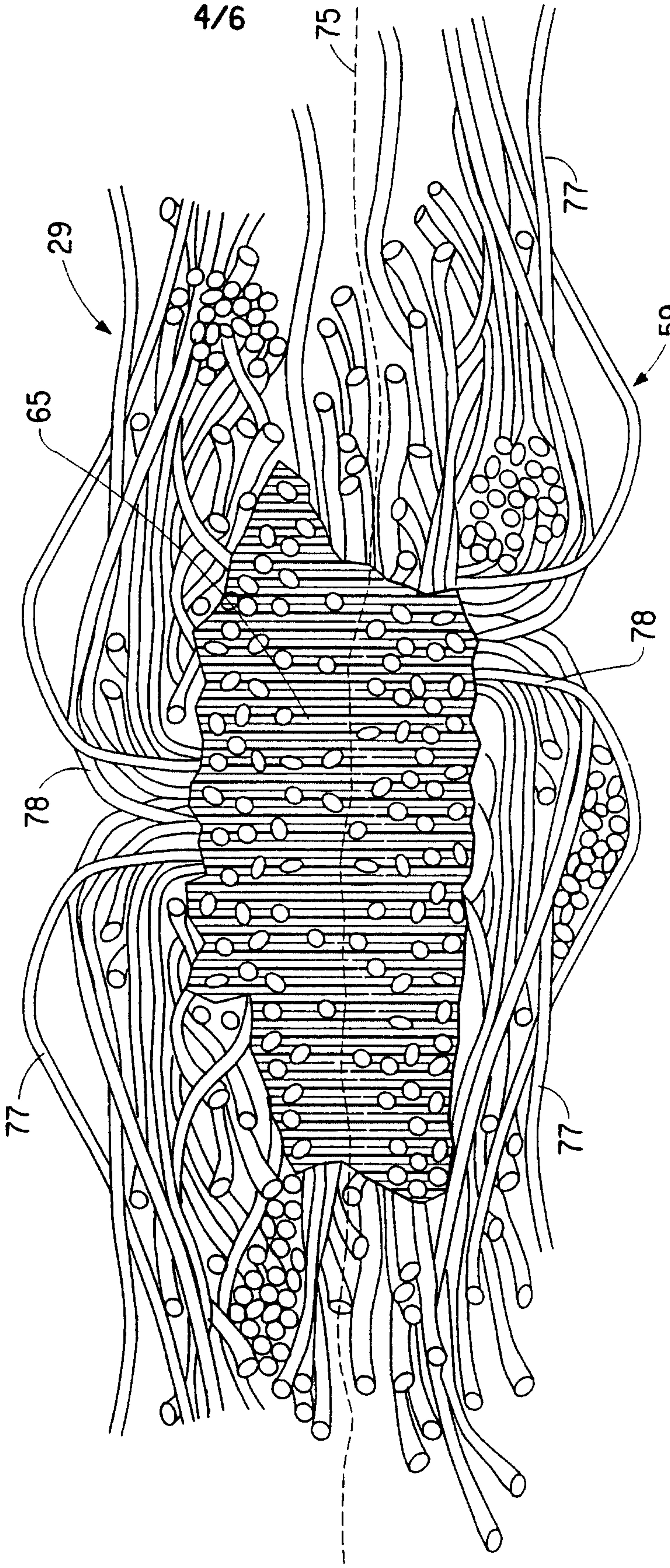


FIG.5

FIG.6A

FIG.6B

FIG.7A

FIG.7B