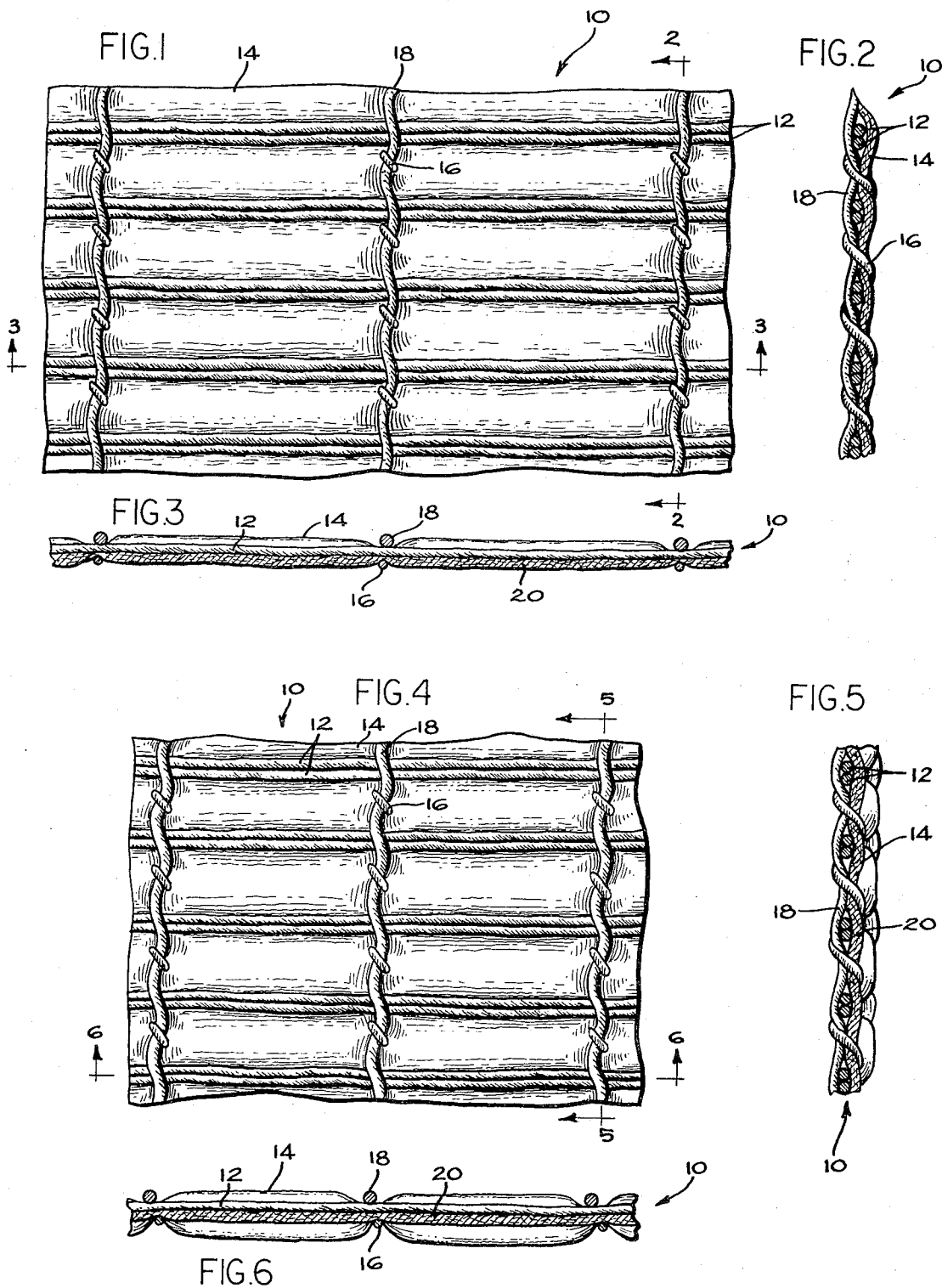


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METHOD OF MAKING FABRIC WITH A FILLER
OF GREATER AREA THAN THE FABRIC
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1

2

3,669,781
**METHOD OF MAKING FABRIC WITH A FILLER
OF GREATER AREA THAN THE FABRIC**

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Original application Apr. 29, 1966, Ser. No. 546,460, now
Patent No. 3,559,810. Divided and this application Mar.
30, 1970, Ser. No. 29,324

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U.S. Cl. 156—84

7 Claims

ABSTRACT OF THE DISCLOSURE

A puckered fabric is formed by stretching a plurality of rack filaments lying in parallel relationship with one another, depositing a stabilized non-woven web of filler material, sewing or stitching cross filaments over said filler and to the rack filaments and then shrinking the rack or cross filaments in at least one direction.

This is a division of copending application Ser. No. 546,460, filed Apr. 29, 1966, now Pat. No. 3,559,810, granted Feb. 2, 1971.

This invention relates to puckered fabrics in which a non-woven fibrous filler is secured to strength members by filaments running transversely thereof and wherein the surface area of the filler is substantially greater than the projected area of the fabric as a whole.

This invention is an improvement on that described in the co-pending application of Charles A. Lee, Ser. No. 431,030, filed Feb. 8, 1965, for "Sewn Fabric and Method of Manufacture," now abandoned. As therein disclosed, a sewn fabric is formed by sewing non-woven filler to a plurality of rack filaments using cross filaments transversely of the rack filaments to sew the filler to the rack filaments. In the improved fabric of the present invention, the filler in the finished fabric is undulated in at least one direction to give it a substantially greater surface area than the projected area of the fabric itself, thus making the fabric puckered.

In accordance with the present invention, the puckered fabric may be made by differentially shrinking the rack filaments or the cross filaments relative to the filler after the fabric has been sewn together in accordance with the teachings of the aforesaid co-pending application. In the preferred method of making the fabric according to the present invention, the filler is stabilized and pre-shrunk before being sewn to the rack filaments. The sewn fabric is thereafter heat treated to shrink the rack filaments or the sewn filaments or both, thus shrinking the sewn fabric substantially without shrinking the filler much, if any, more. The puckered fabric thus produced is then preferably stabilized by chemical treatment with a bonding agent to produce a finished fabric.

A puckered fabric as thus produced has particular advantages when used as a filtration medium. The filler provides the filtering quality of the fabric, and the puckered filler provides a greater area for filtration in a given fabric area, thus providing a greater filtration rate. Further, the chemically stabilized fabric is relatively stiff, and the filler pops up when flexed or pushed up from underneath. This aids in sheet release; that is, it permits easy removal of the material filtered out upon the fabric.

Therefore, a primary object of this invention is to provide a fabric wherein a non-woven filler is secured to rack filaments with cross filaments, the non-woven filler in the finished fabric having a substantially greater surface area than the projected area of the fabric itself.

Another object of the invention is to provide a filter medium which passes a large volume of filtrate while stopping a large fraction of settleable solids.

A further object of the invention is to provide a filter medium of a construction that aids in sheet release of the material filtered out.

Still another object of the invention is to provide methods for making the fabrics of the present invention.

It is still another object of the invention to make the fabric of the present invention by sewing non-woven filler to rack filaments with sewn filaments and then shrinking the sewn filaments or the rack filaments or both relative to the filler.

Further objects and advantages of the present invention will become apparent from consideration of the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a plan view of a piece of one form of puckered fabric made according to the present invention;

FIG. 2 is a cross-sectional view of the fabric shown in FIG. 1, taken along section 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view of the fabric shown in FIG. 1, taken along section 3—3 of FIG. 1;

FIG. 4 is a plan view of a piece of another form of puckered fabric made according to the present invention;

FIG. 5 is a cross-sectional view of the fabric shown in FIG. 4, taken along section 5—5 of FIG. 4; and

FIG. 6 is a cross-sectional view of the fabric shown in FIG. 4, taken along section 6—6 of FIG. 4.

In the preferred form of the invention illustrated in FIGS. 1, 2 and 3, the fabric 10 is formed of a plurality of relatively straight and parallel rack filaments 12 lying substantially in a sheet upon which is disposed a filler 14 which is sewn to the rack filaments 12 by sewn filaments 16 and 18. The filaments 12 are known as rack filaments after the manner in which they are ordinarily assembled into the fabrics. Generally, their function is to give strength to the fabric in the direction of their length, known as the rack direction or the machine direction. The sewn filaments 16 and 18 provide strength in the transverse or cross direction in addition to sewing the filler 14 to the rack filaments 12. The filler 14 may serve various functions, but in a filter fabric it furnishes the greater part of the filtering quality.

Only a portion of the fabric is illustrated in FIG. 1. The fabric ordinarily takes the form of a sheet, that is, it is thin relative to its width and length. However, although the rack filaments 12 are described as being relatively straight or parallel and lying in a sheet and forming a sheet-like fabric, this includes the formation of an endless belt even though the latter requires that the sheet itself be curved and not entirely planar. The rack filaments 12 and sewn filaments 16 and 18 are referred to as a plurality of respective filaments; however, this includes the arrangement where a single strand is passed back and forth or around and around to form the plurality of filaments.

As shown, the filler 14 is non-woven and is preferably formed of filler filaments 20 of predetermined diameter and length, depending upon the particular application to which the fabric is to be put. The dimensions of the filler filaments 20 and the thickness of the filler 14 are selected to provide the desired properties; for example, in a filter fabric they are selected to provide predetermined permeability, porosity and void opening. In general, it is preferable that the filler filaments be long relative to the space between rows of sewn filaments 16, 18 in order that filler filaments bridge the gap between sewn filaments and add their strength to the fabric.

In the fabric illustrated in FIG. 1, a lock stitch was employed to sew the filler to the rack filaments; other

3

stitches can be employed within the scope of this invention. In using a lock stitch, it is frequently desirable, as shown, to utilize different threads on the respective sides of the rack filaments. As illustrated in FIG. 1, the sewn filaments 16 on the filler side of the rack filaments are relatively fine whereas the sewn filaments 18 on the other side of the rack filaments are relatively coarse. Further, the sewn filaments 18 are, as shown, relatively straight, providing certain advantages in some applications. Two-sidedness may also be provided by stitches other than the lock stitch. For example, a two filament chain stitch can be used with different sewn filament materials on the respective sides of the fabric. Of course, in many instances it is quite satisfactory to use the same material and filament size on both sides, in which case a single filament chain stitch can be used as well as any of the two filament stitches.

The qualities of the fabric as thus far described are those of the fabric shown and described in the aforesaid Lee application, Ser. No. 431,030. However, the fabric as shown in FIGS. 1, 2 and 3 of the present application, differs from the prior fabric in that the filler 14 is undulated to provide a surface area substantially greater than the projected area of the fabric itself. This is particularly evident in FIG. 3. In the form of the fabric as shown in FIGS. 1, 2 and 3, the fabric is puckered in but one direction; namely, in the cross direction.

The following is a preferred manner of making the fabric of the present invention as illustrated in FIGS. 1, 2 and 3: A plurality of rack filaments is stretched upon a rack in substantially parallel relationship in a sheet, the tension being sufficient to keep the rack filaments substantially straight. The filler is then deposited upon the sheet of stretched rack filaments. The filler is deposited in non-woven sheet form, the sheet being formed of non-woven fibers and stabilized in some manner, as by chemical bonding, so that the fibers stick together to maintain the integrity of the sheet during subsequent processing. Further, the sheet is pre-shrunk before being deposited. The sewn filaments 16 and 18 are then stitched transversely across the rack filaments in substantially parallel rows, with the stitches being placed discretely between rack filaments 12. This sews the filler 14 to the rack filaments 12. The sewn fabric is then heated to shrink the rack filaments 12 or the sewn filaments 16 and 18 or both relative to the filler, which was stabilized and preshrunk. Bonding agent is then added to bond the rack filaments 12 to the sewn filaments 16 and 18 and stabilize the fabric.

More particularly, the filler 14 may be sewn to the rack filaments 16 and 18 in the manner described in the aforesaid co-pending Lee application Ser. No. 431,030 or in the manner described in either of the co-pending applications of Charles A. Lee and Warren R. Furbeck, Ser. No. 546,390, filed Apr. 29, 1966, for "Method and Apparatus for Making Endless Sewn Fabric," now Pat. No. 3,459,612, and Ser. No. 546,379, filed Apr. 29, 1966, for "Method and Apparatus for the Continuous Manufacture of Sewn Mesh Fabric," now U.S. Pat. No. 3,486,956. In accordance with the present invention, the puckering of the stabilized filler may then be effected by differential shrinking.

The sewn filaments 16 and 18 are shrunk more than the stabilized filler 14, thus puckering the filler in the cross direction as shown in FIGS. 1, 2 and 3. To achieve this, the filler 14 was stabilized and pre-shrunk before being sewn to the rack filaments 12. Shrinking may be effected by heat treatment in the manner disclosed in the co-pending applications of Lee and Furbeck "Method and Apparatus for Making Endless Sewn Fabric" and "Method and Apparatus for the Continuous Manufacture of Sewn Mesh Fabric." At the same time the rack filaments are kept in tension so that the rack filaments do not shrink. In making endless fabrics, the rack filaments may be held to the desired dimensions on the sewing rack throughout the sewing and heat shrinking processes.

4

The fabric may then be further stabilized by adding a bonding agent. This may be effected as disclosed in the aforesaid Lee and Furbeck applications mentioned in the preceding paragraph. The bonding agent may be selected to add any desired stiffness to the fabric.

An alternative form of the fabric is illustrated in FIGS. 4, 5 and 6. In this form the fabric is puckered in both the rack and cross directions, as illustrated. To make this fabric, the filler 14 may be sewn to the rack filaments 12 by sewn filaments 16 and 18 in the manner as described above. The fabric may then be heat treated as described above, except that the rack filaments 12 are not held against shrinking but rather are permitted to shrink along with the sewn filaments 16 and 18.

EXAMPLE I

The particular materials used, the size of the filaments and the construction of the fabric may be varied in accordance with the desired properties of the fabric. However, as a specific example of the fabric shown in FIGS. 1, 2 and 3, a particular endless fabric designed and used as a filter medium will be described. In forming this filter fabric, the sewing process used was that described in the aforesaid Lee and Furbeck application "Method and Apparatus for Making Endless Sewn Fabric."

The rack filaments 12 were made of synthetic polyester fibers sold under the trademark Dacron. The rack filaments 12 were 220 denier disposed at 16 per inch to form an endless sheet.

The filler 14 was also made of synthetic polyester fibers sold under the trademark Dacron. The filler filaments 20 were about 1.5 mills in diameter and their average length was about 1.25 inches. The filler 14 was in sheet form sold under the trademark Reemay Spunbonded. The sheet was about 12 mills thick, being known as Style 240, weighing 2.2 ounces per square foot. The filler 14 was stabilized and pre-shrunk.

The filler 14 was sewn to the rack filaments 12 of sewn filaments 16 and 18 stitched in parallel rows one-third inch apart at 8 stitches per inch, placed discretely between rack filaments 12. A lock stitch was used. The sewn filaments 16 and 18 were each of the same material and size as the rack filaments 12. A tension of about 1.5 pounds per filament was maintained in the rack filaments during the sewing, and the sewing was effected with such tension in the sewn filaments 16 and 18, that upon completion of sewing, the sewn filaments remained slightly taut but not so taut as to produce any substantial wrinkling or puckering of the filler 14 in the cross direction.

The endless fabric as thus sewn was then heat shrunk and chemically stabilized in the manner described in the aforesaid Lee and Furbeck application "Method and Apparatus for Making Endless Sewn Fabric." It was heat shrunk by passing it endlessly at a rate of about 10 inches per minute vertically through an oven about 4 feet long as the oven was gradually brought up to a maximum temperature of about 380° F. The rack filaments 12 were held in tension during the heat treatment to prevent shrinkage in the rack direction. This heat treatment produced shrinkage of the sewn filaments 16 and 18 relative to the filler 14. The filler 14 remained at its original dimensions because it had been previously shrunk. The sewn fabric was passed several times through the oven to assure complete and uniform shrinkage. By this treatment, the fabric was shrunk about 15 to 20% in the cross direction, from about 28.5 inches to about 23.5 inches.

The heat shrunk fabric was then chemically treated with a bonding agent, specifically an epoxy resin sold under the trademark Resiweld, Formula No. 7004, diluted 10 to 1 by acetone. The acetone. The solvent was evaporated and the resin was cured by passing the fabric endlessly at a rate of 10 inches per minute vertically through an oven approximately four feet long heated to

5

a maximum temperature of 380° F., the fabric being held at its sewn length in the rack direction.

This fabric is designed specifically as a filter medium for filtering the effluent from a papermill making newsprint from groundwood stock. Standard mesh filters previously used for this purpose typically filtered about 1.75 gallons per minute per square foot at a pressure of about 5 inches of mercury, leaving a solids content in the filtrate of 5 to 6 and sometimes 8 pounds per 1000 gallons of filtrate. The fabric of this Example I has proved to filter about 2.25 gallons per minute per square foot at a pressure of about 10 inches of mercury, leaving a solids content in the filtrate of only 0.6 pound per 1000 gallons of filtrate.

The finished fabric was relatively stiff. This proved helpful in cleaning the sheet of filtered solids from the fabric, for flexing of the stiff puckered fabric caused the sheet to be released from the fabric.

EXAMPLE II

A particular example of the fabric shown in FIGS. 4, 5 and 6 will now be described. The fabric was sewn in the same way as in the above Example I. The rack filaments 12, the filler 14 and the sewn filaments 16 and 18 were all of the same material and size as in Example I and sewn to the same dimensions. The fabric was heat shrunk in the same manner as in the above Example I, except that the rack filaments 12 were kept only in sufficient tension to keep the fabric unwrinkled, resulting in shrinkage of about 10 to 15% in the rack direction.

This was occasioned both by the shrinkage of the rack filament 12 by the heat applied and by the natural contraction of the rack filaments upon release of tension after sewing.

As a filter fabric, the fabric of Example II proved to have about 10 to 15% better retention of solids. This is believed to be largely because the shrinkage in both rack and cross directions better closes the needle holes made in the filler 14 in the sewing process.

It was noted above that part of the shrinkage in the rack direction in Example II was occasioned by the contraction of the rack filaments 12 upon release of the tension applied during the sewing operation. By selection of the tension during sewing, the amount of rack direction puckering can be controlled.

It should be kept in mind that although various preferred embodiments of the invention have been described above, numerous modifications can be made within the scope of the present invention as defined by the claims. For example, the sewn filaments 16 and 18 may be sewn in tension to produce cross direction puckering when the tension is released in the cross direction. Thus, puckering in either the rack direction or the cross direction may be effected by applying controlled tension during the sewing operation and then releasing the tension. The types and sizes of filaments may be varied, depending upon the intended use for the fabric. Various types of stitches may

6

be used. The fabric may be made endless or flat. The permeability, porosity and void openings of the filter medium may be selected for the particular application. The materials of which the filaments are made is another variable. So also may other bonding agents be used. The invention is therefore limited only by the claims.

What is claimed is:

1. A method of forming a puckered fabric comprising stretching a plurality of rack filaments in substantially parallel relationship in a sheet with tension maintaining said rack filaments substantially straight, depositing a stabilized non-woven sheet of filler on said sheet of stretched rack filaments, sewing a plurality of cross filaments over said filler and said rack filaments transversely of said rack filaments to sew said filler to said rack filaments, and shrinking said filaments relative to said filler in at least one direction.

2. A method of forming a puckered fabric according to claim 1 wherein said sheet of filler is preshrunk before being deposited upon said sheet of rack filaments and said shrinking of said filaments is effected by heating the fabric.

3. A method of forming a puckered fabric according to claim 2 wherein said rack filaments are maintained in tension while said fabric is heated to keep the rack filaments at the same length as the filler so that only the cross filaments are shrunk relative to the filler.

4. A method of forming a puckered fabric according to claim 2 wherein said cross filaments are bonded to said rack filaments.

5. A method of forming a puckered fabric according to claim 1 wherein said shrinking is effected by sewing with the filaments in tension in at least one direction and then releasing the tension.

6. A method of forming a puckered fabric according to claim 1 wherein said cross filaments are stitched discretely between rack filaments in substantially parallel rows.

7. A method of forming a puckered fabric comprising stretching a plurality of rack filaments in substantially parallel relationship in a sheet with tension maintaining said rack filaments substantially straight, depositing a preshrunk stabilized non-woven sheet of filler on said sheet of stretched rack filaments, stitching a plurality of sewn filaments in substantially parallel rows transversely of said rack filaments to sew said filler to said rack filaments, heating the fabric thus sewn to shrink said filaments relative to said filler in at least one direction, and bonding said sewn filaments to said rack filaments.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,669,781 Dated June 13, 1972

Inventor(s) Charles A. Lee et al.

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 72, change "; other" to --; however, other--;
Column 3, line 53, change "546,390" to --546,380--;
Column 3, line 54, change "now Pat." to --now U.S. Pat.--.

Signed and sealed this 26th day of December 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents