CONTINUOUS FILAMENT WEB AND METHOD OF MANUFACTURING THE SAME

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ABSTRACT

A nonwoven unitary web of synthetic textile filaments with each filament having a denier of less than 10 and each filament having an irregular sinusosity with looped fiber portions overlapping and frictionally engaging looped fiber portions of adjacent filaments. The stretched length of substantially all filaments being equal.

6 Claims, 10 Drawing Figures
This invention relates to new nonwoven unitary webs; more particularly to fibrous webs of continuous synthetic textile filaments and to methods of making the same. These textile filaments are known man-made materials, being either artificial or synthetic in nature as hereinbefore indicated, as distinct from natural fibers such as cotton, wool, etc. For convenience herein they will hereinafter be referred to as "synthetic filaments" and/or "synthetic textile filaments."

As used herein the term "web" means a thin, flimsy, fibrous sheet of indefinite length as distinguished from ribbons or batts which have considerable thickness. Also as used herein the term "looped fiber portion" means a portion of an individual filament which bends, folds, doubles, etc., and may or may not do so upon itself to form a closed loop but may bend almost upon itself without touching to form an open loop. The term "looped fiber portion" is used to denote more than standard sinuousness, i.e., where the filament would form a semi-circular arc of 180° or less but to indicate the formation of portions of the filaments into more than 180° arcs but not necessarily full 360° circles, though this may be the case in some instances.

Heretofore, fibrous webs have been made from staple length fibers and/or short paper-making fibers, i.e., fibers less than about 2 inches in length. Such webs are made by a card engine or by paper-making or air-laying machines. These machines produce a thin sheet or web of overlapping, intersecting, randomly arranged fibers. The web is held together by the frictional entanglement of the fibers and is quite weak.

Nonwoven fabrics are produced from these prior art webs by plying a number of the webs together and applying an adhesive to the laminate to bind the same into a unitary structure.

The present invention contemplates a nonwoven unitary web of individual synthetic textile filaments. Each filament in the web has an irregular sinuousity throughout its length, thus presenting looped fiber portions which overlap and frictionally engage looped fiber portions of adjacent filaments of the web. Each filament is in a unit section of the web has a length in its irregular sinuous form equal to the length of the unit web section as measured in the direction of the filament lie, and each filament of the unit section has a length in its stretched or straightened condition substantially equal to the corresponding length of its associated filaments of the unit section in their straightened condition.

As a filament in the unit section, whether the filament is in its sinuous form or in its straightened condition, is of substantially the same length as its adjacent filaments in the same condition the resulting web is of substantially uniform construction throughout its entire area. The unitary web will have a substantially uniform density and uniform "covering" properties, i.e., free of holes or thick areas.

Substantially all of the filaments lie in the same general direction and the nonwoven unitary webs of the invention have considerable strength in the direction in which the filaments lie. Strong nonwoven fabrics may be produced by plying a number of these webs together, usually at angles to each other, and adding a small amount of adhesive to hold the plies together.

The fabrics produced from the webs of the invention have strength and softness characteristics which are not directly dependent on each other.

For example, the starting web for conventional nonwoven fabrics is very soft and weak. Adhesive is applied to the web to hold the staple length fibers together. Though the web develops strength through the addition of adhesive it becomes harsher. Generally the more adhesive that is applied the stronger the resultant fabric and also the harsher the resultant fabric.

In contrast, if the webs of the invention are used to produce a nonwoven fabric, adhesive is applied to hold plies of webs together rather than to hold fibers together. Strong fabrics may be produced with relatively small amounts of adhesive which allows the final fabric to retain the excellent softness of the webs of this invention.

The strength of the webs of the invention is more dependent on the strength of the filaments used and less dependent on the frictional entanglement of filaments and the amount of adhesive applied. This is in contrast to a web of staple length fibers whose strength is less dependent on the strength of the fiber used and more dependent on the frictional entanglement of fibers and the amount of adhesive applied.

The softness characteristics of fabrics made from the webs of the invention are different than the softness characteristics of prior art nonwoven fabrics since the softness of the webs of the invention is a result of filament surface whereas in the prior art fabrics the softness is the result of loose fiber ends, i.e., fiber ends which have not been tied down by adhesive. The large surface area, free of adhesive and fiber ends, gives the webs of the invention a cool, smooth, silk-like softness and makes the fabrics produced from these webs particularly suitable for use as surgical dressings, absorbent dressings, sanitary napkin covers, diapers, etc.

The present invention contemplates methods for producing the nonwoven unitary webs of the invention from a tow of continuous synthetic filaments. Thus, for example, these webs may be made by presenting a tow of continuous synthetic filaments to a liquid flowing through a chamber; any liquid which does not adversely affect the filament may be used; suitable examples are water, alcohol, etc. The tow and liquid move in the same direction but the velocity of the tow is slower than the velocity of the liquid. The flow of the liquid is controlled to present diverging hydraulic forces in the body of the liquid which open the tow and spread it into a thin web of continuous filaments. The thin web is presented to a condensing surface and the filaments therein become condensed or compacted lengthwise, in effect "shortened lengthwise" so that each filament assumes an irregular sinuous path. By effecting a substantially uniform lengthwise condensation of the filaments, the resulting web is of substantially uniform construction throughout its entire area. The resulting web is substantially free of voids, thin areas, and thick areas, and the filaments relatively uniformly cover the entire surface. The sinuous filaments present looped portions which overlap and entangle looped portions of adjacent filaments.
In spreading the tow of continuous filaments into a web of filaments must be maintained under tension until the desired width of the web is attained. The tension may be obtained by the application of hydraulic forces to the tow as it is spread into a web. The hydraulic forces must be strong enough to part the slightly tangled filaments yet gentle enough so that they do not form either open places or conglomerations of filaments in the web. After the tow is spread into a web, the web is placed on a conveyor, moving at a relatively slower speed than the web, and the tension the filaments are under are thus released. This allows the filaments to take the configuration imparted to them by the differential in speed between the filaments and the conveyor.

When the tension is released the filaments fall in sinuous paths and form looped fiber portions which overlap and entangle looped fiber portions of adjacent filaments to form a nonwoven unitary web. The length of each individual filament in its irregular sinuous path is equal to the length of the web formed.

The invention will be further described in conjunction with the accompanying drawings wherein:

FIG. 1 is a plan view of a nonwoven unitary web of the present invention;

FIG. 2 is an enlarged cross-sectional view taken along line 2-2 of FIG. 1;

FIG. 3 is a plan view of a fabric made from a unitary web of this invention;

FIG. 4 is an enlarged cross-sectional view taken along line 4-4 of FIG. 3;

FIG. 5 is a plan view of another fabric made from a nonwoven unitary web of this invention;

FIG. 6 is a plan view of an apparatus for carrying out certain steps in the method of this invention;

FIG. 7 is a side elevation view of the apparatus shown in FIG. 6;

FIG. 8 is a photomicrograph of a typical nonwoven web of the present invention;

FIG. 9 is a photomicrograph of another nonwoven web of the present invention;

FIG. 10 is a photomicrograph of still another nonwoven web of the present invention.

Referring to the drawings, in FIG. 1 there is shown a nonwoven unitary web 21 of the invention. The web comprises individual filaments 22 each of which lies in a sinuous path running in the direction of the length of the web. Looped or kinky portions of filaments overlap and entangle looped or kinky portions of adjacent filaments. Each individual filament in the web is as least as long as the length of the web formed. The web is very thin with the filaments 22 relatively uniformly distributed throughout the width of the web, as indicated in FIG. 2.

In FIG. 3 there is shown a fabric 23 made from two superposed webs of the invention. The first web 24 contains individual filaments 25 whose sinuous paths lie in the direction of the length of the fabric produced. The length of each individual filament in its sinuous path is equal to the length of the web formed. A second web 26 containing individual filaments 27 lying in irregular sinuous paths is plied with the above-mentioned web so that the filaments in the second web run the width of the fabric. The length of the filaments in this web, in their sinuous paths, is approximately equal to the width of the fabric. The two webs are held together by a binder 28 applied in any desired manner, suitably in a pattern of parallel lines running at an angle of about 45° to the length of the fabric.

In FIG. 5 there is shown another fabric 29 made from a nonwoven unitary web 30 of the invention and a superposed fibrous web 32 of randomly arranged staple length fibers. In web 30 the continuous filaments 31 lie in sinuous paths running in the direction of the length of the fabric. Each filament 31 is at least as long as the length of the fabric and presents looped portions which overlap and entangle looped portions of adjacent filaments. The two webs are held together by an adhesive binder 33 applied in any desired manner, suitably in the form of a pattern of dots as shown. The strength of this fabric is much greater in the long direction than in the cross-direction and the softness or "feel" is different on each side. The continuous filament side has a silk-like softness and the side containing the randomly arranged staple length fibers has a nap-like or flannel-like softness.

The webs of the invention may be produced from any of the known synthetic textile filaments, including artificial filaments. Suitable examples are viscose rayon, cuprammonium rayon, ethylcellulose, and cellulose acetate, nylon, polyesters, acrylics, polylefins, i.e., polyethylene, polypolypropylene, polynylidene chloride, polynyl chloride, polyurethanes, etc. These synthetic textile filaments may be used alone or in combination with one another.

The weight of the webs of the invention range from about 25 grams per square yard to 200 grams per square yard and preferably from about 35 grams per square yard to 100 grams per square yard.

The denier of the filaments used to produce the webs of the invention is in the range of from about 1 denier and somewhat less to about 10 denier. It is preferred that the filaments have a denier in the range of from about 1-½ to 6. For example, viscose rayon filaments from about 1-½ to 3 denier have produced excellent results in the production of the fabrics of the invention.

It is extremely important that the filaments used have a denier in the range indicated and also be of a textile nature. The reasons for this are that the larger denier filaments will not produce the desired looped fiber portions and produce webs which have good uniformity and covering power and have sufficient cohesive strength at the light weights desired to allow further processing. The fabrics produced from such high denier filaments are not drapeable textile fabrics having a silk-like softness as contemplated herein, but are rigid and harsh and unsuitable for use in surgical dressings, sanitary napkins and the like.

To produce the desired fabrics with the new properties described the web must be built from individual, i.e., single, filaments and not from yarns or strands of numerous filaments. By utilizing individual 1 to 10 denier filaments in my process I am able to give each filament an irregular sinuosity of looped fiber portions different than that of adjacent filaments so as to produce very light weight webs with filament portions substantially uniformly distributed over the entire area of the web. This produces good covering power and cohesive strength in the web.

In the formation of the fabrics of the present invention, as shown in FIGS. 6 and 7, a bundle 40 of continuous filaments 41 having no definite twist (called a tow) is continuously fed by a pair of nip rolls 42 into an opening 43 of a chamber 44 containing a flowing liq-
The tow and liquid move in the same direction, but the velocity of the tow is less than that of the liquid; the drag of the liquid on the slower moving tow pulls the tow through the chamber. The cross-sectional shape of the chamber is rectangular at the end at which the tow enters. The sides of the chamber diverge from the entry end to the discharge end while the top and the bottom of the chamber converge from the entry end to the discharge end, so that the rectangular shape is widened and flattened to form a slot 45 at the discharge end of the chamber. The divergence and convergence of the walls are such that the area of the chamber either remains substantially constant along the length of the chamber, or decreases slightly in the downstream direction. The liquid enters the chamber at an opening at the same end of the chamber at which the tow enters, suitably as at 46. On entering, the liquid impinges on a baffle 47 so as to prevent any major disruption of the tow. The liquid continually flows through the chamber at a velocity greater than the velocity at which the tow passes through the chamber and thus maintains the tow under tension as it passes through the chamber. As the tow enters the chamber, the flowing liquid opens the tow and separates the continuous filaments into a flat band. The flat band is continually separated and widened as it passes through the chamber to the discharge end. The tow is separated by the shear stress exerted by the liquid on the tow. This stress is in the same direction as the liquid velocity and where the walls and flow are divergent the stress has a shear force component perpendicular to the centerline of the chamber. This perpendicular force component spreads the tow as it passes through the chamber. At the discharge end of the chamber the flat band is in the form of a web 48 of continuous filaments and this web is placed on a continuous wire screen 49.

The upper reach of the wire screen passes from roller 50 closest to the chamber roller 51 spaced away from the chamber and the lower reach from roller 51 to roller 50. As the spread tow contacts the screen, which is moving slower than the tow, the tension is released. The individual filaments fall in irregular sinuous paths on the screen, forming looped portions in the individual filaments, which overlap and entangle looped portions of adjacent filaments.

The screen with the spread tow (web) thereon passes over a suction box 52 to remove liquid therefrom. The web and screen then pass to a hot air drier 53 where the web of continuous filaments is dried. The irregular sinuous path of the continuous filaments causes portions of filaments to overlap and frictionally engage portions of adjacent filaments to form a unitary web. The dried unitary web 54 may then be laminated with card, airlaid, or other nonwoven fiber webs or with other spread tow webs to produce a fabric in accordance with the invention.

It should be noted that to open tows of fine denier filaments into uniform continuous web form of individual filaments, the forces required must be gentle enough so as not to produce entanglement of filaments prior to reaching the desired width and must be uniformly applied to produce the desired results. Air jets, or other fluid jets, vibratory mechanisms, or similar mechanical means have been found unsuitable for producing the products of the present invention.

The liquid used is relatively unimportant in the spreading of tow provided the liquid has no adverse effects on the filaments. Economics, safety, ease of handling, etc. make the use of water one of the better liquids for the spreading of tow in accordance with the invention. The more important variables in the spreading of tow of fine denier filaments according to the method of the invention are: the type of liquid flow, the condition of the layer of liquid at the diverging sides of the chamber and the relative speed of the tow in the liquid.

The type of liquid flow in chamber 44 may be either laminar or turbulent. This flow is controlled primarily by the velocity of the liquid in the chamber, and by the shape of the chamber. The liquid layer at the sides of the chamber has flow characteristics which do not adversely affect the desired spreading of the tow. At the most it has a minimum of turbulence, i.e., the formation of vortices or "eddy" currents at the side walls are kept to a minimum. The condition of the liquid layer at the side walls may be controlled by maintaining the angle of divergence of these walls at less than 10° or by placing release ports or slits along the wall in order to equalize the liquid pressure throughout the chamber.

The liquid velocity in the chamber is greater than the velocity of the tow as it passes through the chamber to maintain the tow under tension and allow the action of the liquid to act on the tow and spread it into web form. Satisfactory results have been obtained with water velocities in the range of from about 50 feet per minute to 500 feet per minute and somewhat higher. As the liquid velocity is raised above the indicated range the problems of preventing velocity fluctuations and the formation of vortices at the walls of the chamber increase. This can be minimized by decreasing the cross-sectional area of the chamber, and thereby increasing the velocity, in the downstream direction to give a favorable pressure gradient, which enhances the stability of the flow and retards flow separation.

Velocity fluctuations may also be reduced by making the distance between the converging walls of the chamber as small as practical. The width of the chamber at the downstream end should be nearly the same as the desired width of the web. The chamber depth at this location should be quite small, on the order of 1/16 inch or less, to give a uniform distribution of filaments across the web.

Once the tow is spread into web form it is presented to the slower moving condensing surface of the wire screen. The differential in speed between the tow and the wire may be varied over wide ranges to impart various irregular sinuous paths to the filaments. The speed differential also governs the amplitude of the sinuous path of individual filaments in the web. Differentials in the speed of the tow and the speed of the wire in the range of from about 1.05 to 1 to 2 have given satisfactory results.

By the method of the invention tows ranging in diameter from 1/32 of an inch up to about 1 inch or more and containing from 5,000 to 60,000 filaments or more may be spread to thin flimsy webs having weights ranging from about .25 grams per square yard up to about 200 grams per square yard or more.

It is important that the tows used be substantially free of twist in order to be opened into wide widths in such
EXAMPLE II

A base web is made as outlined in Example I from 2-denier viscose rayon continuous filaments. The web is approximately 6 inches wide and weighs 80 grains per square yard. This web is used to form a fabric by angle laying two pieces of the web between two other pieces of the web to form a four-ply laminate. The filaments of the outer plies run the length of the laminate while the filaments in one of the inner plies lie at 60° measured clockwise from this length and the filaments in the other inner ply lie at 60° measured counterclockwise from this length.

The four-ply laminate is held together by a viscose binder applied in a pattern of 6 lines per inch with the lines running at an angle of 45° to the length of the fabric. The final weight of the fabric is 340 grains per square yard with 20 grains per square yard of this being binder and 320 grains per square yard being continuous filaments.

The strength of the fabric is determined by taking a 1-inch by 6-inch sample and placing it between the jaws of a conventional elongation tester. The jaws of the machine are 4 inches apart and after the sample is clamped between the jaws, the jaws are separated at a rate of 4 inches per minute until the fabric breaks. When the sample breaks, the tenacity of the fabric is recorded. Five samples are tested with the 6-inch length running in the machine direction of the fabric, i.e., the length of the fabric, and five samples are tested with the 6-inch length running in the cross-direction of the fabric, i.e., the width of the fabric. The final strengths in the machine- and cross-directions are then determined by taking an average of the five samples.

The machine direction tenacity of the fabric of this sample is determined to be 2.15 pounds per inch per 100 grains per square yard and the cross-direction tenacity is determined to be 1.66 pounds per inch per 100 grains per square yard.

The softness of this fabric is determined by two different techniques, as follows:

The flexural rigidity (resistance) of the fabric is determined by cutting an 8½ inch square sample from the fabric and testing the same on an instrument for testing flexural rigidity. In this instrument a metal bar bends the fabric and the resistance to flex is determined in milliamperes which is converted to a "softness" figure in accordance with known procedures. As this figure increases, the softness or flexibility increases. The average flexibility of this fabric as determined by this machine is about 86.

A combination of the surface softness and flexibility of the fabric is also determined by cutting a 6-inch by 7-inch sample randomly from the fabric. This sample is pushed down into a trumpet, the large end of which is 2-½ inches in diameter and the small end of which is ⅜ inch in diameter. The sides of the trumpet curve inwardly toward the center of the trumpet and have a radius of curvature of ½ inch. The small end of the trumpet is integral with a cylinder ⅛ inch in diameter and 3-½ inches in length. The sample is pushed down into the trumpet and through the cylinder by a vertical probe. At the bottom of this probe is a spherical ball ¾ inch in diameter. The top of the probe is attached to a cantilever weigh-bar system. The motion of this weigh-bar is converted electronically to an electric signal which is calibrated in terms of grams of force exerted.
by the sample on the probe. Hence, the final reading in grams of force will decrease as the surface softness and flexibility increase. The surface softness and flexibility of this sample, determined as described, is 10 grams of force.

**EXAMPLE III**

A second fabric is made by taking a continuous filament web as outlined in Example I and angle-lying this between plies of normal card web. The outer plies of card webs each weigh approximately 85 grams per square yard and are made from viscose rayon fibers 1-½ denier and 1-9/16 inches in length. The two inner plies are made from the continuous filament web outlined in Example I. One of the inner plies lies at 60° measured clockwise from the length of the final laminate, while the other inner ply lies at 60° measured counterclockwise from the length of the final laminate.

The 4-ply laminate is held together by a viscose binder applied in a pattern of 12 diagonal lines to the inch with the lines running at 20° to the cross-direction of the fabric. The final fabric weighs 302 grams per square yard with 20 grams per square yard of this being binder, 112 grams per square yard being continuous filament web and 170 grams per square yard being normal card web.

The strength of the fabric is determined by the elongation tester in the same manner as outlined in Example II. The machine direction tenacity of this fabric is 1.21 pounds per inch per 100 grams per square yard and the cross-direction tenacity 2.07 pounds per inch per 100 grams per square yard.

The softness and/or the flexural rigidity of this fabric is also determined by the two techniques outlined in Example II. The flexural rigidity test evaluated the softness of this fabric at 91 while the trumpet test evaluated this fabric at 15 grams of force.

**EXAMPLE IV**

For comparative purposes comparable weight nonwoven fabrics were made from all staple length fibers and the strength and softness of these fabrics determined in the same manner as outlined in Examples II and III.

The first of these all staple length fabrics was made from four card webs each weighing approximately 70 grams per square yard and made from viscose rayon fibers 1-½ denier, 1-9/16 inches in length. Two of the webs formed the outer plies of a four-ply laminate while the other two webs were angle-laid between these outer plies with one ply running at 60° measured clockwise from the length of the fabric and the other ply running at 60° measured counterclockwise from the length of the fabric. The 4-ply laminate was held together by a viscose binder applied in a pattern of 6 lines per inch with the lines running at 45° to the length of the fabric. The total weight of the fabric was 300 grams per square yard, 20 grams of this being binder and 280 grams of this being staple length fiber. The machine and cross-tensities of this fabric and the softness as determined by the flexural rigidity tester and the trumpet test were determined in the same manner as outlined in Examples II and III above and are given in the following table.

The second all staple length fiber nonwoven fabric was made by laminating four plies of normal oriented card web made from viscose rayon fibers 1-½ denier, 1-9/16 inches in length, with each ply weighing approximately 80 grams per square yard and with all of the plies running in the same direction, i.e., the machine direction of the final fabric. The four plies were held together by a viscose binder applied in a pattern of six lines per inch with the lines running at 45° to the length of the fabric. The final weight of the fabric was 340 grams per square yard with 20 grams of this being binder and 320 grams per square yard being staple length fiber.

Again, this fabric was tested for its machine tenacity and its cross-tensicity and its softness by both the flexural rigidity test and the trumpet test as outlined in Examples II and III. These results are also given in the following table.

<table>
<thead>
<tr>
<th>Fabric of all continuous filament webs Example II</th>
<th>Fabric of all continuous filament webs Example III</th>
<th>Fabric of all continuous filament webs Example IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g/yd^2)</td>
<td>340</td>
<td>300</td>
</tr>
<tr>
<td>Weight Binder (g/yd^2)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Weight Continuous Filaments (g/yd^2)</td>
<td>320</td>
<td>122</td>
</tr>
<tr>
<td>Weight Staple Length fiber (g/yd^2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binder patterns (all viscose)</td>
<td>6-45° lines per inch</td>
<td>12-20° lines per inch</td>
</tr>
<tr>
<td></td>
<td>6-45° lines per inch</td>
<td>6-45° lines per inch</td>
</tr>
</tbody>
</table>


Fabric with outer plies staple length fiber webs and angle laid inner ply of continuous filament webs
Fabric of all continuous filament webs Example II

<table>
<thead>
<tr>
<th>Fabric of all continuous filament webs</th>
<th>Example II</th>
<th>All staple length fiber fabric, fiber webs and angle laid inner ply of continuous filament webs</th>
<th>Example III</th>
<th>All staple length fiber</th>
<th>Example IV</th>
</tr>
</thead>
</table>

Machine direction tenacity (l/100 gr/yd²) 2.15 1.21 .91 1.19
Cross direction tenacity (l/100 gr/yd²) 1.66 2.07 .27 .11

Softness by Flexural Rigidity Test (ul) 86 91 74 73
Softness by Funnel Test 10 15 25 26

The four Examples of the above table were of comparative weights. The amount of binder applied in each instance was the same and the manner in which the binder was applied was comparable in all cases. As can be seen from this table the fabrics containing the continuous filament webs were both considerably stronger and considerably softer than the fabrics made from all staple length fibers.

Although several specific examples of the inventive concept have been described for purposes of illustration, the invention should not be construed as limited thereby nor to the specific features mentioned therein except as the same may be included in the claims appended hereto. It is understood that changes, modifications and variations may be made in the fabric and the method herein described without departing from the spirit and scope of the claimed invention.

I claim:

1. A method of producing a nonwoven unitary web of continuous synthetic filaments which comprises: presenting a tow of continuous synthetic filaments, each filament having a denier of from 1 to 10, to a liquid flowing through a chamber, conveying said tow in the liquid in the same direction that the liquid is moving, maintaining the tow under tension while in said liquid, and uniformly applying diverging hydraulic forces to said tow while under tension and being conveyed in said liquid whereby the tow is spread into a thin web of continuous filaments.

2. A method of producing a nonwoven unitary web of continuous synthetic filaments which comprises: presenting a tow of continuous synthetic filaments, each filament having a denier of from 1 to 10, to a liquid flowing through a chamber, conveying said tow in the liquid in the same direction that the liquid is moving and at a velocity slower than that of the liquid, and uniformly applying diverging hydraulic forces to said tow while it is being conveyed in said liquid whereby the tow is spread into a thin web of continuous synthetic filaments.

3. A method according to claim 2 wherein the liquid is water.

4. A method according to claim 2 wherein the web is compacted in a lengthwise direction and the filaments assume irregular sinuous paths, and present looped fiber portions which overlap and entangle looped fiber portions of adjacent filaments to form a unitary web.

5. A method according to claim 2 wherein the web is presented to a surface moving away from said liquid and at a speed slower than the speed of the web in the liquid whereby a thin web of continuous synthetic filaments each having an irregular sinuosity is found.

6. A method according to claim 5 wherein the liquid is water.

* * * * *
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,822,930 Dated April 9, 1974

Inventor(s) Carlyle Harmon

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 3, line 2, "web of filaments" should read --- web the filaments ---.

In Column 6, line 64, " .25 grains " should read --- 25 grains ---.

In Example II, 3rd Column of Table, "122" should read --- 112 ---.

In Example IV, 1st Column of Table, "( /inch 6th and 7th set down, 100 gr/yd²)" should read (#/inch 100 gr/yd²).

Signed and sealed this 10th day of September 1974.

(SEAL)
Attest:

McCoy M. Gibson, Jr. C. Marshall Dann
Attesting Officer Commissioner of Patents