

March 11, 1958

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2,825,958

PROCESS FOR MAKING WOVEN FELTS

Filed May 28, 1953

2 Sheets-Sheet 1

Fig. 1.

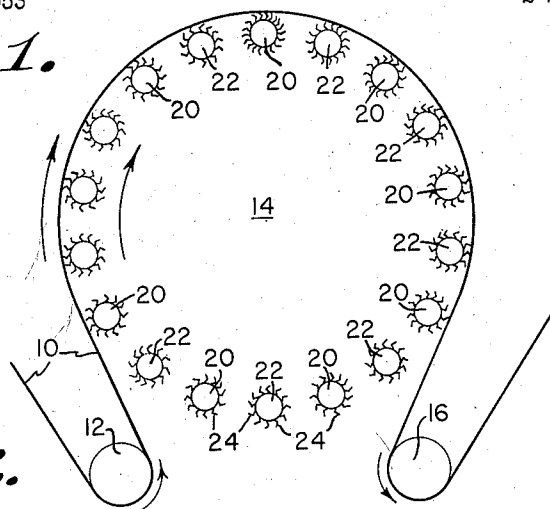


Fig. 2.

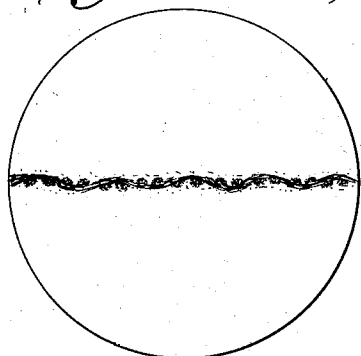


Fig. 3.

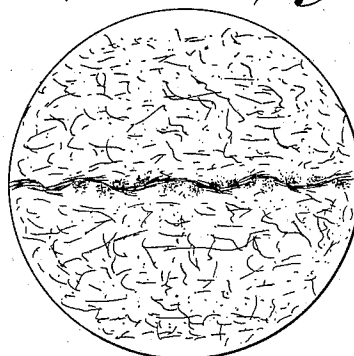


Fig. 4.

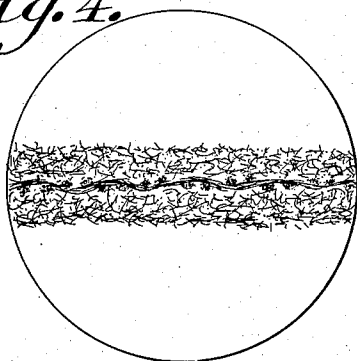
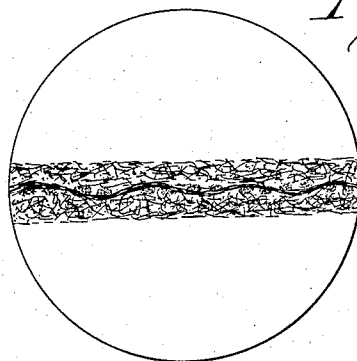


Fig. 5.



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2 Sheets-Sheet 2

Fig. 6.

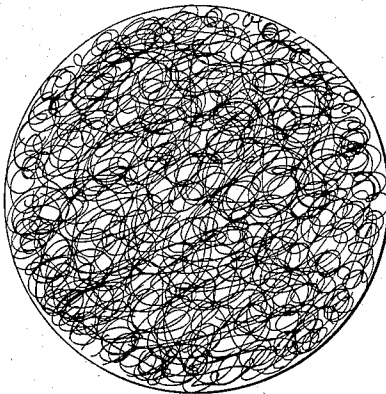


Fig. 7.

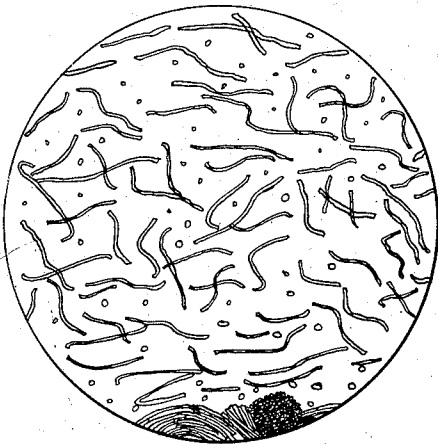
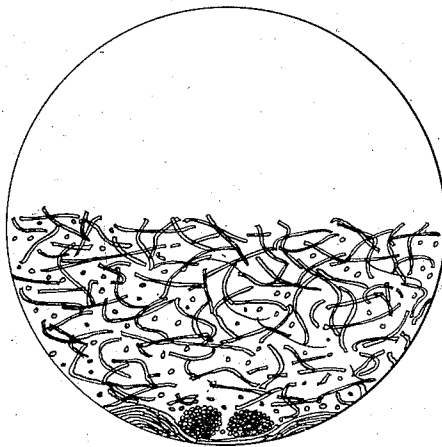


Fig. 8.



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2,825,958

PROCESS FOR MAKING WOVEN FELTS

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Application May 28, 1953, Serial No. 357,974

5 Claims. (Cl. 28—72)

This invention relates to textiles having felt-like surface layers, and more particularly to a type of woven fabric and knitted fabric having an integral non-woven fibrous cover composed of the fibers of the fabric and to processes for forming this kind of non-woven cover on and integral with the fabric.

The invention is applicable to both woven and knitted fabrics and, for simplicity, the term "strand constructed fabric" will be used to include both of these fabrics.

Woven wool fabrics may be given a dense non-woven cover by fulling or milling, usually in combination with other finishing operations, such as brushing, steaming, and pressing. Formation of dense non-woven surface layers in this way is brought about by the felting properties in which wool excels; non-fullable fibers do not exhibit felt-like covers when subjected to identical treatment. Nearly all synthetic fibers lack the characteristics required to produce this effect when subjected to these conventional felting processes.

An object of this invention is to provide a dense non-woven or felt-like cover on and integral with woven fabric made from synthetic fibers. Another object is to produce such felt-like covers on woven fabrics without fulling or milling. A further object is to provide a simple and economical process for treating woven fabrics formed of retractable synthetic fibers to provide a close non-woven cover. Other objects of this invention will become apparent from the disclosure and claims.

The process of this invention comprises the steps of raising a thick nap of fibers on the surface of a fabric woven of retractable synthetic fibers, treating the raised fibers with heat or other suitable treatment to at least the point of retraction of the retractable fibers, but less than the bonding point of any fiber in the fabric and, when desired, completing the treatment by steaming or pressing, e. g., semi-decating, and other conventional fabric finishing steps. When a substantial proportion of the fabric is composed of fibers capable of retracting at least 12 percent, retraction of an adequately raised nap will produce a dense non-woven or felt-like surface of mechanically entangled fibers on and integral with the woven portion of the fabric. The nap is preferably raised with a machine such as the type known in the trade as a double-acting card-wire raising machine, so that the lifted fibers are reasonably erect and entangled to a considerable extent. When a heavy nap is raised which at least doubles the thickness of the untreated fabric contraction of the fibers will produce a felt-like cover or layer of sufficient density to substantially obscure the original weave.

In the drawings, which illustrate preferred embodiments of the invention,

Figure 1 is a diagrammatic side elevation of a suitable raising machine for use in the process,

Figure 2 is a cross-sectional view of woven fabric before processing according to this invention,

Figure 3 is a corresponding cross-section of the fabric after raising a pile and before further processing,

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Figure 4 is a corresponding cross-section of the fabric after the raised fibers have been retracted,

Figure 5 is a corresponding cross-section showing the effect on the fabric of Figure 3 of subsequent blowing with steam and light pressing,

Figure 6 is a surface view of the fabric of Figure 4, showing the appearance of the treated surface,

Figure 7 is a side view of a group of several fibers, such as those extending above the woven surface of the raised fabric of Figure 3 and

Figure 8 is a side view of the same group of fibers after retraction.

The degree of cover provided by the non-woven surface layer obtained according to the process of this invention is a function of fiber composition, fabric construction, and treatment in the process. It can be varied from a complete obscuration of the weave, as found in a fine Melton type of finish, to only a light overcast as in a blanket felt or light flannel. In order to produce a cover which substantially obscures the original weave the fibers should be capable of retracting at least 12 percent in length and the nap raised on each treated surface should be at least sufficient to double the original thickness of the fabric. A cover at least equal in thickness to that of the woven portion of the fabric is generally required to completely obscure the weave. Generally, a fabric area loss of about twenty percent is also desirable to produce a moderate or heavy cover and for most weaves this shrinkage will be provided by fibers capable of retracting twelve percent or more in length. The area shrinkage brings about a lateral densification of the surface to supplement the compacting force exerted in the thickness direction when the fibers retract. The resultant cover is a mechanically tangled mass of fibers on the surface of the fabric, obscuring the weave.

A conventional double action card-wire raising machine, such as the Moser type shown diagrammatically in Figure 1, is an entirely satisfactory machine for raising the nap required. Since those skilled in the textile art are already familiar with this machine, only its principal features will be mentioned. The fabric 10 to be treated is fed by roll 12 at about 15 yards per minute to a large cylinder 14, passes almost completely around the cylinder, and is led away by roll 16. The surface of the cylinder is made up of a large number of small rollers 20 and 22, about eighteen rollers being sufficient.

As indicated, rollers 20 and 22 alternate around the circumference of the cylinder. These rollers are covered with card clothing, which is heavy sheet material of several layers of cloth through which are pressed many fine closely spaced wires 24. As indicated, these wires are bent at about 45° angles to the surfaces of the rollers, with the points on rollers 20 set against the direction of travel of the fabric and the points on rollers 22 set in the opposite direction, i. e., with the fabric travel.

The cylinder 14 is arranged to turn in the same direction as the fabric travels, but at a higher speed. The rollers 20 and 22 turn in the same direction, but in the opposite direction to that of the cylinder so that they roll along the fabric. The relative speeds are regulated so that the wire points penetrate into the fabric, snag onto fibers and carry them out of the fabric as the points are withdrawn. The alternate directions at which the points are set causes them to raise the fibers in two directions and leave them in a tangled nap.

The appearance of a 2 x 2 twill fabric before undergoing treatment according to this invention is presented in Figure 2, which is a cross-sectional view perpendicular to the warp. Only occasional fibers can be seen at any distance from the body of the fabric. Before the first step in the process, which is a raising of the fibers from the surface, other treatments may be employed,

but generally the fabric may be taken directly from the loom. Figure 3 shows clearly the cross-sectional appearance of the fabric after raising. Many fibers have been lifted more or less vertically from the fabric weave, and they extend a distance above it equal to several times the thickness of the fabric. The raising may be done in various ways, of course. Manual snagging of the surface with small needles or brushes or similar implements may lift the fibers away from the surface satisfactorily, although use of machines such as that described is preferred as more practical. Further preference exists for alternate or double-action raising to foster some inter-fiber entanglement at this stage. Figure 7 provides a view of a group of fibers extended and partially entangled by effective raising.

A substantial proportion of the filamentary material used in the practice of this invention must have the ability to retract when properly treated, as with heat or swelling agent. The retraction may result from a simple reduction in length, as of a filament already non-linear in shape, or from a distorting of the filament into an irregular shape, or both. The degree of retraction is expressed as the percent decrease in distance between two points on a filament as a result of the treatment and, when both shrinking and crimping occur, is a summation of the effect produced by shrinking in length and crimping to assume a more irregular path between the points of measurement. A working minimum on retraction is about 12 percent and preferably amounts to at least 25 percent. Retraction of at least 50 percent is especially desirable for some purposes. Materials which do not retract under the conditions of manufacture cannot be used alone but can be blended with a major proportion of retractable filaments in order to achieve special effects.

Especially desirable results in the production of felt-like products intended for the same uses as wool felts have been obtained with polyethylene terephthalate fibers prepared as disclosed in U. S. Patent No. 2,604,689 to Hebel and in the copending application of H. J. Kolb, U. S. Serial No. 295,565, filed June 25, 1952, now Patent No. 2,758,908. These fibers have the property of crimping spontaneously when heated in boiling water, or in hot air at 95° up to about 180–200° C., which is below the bonding point of any fiber in the fabric. The crimped fibers not only have a wool-like appearance, but also compare favorably with wool in resilience and other properties. The crimping of fibers in the practice of this invention has been found to assist in obtaining desirable felt-like covers because of an added interlocking of the fibers.

Another type of spontaneously crimpable fiber which gives felt-like products which are desirable for many purposes is regenerated cellulose of the kind produced as described in U. S. Patent No. 2,515,834 to Nicoll. These fibers crimp spontaneously at room temperature in a swelling agent such as an aqueous alkaline solution or anhydrous liquid ammonia. Other swelling agents are disclosed in the patent. Liquid ammonia will also cause retraction of ordinary viscose rayon and, even though such regenerated cellulose filaments do not crimp, they can be used to prepare felt-like products.

While spontaneously crimpable polyethylene terephthalate filaments are often especially desirable, good results have also been obtained with filaments which retract but do not crimp when heated. The preparation of such filaments is discussed in the above mentioned Kolb application.

Practically all synthetic polymeric filamentary materials can be manufactured so as to have the necessary retraction, and can be treated by the process of this invention to produce useful products. These include polyamides, polyesters and polyesteramides, polyvinylidene and polyvinyl compounds and their copolymers or interpolymers, polymerized hydrocarbons, proteinaceous

polymers and cellulose esters and ethers, as well as regenerated cellulose.

The retraction treatment should be performed in the manner most suitable for the particular fiber type. The synthetic fibers generally, excluding the mineral fibers, can be retracted satisfactorily in one way or another. Thus polyethylene terephthalate fibers require only heating to the retraction temperature in heated air, steam, water, oil or other liquid or gaseous bath. Fibers of oriented thermoplastics such as polyamides, polyesters, polyesteramides, polyvinyl and polyvinylidene compounds and their copolymers may be treated satisfactorily in this way. Other fibers may require use of swelling agent, e. g., mild acid or alkali or a solvent, or some physical treatment, but generally the treatment is a simple one-step affair. At least some of the molecular orientation given the fibers by extrusion and any subsequent orienting treatment, such as cold-drawing, should remain in the fiber to aid in the retraction. Some conventional yarn manufacturing processes include a heat-treating step for the purpose of reducing further dimensional change in the yarn, and elimination of this step in manufacture of yarns to be used in the process of this invention is usually essential if retraction is to be accomplished with heat. The cross-sectional appearance after retraction of the fabric of Figure 3 is shown in Figure 4. The retracted fibers lie closely entangled on the surface, and the weave itself has contracted appreciably. The resulting tangled cover, which is also shown from above in Figure 6, obscures the weave formerly evident in a surface view of the starting fabric. A more detailed cross-sectional view of the felt-like configuration of the surface is evident in Figure 8, which represents the retracted group of fibers shown raised in Figure 7.

After retraction the fabric may be steamed or pressed (e. g. semi-decated) to compact it, especially to densify the non-woven surface layer. This proves useful in many apparel applications, such as suitings and coatings, though it is not a prerequisite for those uses, and is not worthwhile for use in underlinings, wickings, or various forms of insulation, to mention but a few of the possible end-products. The effect of pressing on the cross-section is illustrated by Figure 5. Mechanical working corresponding to fulling or milling is never required and is not desirable in most instances, although it may be desirable when wool fibers are blended with synthetic. Additional treatments, such as brushing, shearing, or napping, may be utilized for the purpose of evening or modifying the surface slightly. Various lubricants may be employed in one or more of the steps of the complete process, but no adhesive or binder of any kind is necessary, since the fibers are held together mechanically as a result of retraction. Novel effects may be obtained by including fibers that are non-retractable under the conditions of treatment applied; they may remain raised above the retracted surface as a sort of pile. Variants of the process and other uses of the products will be more apparent from the specific examples. Results of thickness and specific gravity measurements for each of the examples appear in Table II following Example VI.

EXAMPLE I

A quantity of two-inch staple fiber manufactured from polyethylene terephthalate according to the process described by Whinfield and Dickson in Patent No. 2,465,319, drawn to slightly more than four times its original length but not relaxed and having the capacity for retracting 12% of its drawn length in boiling water, is processed on the American system into 8 Z twist (turns per inch) yarn of 8/1 cotton count, corresponding to about 660 denier. This yarn is woven into a 2 x 2 twill with a fabric count (ends and picks per inch) of 49 x 43. The fabric is scoured at a temperature of 100° F. and a two percent aqueous emulsion of a conventional lubricant comprised of phosphated long chain alcohols is applied

to the fabric by padding. After lubrication the fabric is treated with a conventional double-acting card-wire raising machine until a thick nap is produced. The raising machine contacts and raises the surface fibers of the fabric to an eventual length or height of about $\frac{1}{2}$ inch. The double action card-wire raising operation leaves the fibers entangled in a manner similar to that illustrated in Figure 7. After both sides are raised, the fabric is passed through an oven or similar enclosure heated to 350° F., remaining at that temperature for about five minutes, and is then cooled rapidly to room temperature. The fabric loses 29% of its original area, and on each side the raised fibers retract to form a close felt-like surface layer equal in thickness to about 150% of the weave itself as illustrated in Figures 4 and 8. During the heat treatment the retraction brings about an increase in both specific gravity and fabric thickness. The weave is completely obscured, and the handle of the fabric is soft and lofty. The treated fabric bears a strong resemblance to a medium weight Melton suiting, such as is used in military uniforms. Conventional semi-decating at about 225° F. decreases the thickness of the surface layer by 18% and increases the over-all density of the fabric by about 22%, producing a material useful in slipper linings or the like.

EXAMPLE II

A quantity of 2-inch staple fiber prepared from polyethylene terephthalate in a conventional manner and drawn to 3.35 times its original length and having the capacity to retract 33% of its drawn length when boiled in water is processed on the American system into yarn of 8/1 cotton count, corresponding to about 660 denier. This yarn is woven into a 2 x 2 twill with a count (ends and picks per inch) of 48 x 43. The fabric is scoured, lubricated and treated to raise the surface fibers in the manner described in the above example. A sample of the fabric 43% x 10 inches long is cut from the 10 yards of raised fabric, which is 16% inches wide. This small sample is then sewn to a leader fabric of the same width and loaded on a small "Barotor," which is the rotary dyeing machine described and claimed by Cole in pending patent application Serial No. 289,177 filed May 21, 1952, now abandoned. The fabrics, which have a combined weight of one hundred thirty-nine grams, are scoured ten minutes at 212° F. in one gram per liter solution of sulfonated long-chain alcohols, and dyes with 8.34 grams of Eastman Blue GLF at 250° F. for one hour. The fabrics are scoured for fifteen minutes more at 180° F. and rinsed. The raised polyester fabric shrinks to 37 inches in length and 8 $\frac{3}{4}$ inches in width. The felted fabric is then brushed lightly and sheared on both sides (two passes each) to smooth the surface and finally semi-decated for one minute. The fabric is now very compact but feels soft and resilient, suitable as a high quality overcoating.

EXAMPLE III

A quantity of three-inch nylon staple fiber, manufactured from the polyhexamethylene adipamide described in Carothers Patent No. 2,130,948, is processed on the American system into yarn of 2/32 worsted count, corresponding to about 500 denier. This yarn is woven into a plain weave with fabric count 42 x 38. The fabric is scoured at 100° F., and a 2% aqueous emulsion of a conventional lubricant comprised of phosphated long-chain alcohols is padded onto the fabric under seventy pounds roll pressure. Passage over a double-acting card-wire machine as in Example I raises the surface fibers to an eventual length of from $\frac{1}{4}$ " to $\frac{1}{2}$ ". During the raising process the fabric loses about 35% of its original area. It is passed into a solution containing 26.6% by weight of nitric acid for ten minutes at 70° F. and is then quenched in water, rinsed, and dried. The surface fibers retract during this chemical treatment, as does the fabric generally, losing 20% of the existing area just before the bath treatment. The specific gravity is now about one-

third more than the original value. The resulting product is suitable for conveyor belting or other use where high strength and abrasion resistance are required.

EXAMPLE IV

A quantity of one and one-half inch polyacrylonitrile staple fiber of 1 $\frac{1}{2}$ denier per filament, manufactured according to the process described in Jacobson Patent No. 2,436,926, is mixed thoroughly with an equal quantity of 2 $\frac{1}{2}$ ", 4 $\frac{1}{2}$ denier per filament polyacrylonitrile staple fiber similarly manufactured, both types of fiber having been drawn to four times their original length. The blended fibers are processed on the woolen system into seven-turn per inch Z twist yarn of five-run count, corresponding to about 960 denier. This yarn is woven into a 2 x 2 twill weave with a count of 48 x 42. The fabric is scoured, lubricated, and raised as in Example I, undergoing a shrinkage of 12% in area. The fabric then is immersed in an aqueous solution containing 8.16% cuprous chloride and 6.6% hydrochloric acid by volume and boiled for ten minutes. The fabric is washed in concentrated ammonium hydroxide for five minutes and then rinsed well. This wet processing causes an area shrinkage of 35% and increases the thickness by about 35% and the specific gravity by somewhat over 10%. The product is suitable for a wide variety of uses, from industrial filters and polishing cloths to overcoatings and similar apparel uses.

Many other solvent or near-solvent mixtures or simple compounds are suitable for retracting polyacrylic fabrics. The highly acidic solution used in the above example, while highly effective and quite satisfactory for processing of small lots, is inconvenient for use in conventional textile equipment. Cuprous sulfate solutions in concentrations of about 50 to 100 times the concentration found useful for dyeing according to the cuprous ion technique are quite satisfactory as retracting or shrinking agents. Fabric prepared from polyacrylonitrile fibers subjected to 4X draw lose as much as half their original area in aqueous 6% solution of cuprous sulfate, which may be prepared by addition of 4% hydroxylamine sulfate to 6% cupric sulfate at the boil. Such solution will cause about 2/5 as much area loss in fabrics woven of polyacrylonitrile filaments drawn to eight times their extruded length. Aqueous solutions of dimethylformamide (DMF) also are quite useful for this purpose, although the most effective concentration range is critical, as shown in the following table.

Table I

Concentration of DMF (percent) by volume.	75	81	83	85.
Fabric area loss.....	34.4	48.3	56.5	60.5 (with fusion).

Results similar to those shown in the table can be obtained with tetramethylene sulfone (cyclic) in about the same concentration range. Other suitable treating agents for securing the desired degree of fabric retraction may be selected.

The above examples are drawn to staple fabrics because they are obvious candidates for processing according to this invention. However, continuous filament fabrics may be processed similarly with as good or better results. With conventional fabrics woven from continuous filament yarns, it is necessary either to weave the fabrics loosely enough to permit raising of loops or else to exert enough force to seize and break the filaments at random, to provide the thick nap necessary to form a felt-like cover by retraction. Filament fabrics made of the weaker fiber-forming materials, such as acetate, are particularly suitable because of their susceptibility to breaking during the raising operation.

Bulky continuous filament fabrics of the type described in Breen patent application Serial No. 261,635, filed

December 14, 1951, now Patent No. 2,783,609, are especially suitable in the process of this invention because the tiny loops protruding from the surface of the yarn lend themselves readily to snagging and then raising. These fabrics retain their strength and non-pilling advantages to a large extent even when many of the loops are broken, and the non-woven surface layer produced closely resembles that already disclosed for staple fabrics. The following two examples illustrate the use of the Breen fabrics.

EXAMPLE V

A quantity of continuous filament manufactured from polyacrylonitrile in the conventional manner and drawn to eight times its original length is bulked according to the process described in Breen patent application Serial No. 261,635 filed December 14, 1951. The eighty-filament yarn during bulking undergoes a total denier change from 200 to 240. Two yarns are plied to form a strand with total denier of 480 and five turns per inch S-twist. This is woven into a 2 x 2 twill with a fabric count of 34 x 32. The fabric is scoured, lubricated, and raised as described in the preceding examples, except that the raising operation has the additional effect of pulling and breaking the characteristic loops to leave a multitude of ends extending from one-half to one inch above the fabric surface. The raising produces an area loss of about 40%. Boiling in an 8.16% cuprous chloride-6.6% hydrochloric acid aqueous solution for ten minutes is followed by cuprous ion dyeing with 2% Anthraquinone Blue SWF (Prototype 12) using 3% copper sulfate and 2.5% hydroxylamine sulfate (based upon fabric weight) at the boil for ninety minutes. An additional area loss of 33% occurs during the chemical treatments, while the thickness increases 60%. This fabric has a soft lofty handle and is particularly well adapted for use as heavy suiting or overcoating material.

EXAMPLE VI

A quantity of continuous filament manufactured from polyethylene terephthalate in the conventional manner and drawn to 3.7 times its original length but not relaxed is processed according to the method described in Breen patent application Serial No. 261,635 filed December 14, 1951. The bulking process does not affect the filament's original capacity for retracting 12% of its length when heated to 315° F. The bulked yarn has a total denier of 755. It is woven into a 2 x 2 twill with a count of 46 x 42. The specific gravity of the dry fabric, which is 0.022 inch thick as measured by the method previously mentioned, is 0.54, or about 0.31 ounce per cubic inch. After scouring at 100° F. and padding with a conventional lubricant as previously described, the fabric is raised on the double-action machine described in Example I. The card clothing causes the loops of the yarn to be broken and a nap of about 1/4 inch to be raised evenly on the surface of the fabric, while an area shrinkage of about 20% occurs. A piece of the fabric weighing 55.7 grams is dyed with 2.23 grams of Celanthrene Brilliant Blue FFS (Prototype 228) at a temperature of 212° F. in an aqueous bath of 4450 ml. containing 89.5 grams benzoic acid for a total time of one hour. During the dyeing the fabric increases in thickness and density and decreases in area by about one-third. The weave is completely obscured in the resulting lofty fabric, which is especially adapted to use in suitings and other garment materials.

Although persons skilled in the textile arts use qualitative and subjective methods of evaluating the physical attributes of fabrics both extensively and successfully, as suggested in the examples by terms such as "lofty," it seems desirable to give also some quantitative measure of the characteristics of the fabrics described. What is usually called the "weight" of the fabric can be found easily by measuring the length and width of a rectangular

piece, weighing it, and converting the weight of the piece into ounces per yard length of fabric one yard wide. The density or specific gravity of the fabric may be computed from the weight figure if the thickness is known. However, measurement of thickness is more difficult than determination of length or width because the surface of the fabric is so much less clearly defined than the edge is (for the magnitude of the dimensions involved). Consequently, in conventional thickness measurements, the surface of the fabric is compressed until the distortion sets up a known amount of restoring force before the thickness is determined. A well-known test of this sort is the ASTM (American Society for Testing Materials) D-39-49 method in which a pressure of 3.4 p. s. i. is used. However, this pressure is so great as to give results hardly comparable with many of the subjective methods. A low-pressure test in which only about 1% as much pressure is employed (here, actually 0.075 p. s. i.) is the BSI (British Standards Institution) method described in their Handbook No. 11: "Methods of Test for Fabrics," p. 119 of the 1949 edition. A description of this low-pressure method by Marsh may be found at p. 382 of vol. 6, Journal of Scientific Instruments (1929). The following table gives data obtained by both of these methods for the fabrics of the above examples.

Table II

State of Finish	Weight (oz./yd. ²)	Measured Thickness (Inch)		Computed Specific Gravity	
		ASTM	BSI	ASTM	BSI
Example I:					
Greige.....	8.9	0.025	0.033	0.476	0.357
Raised.....	12.7	0.049	0.091	0.347	0.185
Raised and Retracted.....	16.7	0.061	0.113	0.368	0.199
Raised, Retracted and Pressed.....	16.8	0.050	0.059	0.449	0.380
Example II:					
Greige.....	8.6	0.024	0.029	0.475	0.392
Raised.....	11.9	0.047	0.076	0.336	0.207
Raised and Retracted.....	16.0	0.050	0.055	0.425	0.327
Example III:					
Greige.....	8.7	0.022	0.031	0.536	0.380
Raised.....	11.6	0.043	0.086	0.358	0.179
Raised and Retracted.....	16.5	0.048	0.073	0.459	0.303
Example IV:					
Greige.....	7.3	0.029	0.034	0.333	0.291
Raised.....	7.6	0.050	0.103	0.205	0.099
Raised and Retracted.....	19.0	0.069	0.088	0.376	0.291
Example V:					
Greige.....	6.5	0.019	0.024	0.455	0.361
Raised.....	9.6	0.040	0.057	0.324	0.194
Raised and Retracted.....	11.8	0.038	0.059	0.415	0.267
Example VI:					
Greige.....	3.8	0.022	0.032	0.233	0.160
Raised.....	6.7	0.048	0.099	0.189	0.092
Raised and Retracted.....	15.1	0.081	0.131	0.252	0.156

As shown in this table, the general retraction resulting in loss of fabric area may be accompanied by either an increase or decrease in thickness. The direction and extent of the change are dependent upon many factors, such as the nature of the constituent fibers and the type and tightness of weave. Unknown factors doubtless contribute, but usually the effects of the known factors can be determined by varying the experimental conditions. The high-pressure method of thickness measurement shows a decrease in only one (Example V) of the three Examples III, IV and V, where the low-pressure method indicates a decrease.

In addition to the uses already mentioned, fabrics treated according to this invention are useful for table covers, filters, upholstery, blankets, and many other apparel and industrial uses. Wherever bias-cut fabrics are used, the treatment described is quite effective in preventing ravelling of the yarn ends. The advantages of such simple processing to obtain the many desirable features of the materials described are obvious. Suitable blends of retractable and non-retractable fibers may be chosen to accommodate particular end-use requirements. The availability of woven felt-like materials composed entirely of synthetic fibers characterized by high abrasion

and chemical resistance and by superior tensile strength enables conventional materials to be diverted to other uses where these attributes are not critical. Many other advantages inherent in this invention will be apparent to those skilled in the textile arts.

Since many different embodiments of the invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited by the specific illustrations except to the extent defined in the following claims.

What is claimed is:

1. The process for preparing a non-woven felt-like cover on a strand constructed fabric which comprises raising a thick nap on a strand constructed fabric composed of a major proportion of synthetic fibers capable of retracting at least 12% in length and then treating the fabric to at least the point of retraction of the retractable fibers but less than the bonding point of any fiber in said fabric to retract the retractable fibers and compact the nap into a felt-like layer of mechanically entangled fibers on the surface of the strand constructed fabric.

2. The process for preparing a non-woven felt-like cover on a strand constructed fabric which comprises treating the surface of a strand constructed fabric, composed of synthetic fibers capable of retracting at least 12% in length, to raise a nap sufficient to double the original thickness of the fabric and then treating the fabric to at least the point of retraction of the retractable fibers but less than the bonding point of any fiber in said fabric to retract the retractable fibers and compact the nap into a felt-like layer of mechanically entangled fibers on the surface of the strand constructed fabric.

3. A process as defined in claim 1 in which the fabric is treated by heating the fabric between 95° and 200° C.

4. A process as defined in claim 1 in which the fabric is treated by soaking the fabric in a swelling agent.

5. A process for preparing a non-woven felt-like cover on a strand constructed fabric which comprises raising a thick nap on a fabric strand constructed from continuous filaments capable of retracting at least 12% in length and then treating the fabric to at least the point of retraction of the retractable fibers but less than the bonding point of any fiber in the fabric to retract the retractable fibers and compact the nap into a felt-like layer of mechanically entangled fibers on the surface of the strand constructed fabric.

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