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WOVEN FABRICS

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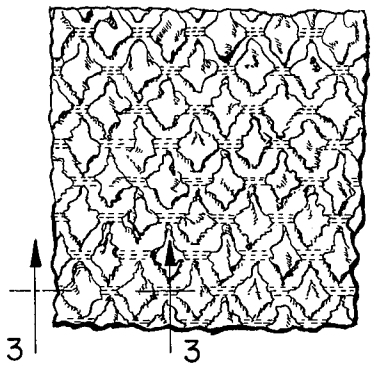

FIG. -1-

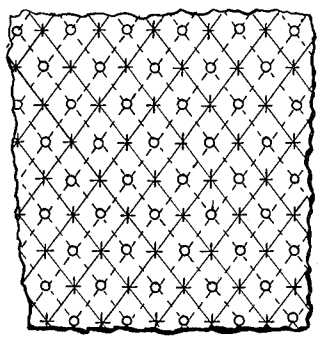

FIG. -4-

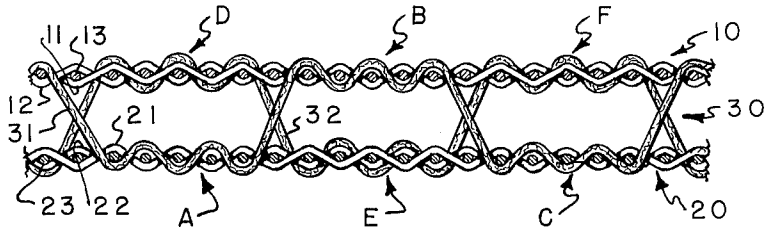

FIG. -2-

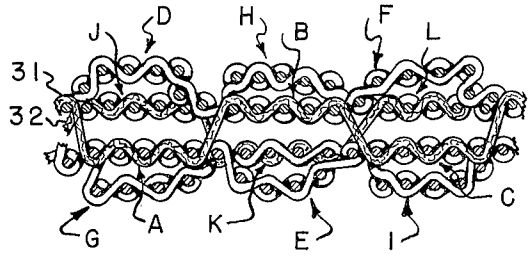

FIG. -3-

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WOVEN FABRICS

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This invention relates to new and novel fabric constructions, especially to fabric constructions having improved surface characteristics. In particular, it relates to corrugated multiple-ply woven fabric constructions possessing, among other properties, outstanding resiliency or stretch.

Fabrics having three-dimensional surface characteristics are known to workers of the art. Such fabric constructions are generally woven from yarns possessing different shrinkage characteristics. These fabrics are then post treated or processed to produce shrinkage. Because of the differential shrinkage characteristics of the individual yarns constituting the fabric the shrinkage produces three-dimensional or corrugated surface characteristic. These fabrics provide good properties of insulation, and can e.g. be used in clothing. Unfortunately, however, such usage greatly limits the wearers' freedom of movement; far beyond that provided a wearer of non plied fabric constructions.

For this reason, among others, the usage of multi-ply fabrics is greatly restricted. What is needed are multi-ply fabric constructions which possess greater resiliency and elasticity to allow, among other things, greater freedom of movement.

Accordingly, it is a primary objective of the present invention to provide multi-ply fabrics having such desirable characteristics.

In particular, it is an object to provide durable, resilient or elastic corrugated fabrics which upon being deformed by compressive or tensile forces are capable of returning repeatedly to their original shape after removal of the deforming forces. It is also an object to provide such fabrics possessing extremely good insulating properties, useful against heat or cold. These objects and others will be apparent in view of the following description of the invention.

The fabric constructions contemplated in accordance with this invention are multiple-ply fabrics or fabrics having a plurality of plied fabric layers, including a layer of essentially non-elastic or inelastic yarns and a layer or ply of essentially elastic fibers capable of shrinkage by post treatment with heat after fabrication but which elastic yarns nevertheless retain the properties of resiliency and stretch after such treatment of the fabric. Moreover, these plied fabric constructions are retained together by a weave of the elastic yarns with the fabric composed of the inelastic yarns, the elastic yarns being woven into the ply of inelastic yarns at discrete locations of attachment spacially separated from other locations of attachment to leave relatively wide areas of non-attachment. Thus, the ply of elastic yarns attached at relatively few locations float on one surface of the ply of inelastic yarns to which it is bound by the construction of composite fabrics. In this manner a corrugated effect is produced in the ply of inelastic yarns by the post heat treatment to cause shrinkage of the elastic yarns and a puckering or outward displacement of the ply of inelastic yarns at the locations of non-attachment. Various designs and effects can be produced as regards the surface characteristics of the ply of inelastic yarns, and the resultant bulked fabric or cloth will remain highly flexible or elastic.

A preferred embodiment of the invention contemplates, in particular, a multiple-ply woven fabric construction having outer plies of inelastic fibers retained together by

an inner weave of elastic yarns which attach with the plies composed of the inelastic yarns at locations spacially separated one from another. A highly useful and especially desirable construction of this type contemplates a two-ply woven fabric construction having two outer fabric layers of essentially inelastic yarns, these being retained together by a weave of elastic yarns which attaches at spacially separated locations with both the outer fabric layers composed of inelastic yarns.

The contemplated constructions of the elastic yarns range from about 2 to about 65 percent by weight, based on the total weight of the fabric. Preferably, however, the elastic yarns constitute from about 5 to about 15 percent of the overall weight of the fabric.

The invention will be better understood by reference to the following detailed description and to the attached drawings which specifically described preferred embodiments.

In the drawings:

FIGURE 1 is a top plan view of a post heat treated multi-ply fabric construction;

FIGURE 2 is an expanded sectional or edge view of a two-ply fabric construction prior to any post heat treatment to effect shrinkage;

FIGURE 3 is an expanded sectional view taken along section 3—3 of FIGURE 1 and is similar to the fabric construction shown in FIGURE 2 but differs therefrom only in that it has been post heat treated to effect shrinkage of the elastic fibers;

FIGURE 4 is a schematic diagram showing formation of a diamond shaped pattern in a three-ply fabric construction.

The following numerical reference to individual filler yarns, whether elastic or inelastic, is intended in generic sense. Letters are used to designate characteristic areas or segments formed on the surfaces of the fabric in accordance with the invention.

Referring to FIGURES 1–3, and especially to FIGURE 2, is shown a two-ply fabric construction embodying an upper ply **10** and lower ply **20**, these plies **10**, **20** being retained together by elastic yarns or threads constituting in effect a third or inner ply **30**.

In such construction the upper ply **10** is constituted of filler yarns **11**, **12** with warp yarns **13** and the lower ply **20** is constituted of filler yarns **21**, **22** with warp yarns **23**. These plies **10**, **20** are retained or laced together by elastic yarn **31** which is attached at certain discrete segments or locations within upper ply **10** and lower ply **20**. Thus, it will be noted that the elastic yarn **31**, from a location of attachment with upper ply **10**, descends downwardly and passes around and over, then twice under and over the filler yarns **23** of the lower ply **20** as shown at segment A. The elastic yarn **31** then ascends and passes around and over, then twice under and over the warp yarns **13** at segment B to attach to upper ply **10**. This method of attachment is repeated over and over to produce the desired locations of attachment and non-attachment. Thus, at segment C the elastic yarn **31** attaches to lower ply **20** as at segment A. In the same plane defined by elastic yarn **31** and in both upper ply **10** and lower ply **20** will also be observed segments of non-attachment D, E, and F. The segments D, E, and F, locations of non-attachment, upon shrinkage of the elastic yarn **31** by post heat treating (FIGURE 3), pucker or deform outwardly to craete a corrugated or other surface effect.

In similar vein it will be observed that if in another distinct plane formed as along the line of passage of an elastic yarn **32** through the upper ply **10** and lower ply **20**, but 180° out of phase with elastic yarn **31**, other puckers can be formed, these puckers being in different phase from segments D, E, and F. Such effect is clearly shown by reference to FIGURE 3.

In FIGURE 3 is shown puckered segments D, E, and F formed by shrunken elastic yarn **31** attached at segments A, B, and C. Shown also in this figure, and lying in another plane, are puckered segments G, H, and I formed by attachment of the yarn **32** at segments J, K, and L. FIGURE 3 thus differs from FIGURE 2 only in that the elastic yarns **31, 32** have shrunken as a result of having been post heat processed, as by treatment in an oven or in hot water so as to produce said shrinkage. It is thus seen that shrinkage at the discrete segments of multi-ply points of attachment maintain the relative rigidity of the segment while, in sharp contrast, at the segments of non-attachment the outer ply **10, 20** are raised to produce corrugated or puckered effects. It will be apparent to one knowledgeable in the art that numerous patterns can be produced by selection of various locations of attachment and non-attachment.

Thus it is readily seen that the shrunken elastic yarns, that are attached to each of the plies of inelastic yarns, as for example by weaving, at spaced locations, displace outwardly the locations to which the elastic yarns are not attached, so as to form a puckered effect at the outer faces of the fabric.

In FIGURE 1 specifically is affected a diamond shaped pattern, the cloth having been woven pursuant to the principles herein described and then post heat treated. The locations of attachment are shown in this plan diagram as dotted lines lying at the four corners of each of the "diamonds." Except at the four corners of attachment the upper layer of fabric (the side shown) puckers outwardly, as small hollow pockets. On the opposite side of this fabric (the side not shown) and lying at the center of each of the diamonds of the side shown are centers of attachment (not shown) between the elastic yarns and a lower fabric layer. These corners of attachment also define puckered diamonds on the opposite face of the cloth, similar to that of the side shown. The diamond shapes on the two faces are thus similar but out of phase.

A procedure for preparing a two-ply fabric construction having a diamond pattern on each face of the fabric is thus shown by reference to the schematic diagram of FIGURE 4. In the simplified figure the upper and lower plies of cloth are not shown except in an outline representing the metes and bounds of a "transparent" fabric. In such fabric construction is shown only parallel series of lines representing elastic yarns lying between the upper and lower plies of fabric; and, lying along these lines, crosses and circles representing points of attachment of the elastic yarns with the upper or lower plies. The crosses represent points of attachment with the upper ply and the small circles represent points of attachment with the lower ply. The lines connecting the crosses and circles, unbroken and dotted lines, respectively, are used to show the outline of diamond shapes upon the upper or lower face respectively. It will be apparent that a true corrugated effect can be produced, for example, by a construction wherein all points of attachment, in the upper or lower plies, respectively, are not out of phase, but placed one behind the other.

It is of course clear that two or more plies of fabric, such as 3 plies, 4 plies, 5 plies, 6 plies, etc. can be attached together in keeping with the scope and spirit of the present invention. Moreover, various designs can be created by use of different phase relationships between the different points or locations of attachment.

A specific mode of practicing the invention is given by the following example.

Example

A fabric was woven on a Crompton & Knowles W–III automatic loom using 106 ends per inch and 120 picks per inch. The warp yarn was 25/2 (cotton count), 50% rayon and 50% acetate yarn spun with 15.3 "Z" turns per inch in the singles and 11.0 "S" turns per inch in the ply. The filling yarns were full picks of the same material as the warp yarns but included two picks of textured stretch nylon yarn, two ply 70 denier-17 filament produced with 0 turns of "S" torque and 0 turns of "Z" torque plied together with 5 turns of "S" twist. The fabric was woven with a reed width of 65.8 inches, 4 ends per dent, and 26.5 dents per inch. The warp tension employed was 87 grams per 50 ends. The harness crossing was 5 teeth back of center with medium speed at start, slow speed at crossing, and medium speed at stop. The greige width was 64⅛ inches.

After the fabric had been woven it was treated for 20 minutes by immersion in hot water at 56°C. after which time it was removed from the water and dried. The fabric was found to be highly satisfactory as a three dimensional insulating fabric and was found to possess exceedingly superior properties of resiliency and stretch.

It is apparent that some variations can be made without departing the spirit and scope of the invention. A feature of the invention resides in the use of special texturized yarns in the weaving together of the plies of inelastic yarns, which textured yarns possess the ability to shrink upon post heat treatment to provide fabrics with raised surface areas, puckers, or hollow air spaces for insulation qualities and appearance, but yet, which retain sufficient elasticity to provide a comfortable amount of stretch. It is of course apparent that fabrics could be constructed with elastic yarns in a stretched taut condition and afterwards relaxed to provide some of the advantages of this invention, and such constructions are considered within the spirit and scope hereof.

Numerous non-elastic fibers are known to the art and are suitable for the practice of this invention. Illustrative of non-elastic or substantially non-elastic fibers suitable for such use include cotton, rayon, Dacron, nylon, Orlon, acetate, Acrilan, Creslan, Dynel, Fortrel, Kodel, wool and the like. Likewise numerous textured or elastic yarns are known, and are suitable for the fabric constructions of the present invention including e.g. crimped nylon, polyurethane and the like.

The woven fabric after its fabrication is subjected to a thermal treatment to shrink or partially shrink the elastic fibers. This involves transferring heat into the elastic yarn by any known wet or dry method, but preferably the fabric is immersed in hot water, over 75° F.. It is understood, of course, that the shrinkage characteristics of various fibers differ and require various temperature-time relationships. As examples, the spandex yarns generally develop best at a temperature ranging from about 100 to about 140° F.; nylon from about 140 to about 160° F.; and Dacron at from about 180 to 212° F. Generally the yarns require only about 10 to 30 minutes for sufficient shrinkage.

Having described the invention, what is claimed is:

1. As an article of manufacture, a woven fabric construction of at least two plies, having outer woven plies of inelastic yarns, these plies being retained together by a weave therewith of shrunken elastic yarns, each of the shrunken elastic yarns being woven into each of the plies of inelastic yarns at spaced locations so that the shrunken elastic yarns in each of the inelastic plies into which they were woven displace outwardly the locations to which they are not woven so as to form a puckered effect at the outer faces of the fabric.

2. The multi-ply article of manufacture of claim **1** further characterized in that the points of attachment on adjacent plies of inelastic material are one behind the other.

3. The multi-ply article of manufacture of claim **1** further characterized in that the points of attachment on one ply of inelastic material form straight diagonal lines and the points of attachment on an adjacent ply of inelastic materials form straight diagonal lines that are out of phase with the first said lines.

4. The multi-ply article of manufacture of claim 3 wherein the attached points define a diamond on at least one face of the material.

5. The multi-ply article of manufacture of claim 2 further characterized in that the points of attachment define corrugated surface on at least one face of the material.

6. The multi-ply article of manufacture of claim 1 further characterized in that the elastic yarns constitute from 2 to about 65% by weight, of the total weight of the fabric.

7. The multi-ply article of manufacture of claim 1 further characterized in that the elastic yarns constitute from 5 to 15% by weight of the total of the fabric.

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