

Dec. 6, 1960

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2,963,381

POROUS FABRICS AND METHODS FOR PRODUCING THE SAME

Filed Oct. 10, 1956

2 Sheets-Sheet 1

Fig. 1.

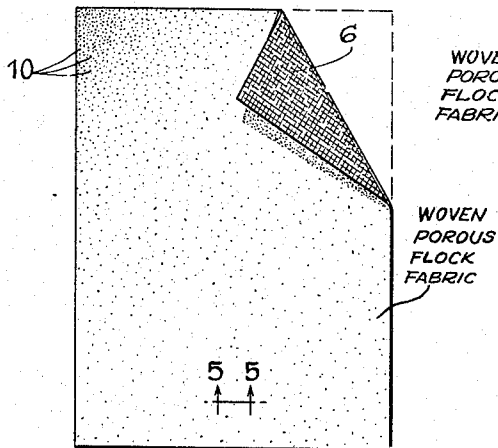
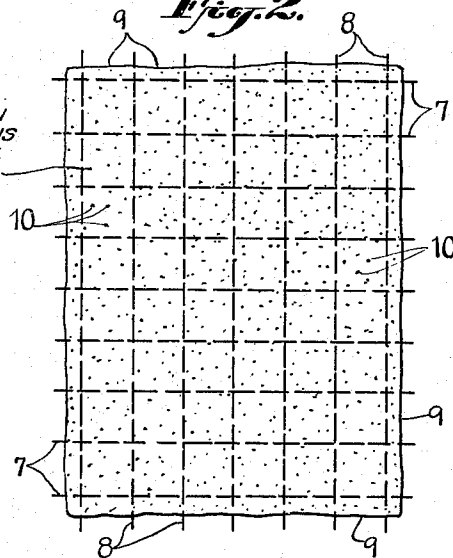
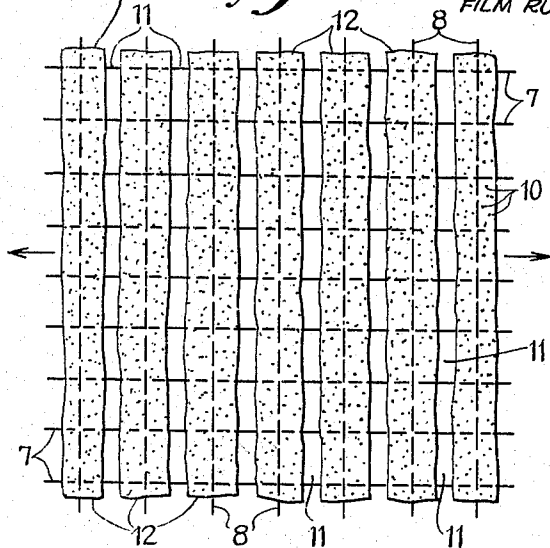


Fig. 2.



TENSIONED FABRIC
ADHESIVE FILM
RUPTURE

Fig. 3.



RELAXED FABRIC
FILM RUPTURE

Fig. 4.

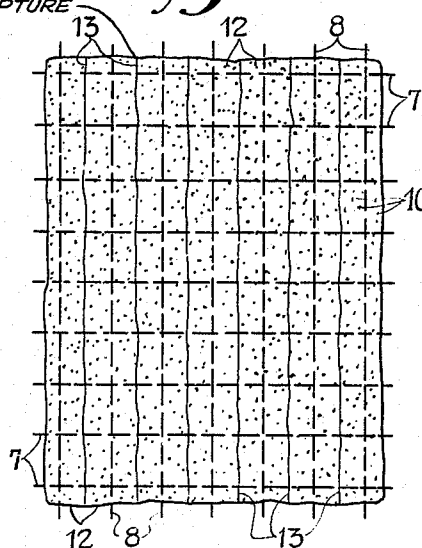


Fig. 5.

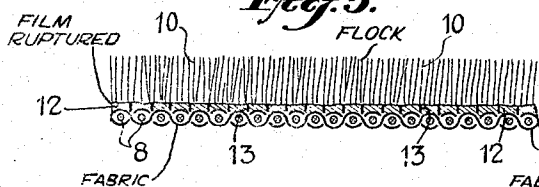
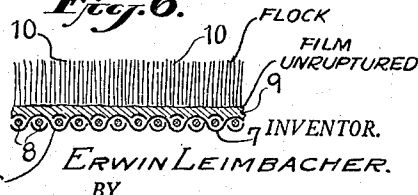


Fig. 6.



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2 Sheets-Sheet 2

Fig. 7.

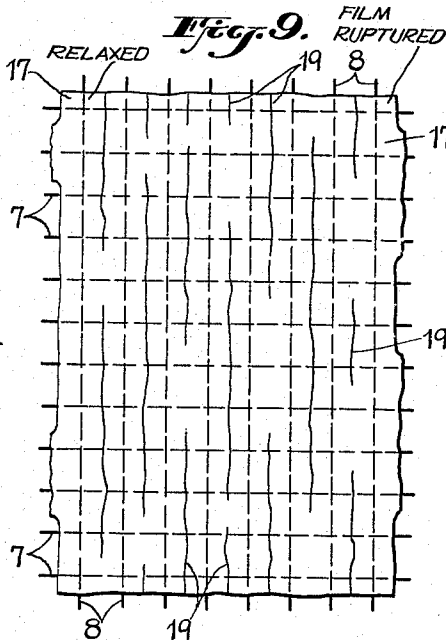
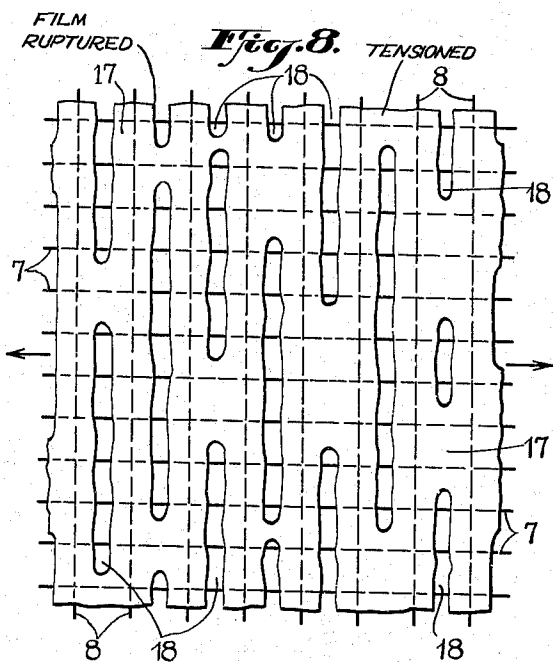
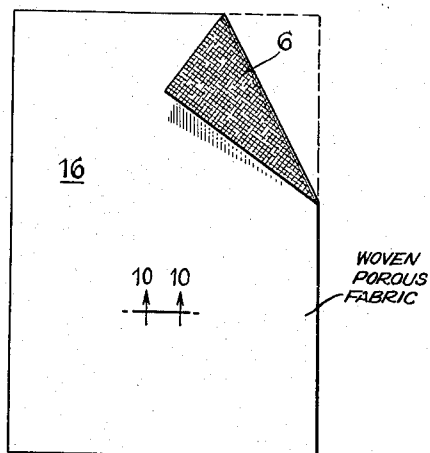
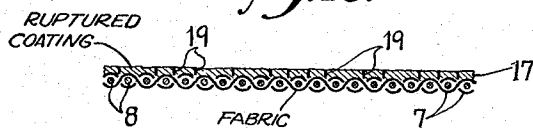


Fig. 10.



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**POROUS FABRICS AND METHODS FOR
PRODUCING THE SAME**

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Filed Oct. 10, 1956, Ser. No. 615,110

Claims priority, application Austria Oct. 11, 1955

9 Claims. (Cl. 117—7)

This invention relates to a porous fabric and more particularly to an air-permeable, water-repellent fabric. The invention also relates to methods for producing such fabric, and to methods for producing air-permeable fabric having a velvetlike or flock finish. The word "porous" as employed herein is intended to mean air-permeable.

It is well known to coat textile materials with a film of a water-repellent material in order to impart water-repellency to the fabric. Materials suitable for this purpose include lacquers, resins, as well as natural and artificial rubbers. The water-repellent material, in order to completely cover the fabric, is generally applied in several coats, with the result that the pores of the fabric are completely closed, because of the continuous and non-porous nature of the film. The resulting fabric although waterproof is non-porous, and for this reason, is not suited for use as wearing apparel. Attempts have been made to perforate this non-porous film by means of needles or by burning as with an electric spark. However, neither of these perforating techniques have been particularly successful, since the permeability so obtained was insufficient.

Since the water-repellent material prior to drying is generally an excellent adhesive, the latter method of producing porous, water-repellent fabrics is akin to the problem of applying a velvetlike or flock coating to a supporting fabric. Today, materials of this type are produced by applying a film of an adhesive material, such as sticking and drying lacquers, hardenable artificial resins, or natural or synthetic rubbers to the fabric, thereafter applying a flock material, and subsequently drying the adhesive. In order that the resulting fabric have a uniform flock surface, the adhesive film must be continuous, and accordingly, must completely cover the fabric, thus closing all of the pores therein. For the latter reason, fabrics of this type are not suited for use in articles of apparel, since they cannot "breathe." Puncturing and electric spark burning have been resorted to in order to produce an acceptable porous flock fabric, but the results have not been encouraging, especially since both of these puncturing techniques disrupt and make uneven the flock surface of the fabric.

Thus the porous, water-repellent fabric which has a substantial film of water-repellent material thereon and a flock fabric with a similar continuous and well covered film of adhesive material have in common the continuous, non-porous film. Accordingly, a method of imparting porosity to this film without damaging the supporting fabric or the flock finish would be highly desirable.

The principal object of the present invention, accordingly, is to provide porous, water-repellent fabrics of the above-mentioned type as well as porous flock fabric, and to overcome the disadvantages presently attending present day methods for producing these materials.

The invention accordingly comprises the novel prod-

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ucts as well as the novel processes and steps of processes according to which such products are manufactured, the specific embodiments of which are described hereinafter by way of example, in accordance with which it is now preferred to practice the invention.

The present invention provides a porous, water-repellent fabric comprising a stretchable fabric base having a water-repellent coating or film thereon, which film is more easily ruptured than the threads of said fabric, i.e., more frangible, the said film being ruptured in substantially parallel grooves on said fabric, with the edges of these grooves lying close to one another when the fabric is in relaxed, unstretched condition. The grooves in the relaxed fabric are sufficiently wide and irregular to impart air-permeability to the fabric, but of insufficient width to permit the passage of water.

In the drawings:

Fig. 1 illustrates a piece of woven porous flock fabric produced in accordance with the method of the present invention;

Fig. 2 illustrates a piece of flock fabric, greatly enlarged, prior to making the same porous;

Fig. 3 is a view similar to Fig. 2, illustrating the effect of tension applied in the direction of the arrows sufficient to effect maximum rupturing of the adhesive film;

Fig. 4 is a view similar to Fig. 3 following release of tension, or with the goods in relaxed, unstretched condition;

Fig. 5 is a greatly enlarged vertical section taken on the line 5—5 of Fig. 1, illustrating the even and unruptured flock surface of the fabric following the process of the present invention;

Fig. 6 is an enlarged section, similar to Fig. 5, but of the flock-coated fabric of Fig. 2 prior to stretching;

Fig. 7 illustrates a piece of woven, porous, water-repellent fabric produced in accordance with the method of the present invention;

Fig. 8 illustrates a piece of fabric greatly enlarged with a water-repellent film under sufficient tension applied thereto in the direction of the filler threads (see arrows) to cause partial rupturing of the water-repellent film;

Fig. 9 is a view similar to Fig. 8, but with tension on the goods relaxed; and

Fig. 10 is a greatly enlarged section taken on the line 10—10 of Fig. 7, illustrating the grooves or cracks in the water-repellent film produced by the method of the present invention.

It has been discovered that a porous, water-repellent fabric may be obtained by employing as the supporting material a woven or knit fabric which displays a high stretchability or elasticity either in the transverse or lengthwise direction or both. In accordance with the method of the present invention, a continuous, non-porous, water-repellent film is applied to the fabric, and dried, cured or gelatinized. The supporting fabric is then tensioned or stretched in the transverse or lengthwise direction or both, depending in part upon the direction in which the fabric is stretchable, to such an extent that the water-repellent film is ruptured in furrows or grooves running normal to the direction of stretching. When tension is released the fabric, because of its elasticity, returns to its normal or pretension state and the surface characteristics of the goods appears substantially the same as before tensioning. When the goods are stretched to rupture the film, the film is parted in the grooves aforesaid which are, for the most part, substantially parallel and have slightly irregular edges. When the fabric is relaxed, the edgth of these grooves approach

and lie adjacent one another throughout, and the resulting closed grooves or cracks are sufficiently wide to afford a high degree of air-permeability to the film and, accordingly, to the fabric. In the normal or non-stretched condition, these cracks or closed grooves are not of sufficient dimensions to permit the passage of water as it would normally be encountered in rainwear, for example, or in canvas shoes.

In order to assure the requisite stretchability, it is preferred that the supporting fabric contain warp and/or filler threads of stretch textile fibers, and threads of this type and their methods of manufacture are well-known in the art. They may be of synthetic, organic textile fibers, such as polyamide, polyester, or fibers with a polyvinyl basis. Stretch threads found to be best suited to the present invention are those which are crimped by being high twisted, thermally set in the high twisted state and subsequently detwisted. Since fabrics which do not contain stretch threads may be inherently stretchable, as knit goods of cotton, etc., for example, they may also serve as the supporting material. However, it is generally preferred that the fabric contain at least some stretch threads.

The water-repellent materials with which the supporting fabric is treated are preferably high polymers in a suitable solution or dispersion, as for example, plastified vinyl resins, acryl or methacryl resins, alkyd resins, polyester-isocyanate adducts, plastified urea- or melamine- and phenol resins, natural and synthetic rubber, polyethylene or silicones, as well as suitable mixtures of these high polymers. Softeners, filling agents, dyestuffs, etc. may also be added to the water-repellent-containing solution or dispersion. Regardless of the composition, it is important that the layer or film of the same applied to the supporting fabric be more frangible or more easily ruptured after drying and/or curing than the threads of the fabrics, and particularly the threads thereof running in the direction in which the fabric is stretched or tensioned in accordance with the method of the present invention. This is necessary to assure rupturing of the adhesive film rather than breaking of the textile threads during tensioning.

Referring again to the method of preparing a porous, water-repellent, non-flock fabric, the supporting fabric base having elasticity in at least one direction is coated with one or more layers of water-repellent material in order to assure a continuous film of this material on the surface of the base. The water-repellent material is dried and/or cured as required and the fabric then tensioned in at least one direction, this direction being parallel to the direction of the stretch threads therein. Stretching or tensioning is effected to a degree sufficient to cause rupture of the film in a plurality of grooves which are oriented in a direction normal to that of stretching. The number or frequency of ruptured grooves as well as their length depends upon the extent to which the goods are stretched. Theoretically then, when the supporting fabric is stretched to the maximum degree, the ruptured grooves in the water-repellent film will appear between each of the filler threads, assuming them to be the stretch threads, and the grooves will, accordingly, be substantially parallel and run normal to direction of stretching (see Fig. 3). However, in actual practice, the goods are not stretched to their maximum degree and thus, while the grooves are substantially parallel and run normal to the direction of stretching, they are usually not necessarily continuous, i.e., regular, and between each of the warp threads. Instead, they are of varied length and intermediate most of the warp threads. Accordingly, the degree of porosity in the thus treated fabric can be controlled by the severity of tensioning or stretching.

As a practical matter, continuous tensioning following drying of the film is most easily accomplished in a direction transversely of the goods, or in the direction of the filler threads. Accordingly, in the case of woven sup-

porting fabrics, filler threads at least will have stretch characteristics. While the warp threads between which ruptured grooves in the film develop during tensioning may also be of stretch thread, this is not necessary to the production of a fabric having the requisite porosity for use as apparel. It is, nevertheless, within the scope of the present invention to employ a supporting fabric fashioned of stretch threads in both the warp and filler, although tensioning of such fabrics will usually only be effected in the filler direction. However, fabrics of this type may additionally or alternatively be stretched in the direction of the warp threads, i.e., lengthwise. When such materials have already been tensioned transversely, lengthwise stretching causes rupturing of the film adhering to the warp threads, and grooves appear intermediate the filler threads, which results in a very substantial increase in porosity of the finished goods. Again, the degree to which the goods are stretched has a direct bearing upon the frequency of grooves, in the latter case, intermediate the filler threads. Furthermore, it is not necessary in the case of a woven fabric that the warp and filler threads be of the same material. For example, the filler may be a stretch nylon thread and the warp rayon, cotton or wool. The warp may of course be normal non-stretch nylon.

When it is desirable to produce a porous flock fabric in accordance with the present invention, a supporting fabric having the requisite stretchable properties above discussed is first coated with one or more layers of an adhesive material. Any of the aforementioned water-repellent materials may be employed as the adhesive, however, the present invention is not limited to the materials enumerated. Onto this freshly applied adhesive film a flock material in the form of short fibers or dust is then shaken, blown, sprayed, or applied by means of an electrostatic field. The adhesive film is then dried or cured as required, usually at elevated temperatures. Following drying, excess non-adhering flock material is removed from the surface, preferably by brushing. The fabric is then tensioned in at least one direction, as above described in connection with the preparation of the porous, water-repellent fabric. As indicated, tensioning causes the adhesive film to rupture in a plurality of grooves in substantially the same manner as indicated earlier. After rupturing of the adhesive film, the goods are relaxed and reassume their original dimensions, with the edges of the grooves approaching and lying close to one another. Following this treatment, the characteristics of the flock surface of the fabric appear unchanged. That is to say, the furrows or grooves thus produced in the adhesive film do not affect or interrupt the continuous surface of flock material. This is due to the fact that the adhesive properties of the film have not been altered by stretching. Stamping and puncturing or electric spark burning on the other hand affect uniformity of the flock surface. Furthermore, the present treatment imparts to the fabric the air-permeability required of material to be used for wearing apparel.

The flock material employed may be any finely divided material, as for example, leather dust, but will usually be short staples of cotton, wool, silk, rayon or synthetic fibers, which latter materials permit the manufacture of finished goods having a velvetlike finish.

The method of the present invention will be even more fully understood from a consideration of the drawings herein. While the invention is applicable to either knit or woven supporting fabrics, in order to clearly illustrate the nature of the novel process, a simple woven fabric has been referred to in the foregoing description and in the drawings. Figs. 1-6 illustrate various stages in the production of a porous flock fabric, while Figs. 7-10 apply to the production of a conventional non-flock porous, water-repellent fabric.

With reference first to the preparation of the porous flock fabric, it will be seen from Fig. 1 that the supporting

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fabric is of a simple single thread weave illustrated as 6. Referring to Figs. 2-4 which are greatly enlarged for purposes of clarity, the filler threads 7 are of stretch yarn, while the warp threads 8 are either of stretch or normal non-stretch thread. As shown in Fig. 2, the adhesive material 9 is applied to the fabric uniformly and flock material 10 is similarly applied over the adhesive film, and that following drying or curing the adhesive film is continuous and non-porous. With excess flock material brushed from the surface of the fabric, the goods are tensioned or stretched as on a tentering frame in the direction of the filler threads 7, as indicated by the arrows in Fig. 3. In the case illustrated, sufficient tension is applied so that filler threads 7 are stretched almost to their ultimate, causing the adhesive film to rupture between warp threads 8 thus producing wide grooves 11 of substantial length, oriented longitudinally of the goods and parallel to the warp threads. Following tensioning, the ruptured adhesive is now in a plurality of strips 12 adhering to warp threads 8 and to the filler threads 7 where they intersect the warp. Upon release of tension, the goods reassume their original dimensions as indicated in Fig. 4, and the wide grooves 11 between the warp threads are reduced to narrow grooves or cracks 13, which are sufficiently wide to impart a high degree of porosity and air-permeability to the goods. However, such cracks are irregular and the edges thereof are adjacent over substantially their complete length, thereby preventing passage of drops of water. By comparing Fig. 6, before, with Fig. 5, after tensioning and relaxing, it is seen that the longitudinal cracks 13 do not affect or interrupt the continuous surface of flock material 10, nor has adhesion of the flock material been affected by stretching.

Referring to Figs. 7-10 and the production of a porous water-repellent fabric 16, the supporting fabric is of a simple single thread woven construction as indicated at 6, including filler threads 7 of stretch yarn and warp threads 8 of either stretch or normal non-stretch yarn. A continuous film of water-repellent material 17 is applied to the goods in amounts sufficient to completely close all the pores of the fabric. The film is dried, tension is then applied and the goods stretched in the direction of the filler threads 7 as indicated by the arrows in Fig. 8, to rupture film 17. However, the degree to which the goods are stretched is somewhat less than that described in connection with Fig. 3, with the result that the film is ruptured as at grooves 18. It is seen that grooves 18 are of irregular length and are spaced somewhat at random on film 17. However, all of said grooves are oriented in the direction of the warp threads 8 and are substantially parallel to one another. Following tensioning as aforesaid, the goods are relaxed as in Fig. 9 and grooves 18 which were of substantial width when the goods were stretched are now reduced to narrow grooves 19, the edges of which approach each other very closely. However, narrow grooves or cracks 19 are of sufficient width to permit the free passage of air through the fabric, but of insufficient width to allow passage of water drops. The random spacing of the narrow grooves is also apparent in the enlarged cross-section which is Fig. 10.

In addition to the satisfactory porosity of the fabrics of the present invention, their stretch properties permit one to temporarily widen the grooves therein by stretching the fabric, thus facilitating cleaning, particularly removing foreign substances which may have become lodged in the grooves.

The following examples illustrate several preferred methods of carrying out the process of the present invention to produce the novel porous fabrics.

Example I

A two-thread construction fabric was used as supporting material. It contained in warp and filler 22 two-ply yarns per cm. of high stretch nylon 70 den. single yarn,

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which had been crimped by high twisting to approximately 3000 turns per meter, thermally set in this state and detwisted to approximately 100 turns per meter. The supporting fabric was then covered by means of a doctor blade with a water-repellent material of the following composition in parts by weight:

Polyvinylchloride	49
Diocetylphthalate	50
Lead stearate	1

The resulting film was gelatinized in a heating chamber at 150-160° C. for approximately five minutes. By means of a clamping device, the sheet material was then stretched in the transverse direction to such an extent that the dried non-porous film ruptured between warp threads, with the resulting grooves being oriented in the direction of these threads. Tension was then released and the grooves closed sufficiently so that they were invisible in the relaxed fabric. The thus treated fabric was waterproof and possessed a high degree of air-permeability.

Example II

To the supporting fabric of Example I with the film of water-repellent material applied thereto and prior to drying of the same, there was applied by means of an electrostatic high voltage field a flock material consisting of rayon fibers, having an average fiber length of 0.5 mm., which had been dyed green. Thereafter the film was cured in the manner set forth in Example I. Thereafter, excessive fiber material was removed with brushes. The material was then stretched as set forth in Example I and relaxed. The resulting fabric had a uniform flock finish which had not been interrupted or distorted by the tensioning treatment, and was highly permeable to air.

Example III

A two-thread construction, black dyed, mixed fabric was employed as the supporting material. It contained in the warp 23.5 cotton threads per cm. of a count of 20-1, and in the filler 26.5 two-ply yarns per cm. of highly elastic nylon 70 den. single yarn as employed in Example I. The black dyed supporting fabric was covered by means of a doctor blade with a water-repellent material of the following composition in parts by weight:

Revertex (latex concentrate with 25% water)	100
Sulphur	1.2
Piperidine pentamethylenedithiocarbamate	0.25
Cyclohexylethylamine of cyclohexylethyldithiocarbamate	0.25
Zinc oxide	3
Zinc stearate	0.6
Kaolin	10
Soot	2
Phenylbetanaphthylamine	0.2
Paraffin emulsion	0.1

The thus treated fabric was then dried and the film vulcanized by subjecting the fabric to a temperature of 120° C. for a period of 10 minutes, after which the sheet material was stretched in the transverse direction which caused the non-porous film to rupture in lengthwise grooves oriented in the direction of the warp threads. The material was then relaxed whereupon it returned to its original width with the result that said grooves were sufficiently narrow to resist the passage of water. However, the grooves were wide enough to impart a high degree of air-permeability to the fabric.

Example IV

To the supporting fabric coated with the material and in the manner set forth in Example III, black dyed cotton fiber dust was evenly distributed on the undried film by means of a screen. The fabric was then dried, vulcanized, stretched and relaxed as set forth in Example III. The resulting flock fabric exhibited a high degree of air-

permeability, and had the appearance of the unstretched fabric.

Example V

A one-thread construction, red dyed, supporting fabric was employed. It contained in the warp 22 and in the filler 17.5 two-ply yarns per cm. of highly elastic nylon 70 den. single yarn, similar to that employed in Example I. The supporting fabric was covered by means of a doctor blade with a soft acrylic acid ester dissolved in ethyl acetate, and then calendered. The fabric was again covered with a film of the same material, and immediately thereafter, red dyed fibers of artificial silk were scattered on the fabric by means of a screen, while the supporting fabric was being vibrated by means of a beating device. The material was then placed in a heated chamber at 70–100° C. to dry the adhesive coating. After brushing and cooling, the fabric was stretched in the transverse direction, whereby the adhesive film cracked lengthwise intermediate the warp threads. When the fabric was relaxed, it was highly porous.

Example VI

A warp knitted double Atlas ("locknit") cotton fabric, brown dyed, was employed as base. The backing was on the back side covered by means of a doctor blade with a water-repellent material in the form of a rubber solution of the following composition in parts by weight:

Crepe	100
Zinc oxide	5.0
Clay	100
Stearic acid	0.5
Phenylbetanaphthylamine	0.5
Sulphur	1.0
Caplax (Mercaptobenzothiazole)	1.0
Tuads (Tetramethylthiuramdisulfide)	0.5
Brown dye pigments	1.5

This composition was dissolved in a mixture 1:1 by weight of toluene and carbon tetrachloride. This cement was applied to said knitted fabric by means of a doctor blade and immediately flocked with brown rayon flock of 0.5 mm. length, by means of an electrostatic field. The material was now dried out and then cured at 135° C. during 40 minutes. After a cooling cycle, the coated fabric was brushed and then stretched on a tenter frame, whereby the adhesive film was cracked. When the fabric was relaxed, it was porous.

I claim:

1. A process which comprises applying a non-porous, water-repellent adhesive film to a supporting fabric base fashioned of synthetic, organic stretch threads, said film being substantially more frangible than the threads of said fabric, stretching the base in at least one direction to break the applied film without substantially breaking the base to produce a plurality of grooves substantially normal to the direction of stretching which impart porosity to the film carrying fabric, and subsequently relaxing the fabric.

2. A process as set forth in claim 1 wherein the thus stretched and relaxed fabric is subsequently stretched in a direction transverse to that of initial stretching and

thereupon relaxed, whereby said film is ruptured in a plurality of grooves oriented in the direction of initial stretching, and the porosity of the film carrying fabric is substantially increased.

3. A porous air permeable stretchable fabric formed by the process of claim 1.

4. A process which comprises applying a non-porous, water-repellent adhesive film to a woven supporting fabric base having in the filler synthetic, organic stretch threads, said film being substantially more frangible than said stretch threads, stretching the base in the direction of said filler threads sufficiently to break the applied film without substantially breaking the base to produce a plurality of grooves oriented in the direction of warp threads in said fabric, whereby porosity is imparted to the film carrying fabric, and thereafter relaxing said fabric.

5. A process as set forth in claim 4 wherein the warp threads of said supporting fabric are non-stretch threads.

6. A process for producing an air-permeable flock fabric which comprises applying a non-porous adhesive film to a supporting stretchable fabric base fashioned at least in part of synthetic, organic stretch threads, said film when dry being substantially more frangible than the threads of said fabric, applying a flock material to the surface of said film and thereafter drying said film, then stretching said fabric in at least one direction to break the film without substantially breaking the fabric, thereby producing a plurality of grooves oriented normally of the direction of stretching which impart porosity to the film carrying fabric, and subsequently relaxing said fabric.

7. A porous air permeable flock stretchable fabric formed by the process of claim 6.

8. A process for producing an air-permeable flock fabric which comprises applying a non-porous adhesive film to a woven stretchable supporting fabric base having in the filler synthetic, organic stretch threads, said film when dry being substantially more frangible than said stretch threads, applying a flock material to the surface of said film and thereafter drying said film, then stretching the fabric in the direction of said filler threads to break the film without substantially breaking the fabric to produce a plurality of grooves oriented in the direction of the warp threads in said fabric, whereby porosity is imparted to the film carrying fabric, and thereafter relaxing said fabric.

9. A process as set forth in claim 8 wherein the warp threads of said supporting fabric are non-stretch threads.

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