United States Patent

[11] 3,615,989

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[54] **NONWOVEN FABRIC STRUCTURE**
5 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **156/148,** 156/306, 161/154
[51] **Int. Cl.** **B32b 31/14**
[50] **Field of Search** 161/170, 111, 64, 67, 154, 155; 156/148, 149, 306, 309, 72, 435; 28/72.2

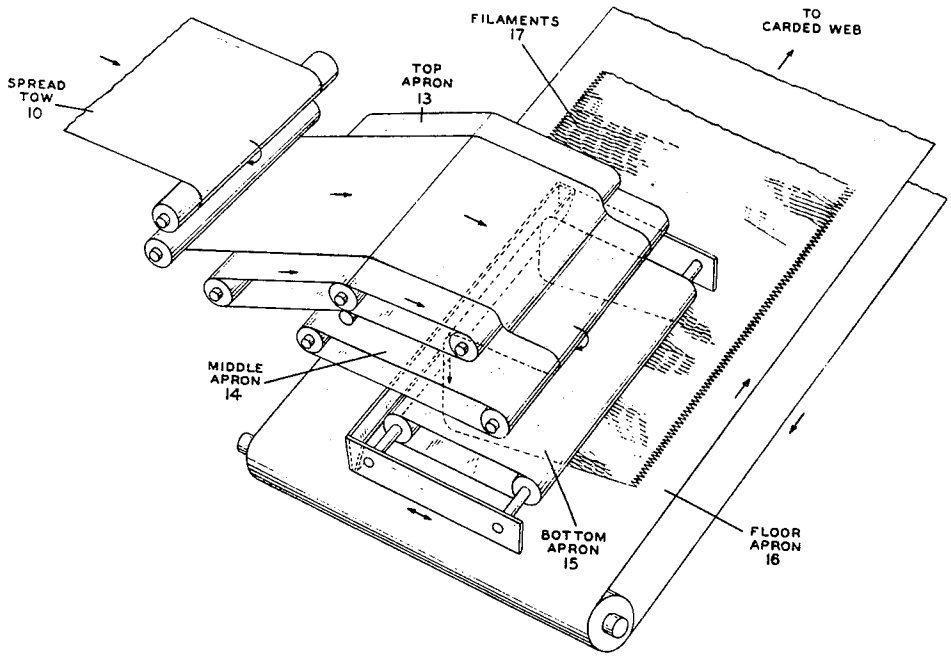
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ABSTRACT: A process for producing a novel nonwoven fabric structure by cross-lapping a deregistered tow of continuous multifilament synthetic fibers to form a plurality of layers wherein the filaments in each layer are disposed in substantially parallel relation with respect to each other and are angularly disposed with respect to filaments of adjoining layers, adding thereto a web of lower-melt thermoplastic fibers, and thereafter heating the entire structure to bond the fibers.



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SHEET 1 OF 2

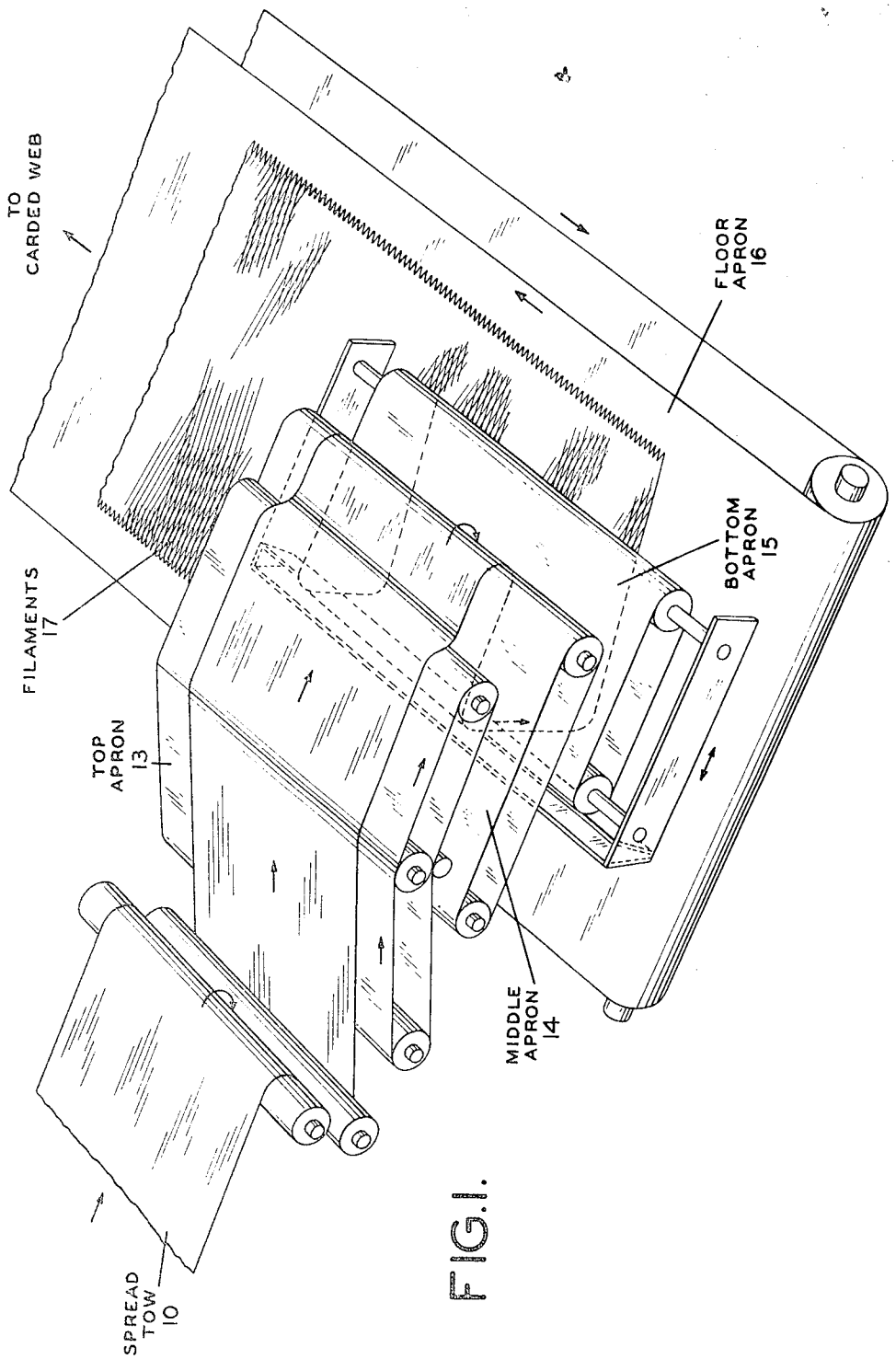


FIG. 1.

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FIG.2.

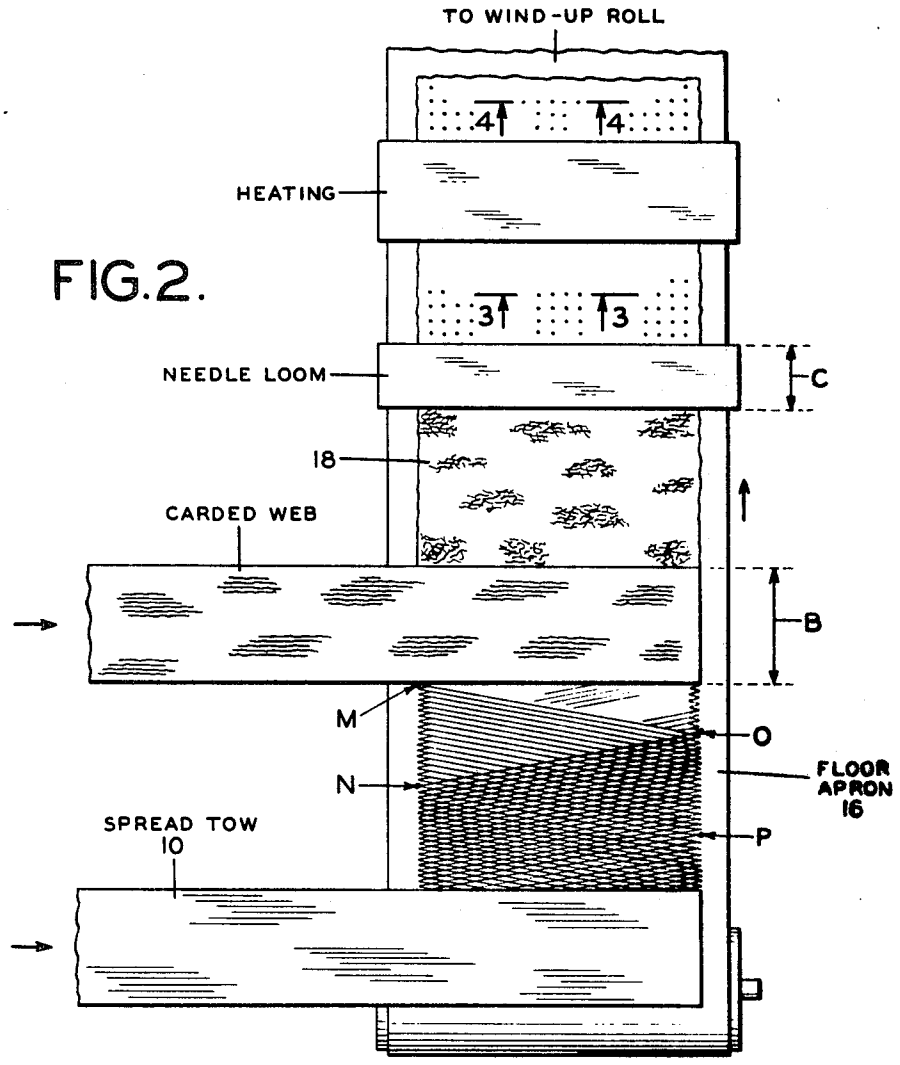


FIG.3.

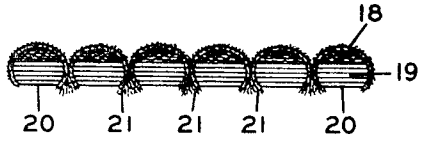
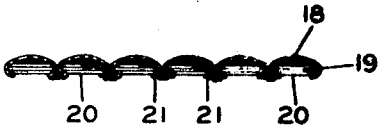


FIG.4.



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NONWOVEN FABRIC STRUCTURE

The present invention relates to a method of producing a nonwoven fabric structure and to the article obtained thereby. More particularly the present invention relates to a method of producing a nonwoven fabric structure suitable as a backing fabric such as a carpet backing fabric.

As is known, in producing carpeting material by conventional techniques, it is often necessary that the fibers or yarns which constitute the carpet pile be needled or tufted respectively through a backing material which provides reinforcement to the finished product. Woven carpet backing formulated from jute fibers has been conventionally employed for this purpose. The use of jute as the fiber constituting the carpet backing, however, is not entirely satisfactory from a practical commercial standpoint. For example, jute fibers, because of their natural origin, often contain impurities in their fibrous structure which tend to discolor the carpeting pile during dyeing and,, in addition, these impurities usually lower color stability to sunlight. Furthermore, woven jute is not always of uniform quality from lot to lot, thus presenting processing problems, and problems in shading, dyeing, etc. In order to offset these disadvantages, it has been proposed to employ synthetic fibers in lieu of the jute fibers normally utilized as the backing material. The synthetic fibers are employed in the form of a carded or garnetted web, in a manner such as to form a structure comprising a plurality of such webs which are subsequently needle punched to a woven fabric to form an integral fabric. Unfortunately, however, backing material fabricated in this manner suffers from several disadvantages, such as uneven distribution of fibers across the surface of the needle punched webs, relatively uneven strength in the longitudinal as contrasted to the lateral direction of the cloth, and pilling of the fibers which results generally from the employment of staple fibers. In addition, the width of the resultant product is limited to the width of the woven cloth which is in turn limited to the size of the loom employed.

The present invention is a further improvement in the process for making carpet backing material and to the article obtained thereby, in that it provides for increased overall strength in the resultant product, eliminates the necessity of the weaving operation required for the base fabric, and a product virtually of any width can be made instead of being limited to the width of woven fabric. Therefore, an object of the present invention is to provide an improved method of manufacturing a carpet backing material.

Another object of the present invention is to provide a backing material having relatively uniform strength in the longitudinal as well as in the lateral direction of the backing material.

Still another object is to provide a backing material which has an even distribution of fibers throughout its surface area.

These and other objects will become apparent from the following description taken in conjunction with the accompanying drawings.

Broadly contemplated, the present invention provides a method of producing a nonwoven fabric structure comprising the steps of advancing a deregistered tow of continuous multifilament synthetic fibers arranged in substantially parallel side by side relationship into a cross-lapping zone, cross-lapping said deregistered tow to form a plurality of layers in a manner such that the filaments in each layer are disposed in substantially parallel relation with respect to each other and are angularly disposed with respect to filaments of immediately adjoining layers, adding to said layers a web comprising a system of fibers of lower melt characteristics than of said multifilament synthetic yarns, needle punching said layers and web to form an integral structure, and thereafter heating said integral structure an amount sufficient to soften the fibers in said web thereby resulting in a bonded nonwoven fabric structure.

For a clearer understanding of the invention, reference is made to the drawings in which:

FIG. 1 is a side elevational view diagrammatically illustrating the path of the deregistered tow as it enters the cross-lapping zone.

FIG. 2 is a plan view showing the deregistered tow in various stages of treatment.

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 2.

FIG. 4 is a view taken along the line 4—4 of FIG. 2 showing the structure after it has been heated and bonded.

Referring to FIG. 1 of the drawings, a deregistered tow of synthetic continuous multifilament yarns generally represented by reference numeral 10, is shown entering a cross-lapping zone in which is located a conventional cross-lapper.

The tow can be comprised of a plurality of synthetic continuous multifilament yarns such as those formulated from polyamides, polyesteramides, polyesters, polymerized hydrocarbons, and a halogenated derivatives thereof, cellulosics including esters, ethers, and similar derivatives of cellulose; and mineral fibers such as glass, metal, etc., or any desired mixtures of the above.

The total denier of the tow can be in a range of 30,000 to 450,000 denier, preferably 100,000 to 150,000 denier.

The tow can be deregistered by any suitable conventional technique. Merely as illustrative, the tow can be passed sinuously around a series of rollers from a tensioning device such as a series of lease rods and passed from rollers to an arcuate spreader such as a rod or cambered roller, on through an air plenum in a manner well known in the art.

The deregistered tow in which the filaments are arranged in substantially parallel side-by-side relationship passes over the top apron **13** of conventional cross-lapper which, as is shown, is rotated in a clockwise direction. The top apron supports the tow and carries it over and around a middle apron **14** which is rotating in the same direction as the top apron **13**. The middle apron deposits the tow onto a bottom apron **15** which, as is shown, traverses a path back and forth, depositing the advancing tow **10** onto a floor apron **16** which is disposed in substantially perpendicular relationship to the bottom apron **15**. The action of the cross-lapper above mentioned is well-known in the art and for this reason no further detailed description of its operation is necessary for the purpose of explaining the present invention. The floor apron rotates in a direction as indicated by the arrows in FIG. 1 of the drawings. By correlating the speed of travel of the floor apron **16**, with the speed of the advancing deregistered tow **10**, in a manner such that the filaments **17** in each layer formed on the floor apron **16** are disposed in substantially parallel relation with each other and are angularly disposed with respect to filaments of immediately adjoining layers as shown in FIG. 2.

Thus, referring to FIG. 2 it will be seen that as the floor apron **16**, which traverses a path substantially perpendicular to the advancing tow **10**, moves away from the tow **10**, there results a series of layers of filaments deposited on the floor apron which will also be hereafter referred to as the "base layer". Since the tow **10** is deposited on the floor apron **16** in the direction which constitutes the width of the fabric which is subsequently formed, the filaments will be deposited angularly with respect to the lateral axis of the floor apron in side-by-side relationship. There is shown in FIG. 2 two layers of filaments within the area M, N, P, and O which represent three traverses of the bottom apron **15**. It will be obvious that the filaments of each layer are disposed substantially parallel and in side-by-side relationship to each other and angularly disposed with relation to the filaments constituting separate layers. In similar manner, the deposition of layers of filaments are repeated as the bottom apron moves away from the cross-lapper. These layers can be built up in even, numbered multiples, of **2**, **4** etc. by adjusting the action of the cross-lapper as is well known in the art.

As the base layer traverses a path along the bottom apron away from the cross-lapper as shown in FIG. **2**, it enters a second cross-lapping zone designated as B wherein a system of

fibers which can be of staple form or in the form of continuous multifilament yarns are added to the previously formed base layer in the form of a web.

In the second cross-lapping zone there is located a second conventional cross-lapper (not shown) which feeds the system of fibers to the formed layers or base layer in a manner similar to the feeding of the tow **10** to the floor apron **16**. The system of fibers or web added are of lower melt characteristic than the multifilament synthetic yarns added in the first cross-lapping zone. Illustrative of the type of fibers which can be employed are fibers formed from polypropylene, vinylidene chloride polymers, modacrylic fibers and the like, preferably fibers formed from polypropylene.

It is important that the fibers which constitute the web be of lower melt characteristic than the fibers which constitute the base layer. Thus, any of the thermoplastic fibers which can be employed for the base layer, can also be employed for the web provided that the fibers of the web be of lower melt characteristic than the fibers of the base layer. Merely as illustrative, when the fibers which constitute the base layer are fabricated from polyesters, then the fibers constituting the web can be fabricated from polypropylene. Other examples include the use of cellulose acetate and/or rayon as the fibers constituting the base layer and polypropylene fibers constituting the web.

In the case wherein the fibers are in the form of continuous multifilaments they appear in the form of a deregistered tow. However, in the case wherein the fibers are staple fibers, they can be employed in the form of a carded web, a garnetted web, and like systems. The second cross-lapper deposits the web onto the surface of the previously formed base layer and the entire structure thereafter enters the needle punching zone as indicated at C in FIG. **2**. Located within the needle punching zone is a conventional needle loom through which the entire structure i.e., the base layer and web passes. The structure is then needle punched to form an integral structure a cross section of which is shown in FIG. **3**. Referring to FIG. **3** it will be seen that the needles of the needle loom (not shown) have carried fibers from the web **18** or "surface layer" through the base layer **19** causing fibers from the surface layer to extend beyond the lower surface **20** of the base layer as shown at **21**. After this operation, the needle punched assembly may be readily handled and taken up on a conventional takeup roll (not shown).

The integral structure can then be heated in conventional manner to a temperature adequate to fuse the surface layer **18**, comprising thermoplastic fibers whereupon the material constituting the surface layer fuses and further permeates the structure and then cooled, whereupon the low melt thermoplastic material functions as a binder locking in the filaments of the layers as shown in FIG. **4**.

It will, of course, be understood that the heating step can precede the takeup step previously mentioned and that there can be employed as heating means, heated calendar rolls, hot gas systems, and other conventional suitable heating means.

The amount of heat necessary to fuse the fibers, of course, depends upon the type of thermoplastic material employed. In any case, the temperatures employed should be sufficient to fuse the fibers constituting the surface layer of the structure, while leaving uneffected the filaments constituting the base layer.

While it is convenient to refer to the layers as "base layer" and "surface layer" in describing the herein constructed integral structure, such layers are hardly visibly noticeable in the finished material. The so-called "surface layer" containing the lower melt thermoplastic fibers usually will range in weight from about one ounce (1oz.) to about 10 ounces (10 ozs.) per square yard preferably from about two to five ounces per square yard; and the so-called "base layer" will range in weight from about 0.25 to 1.0 ounces per square yard.

It will thus be seen that there has been provided by this invention a method in which the various objects hereinbefore set forth, together with many practical advantages, are successfully achieved.

What is claimed is:

1. A method of producing a nonwoven fabric structure comprising the steps of advancing a deregistered tow of continuous multifilament synthetic yarns arranged in substantially parallel side-by-side relationship into a cross-lapping zone, cross-lapping said tow to form a plurality of layers in a manner such that the filaments in each layer are disposed in substantially parallel relation with respect to each other and are angularly disposed with respect to filaments of immediately adjoining layers, adding to said layers a web comprising a system of fibers of lower melt characteristics than of said multifilament synthetic yarns, needle punching said layers and web to form an integral structure, and thereafter heating said integral structure an amount sufficient to soften the fibers in said web to form a bonded nonwoven fabric structure.

2. A method according to claim **1** wherein said deregistered tow is fed to said cross-lapping zone substantially perpendicular to the longitudinal axis of said formed plurality of layers.

3. A method according to claim **1** wherein the fibers constituting said layers are formulated from polyesters and the fiber constituting said web are formulated from polypropylene.

4. A method according to claim **1** wherein the fibers constituting said layer are cellulose acetate fibers and the fibers constituting said web are polypropylene fibers.

5. A method according to claim **1** wherein the fibers constituting said layer are rayon fibers and the fibers constituting said web are polypropylene fibers.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,615,989 Dated October 26, 1971

Inventor(s) Ronald L. Depoe

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

Column 2, line 47, after "tow 10, " insert -- the deregistered tow is deposited on the floor apron 16, -- , as correctly shown on page 6, lines 23 and 24 of the application specification.

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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