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SPACER FABRICS AND METHOD OF MAKING THEM

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2 Sheets-Sheet 1

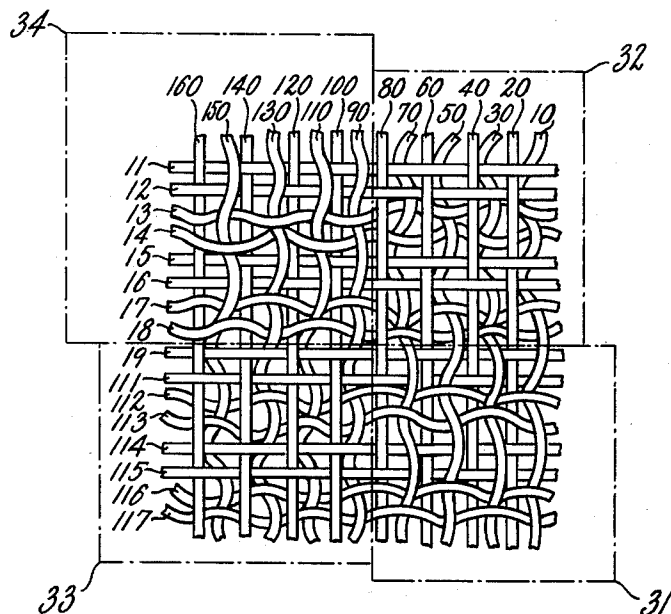


Fig. 1

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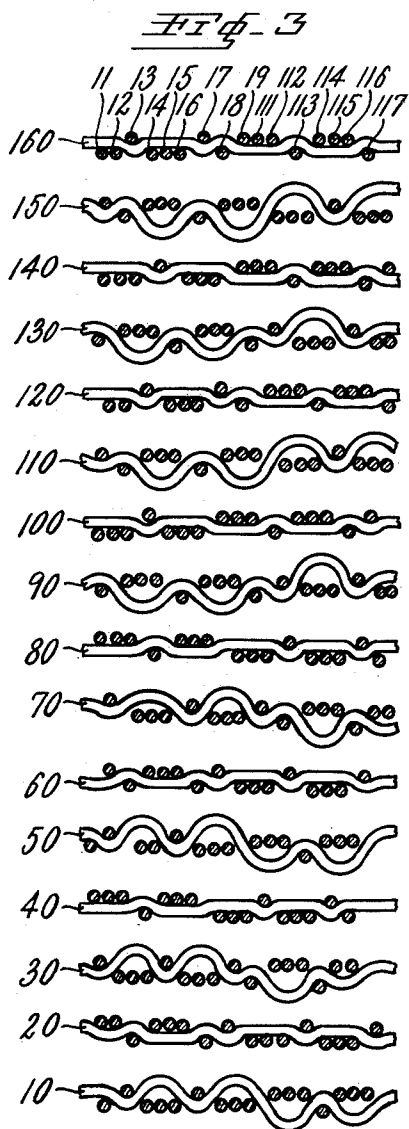
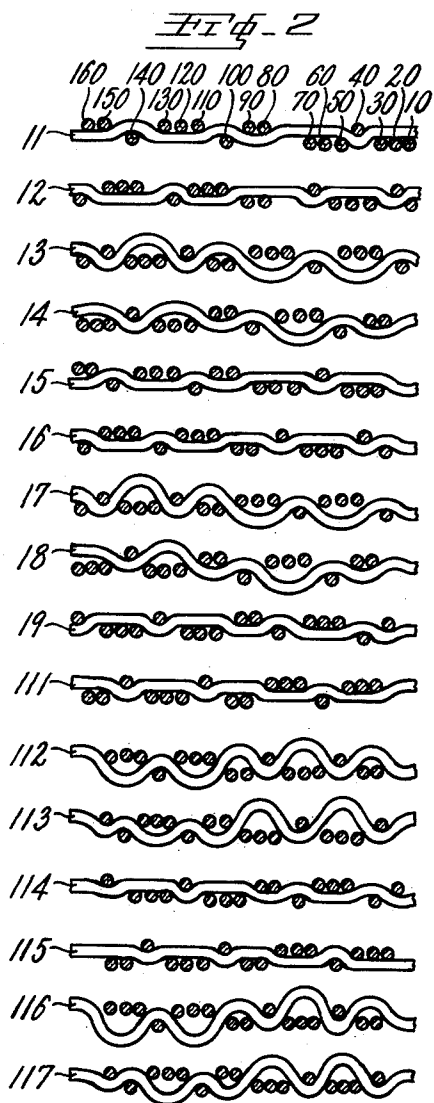
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SPACER FABRICS AND METHOD OF MAKING THEM

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13 Claims. (Cl. 28—72)

In United States Patent Re. 24,007 to Foster there are disclosed and claimed multi-ply fabrics. This invention relates to a novel multi-ply fabric and to a method of making the same.

In the fabric of this invention, the yarns in one direction, referred to herein for convenience as the longitudinal direction, of the fabric are divided into two groups. Those yarns in the first of these groups shrink a relatively great amount when subjected to a given shrinking treatment; the longitudinal yarns in the other group shrink at least 15% less than the longitudinal yarns in the first group under the given shrinking treatment.

Crossing yarns are interlaced with the longitudinal yarns in the aforesaid groups. The crossing yarns similarly are divided into two groups. The crossing yarns in the first group shrink a relatively great amount when subjected to the given shrinking treatment; the crossing yarns in the second group shrink at least 15% less than the crossing yarns in the first group under this shrinking treatment.

The fabric is divided into discrete areas. In any given area, the high shrink longitudinal yarns and the high shrink crossing yarns are disposed on the same side of the low shrink crossing yarns and the low shrink longitudinal yarns, respectively. Substantially all of the high shrink longitudinal yarns and of the high shrink crossing yarns in the given discrete area float over a plurality of low shrink crossing yarns and low shrink longitudinal yarns, respectively.

At the borders of the discrete areas, the high shrink longitudinal yarns and the high shrink crossing yarns pass from one side to the other side of the low shrink crossing yarns and the low shrink longitudinal yarns respectively, so that in the contiguous areas surrounding any given discrete area in the high shrink longitudinal yarns and the high shrink crossing yarns appear on the side of other low shrink crossing yarns and other low shrink longitudinal yarns, respectively, which is opposite from the side of the low shrinking crossing yarns and the low shrink longitudinal yarns they appear on at the given discrete area.

Thus at any given area of the fabric the high shrink longitudinal and crossing yarns will be at one surface of the fabric, and in the contiguous areas the low shrink longitudinal and crossing yarns will be at that surface of the fabric. In the given area the low shrink longitudinal and low shrink crossing yarns will be at the other surface of the fabric, and in the contiguous areas of that other surface the high shrink longitudinal and high shrink crossing yarns will be situated.

This fabric is shrunk, and the low shrink yarns buckle between the points where they pass from one side to the other of the high shrink yarns to produce a very thick spacer fabric.

For a better understanding of the nature of this invention, reference should be had to the following detailed description of a specific embodiment thereof, when read in conjunction with the accompanying drawing forming a part hereof, wherein:

FIG. 1 is a schematic plan view illustrating the interlacings of the yarns in a fabric in accordance with this invention;

FIG. 2 is a somewhat schematic view of the several yarns in one repeat of the pattern extending in one direc-

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tion of the fabric of FIG. 1 and showing their interlacings with the crossing yarns, and

FIG. 3 is a somewhat schematic view of the crossing yarns showing their interlacings with the yarns of FIG. 2 in one repeat of the pattern of the fabric of FIG. 1.

Referring now to the drawing, there is shown a woven embodiment of a fabric in accordance with this invention comprising warp yarns 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150 and 160 extending in parallel in one direction of the fabric, and interlaced weft yarns 11, 12, 13, 14, 15, 16, 17, 18, 19, 111, 112, 113, 114, 115, 116 and 117 extending in parallel in the other direction of the fabric and interlaced with the warp yarns in a manner to be described. The fabric illustrated forms one repeating unit with the 16 warp yarns and the 16 weft yarns shown.

Selected warp yarns, namely 20, 40, 60, 80, 100, 120, 140 and 160 and selected weft yarns, namely 11, 12, 15, 16, 19, 111, 114 and 115 are capable of shrinking a relatively great amount under a given shrinking treatment. Preferably these yarns are heat shrinkable synthetic yarns which shrink at elevated temperatures an amount from 15% to 60% of their original length. Many heat shrinkable synthetic yarns having relatively high shrinkages at elevated temperatures, and which consequently are well suited for these yarns, are well known in the textile art. Examples of fibers from which such yarns are made are: branched polyethylene (an oriented polymerized ethylene), as distinguished from the so-called "linear" polyethylene; Rhovyl (polyvinyl chloride); saran (a copolymer of vinylidene chloride and vinyl chloride), the so-called high shrink type; Verel II (acrylonitrile copolymer); etc. In general the foregoing fibers will shrink a substantial amount at temperatures at or below the boil (212° F.) and are eminently suitable for the relatively high shrink yarns required by the fabrics of this invention. Other high shrink yarns are well known which will shrink an equivalent amount at higher temperatures, e.g. yarns formed of blends of branched and linear polyethylene, and they may be used in this invention with a suitable shrinking treatment.

Extending unidirectionally with the high shrink warp yarns 20, 40, etc., are other warp yarns 10, 30, 50, 70, 90, 110, 130 and 150 which shrink at least 15% less than the high shrink yarns at the given shrinking treatment. Extending unidirectionally with the high shrink weft yarns 11, 12, etc., are other weft yarns 13, 14, 17, 18, 112, 113, 116 and 117 which shrink at least 15% less than the high shrink yarns under the given shrinking treatment.

Many yarns are well known to the textile art which are suitable for the low shrink warps and wefts in the fabric shown. If the high shrink yarns 20, 40, etc., and 11, 12, etc., are the preferred heat shrinkable synthetic yarns, the low shrink warp yarns 10, 30, etc. and the low shrink weft yarns 13, 14, etc. may be yarns which have low shrinkage at the given elevated temperature shrinking treatment. For example, if the heat shrinking treatment is to be a shrinkage in boiling water, and one of the yarns hereinabove mentioned which shrinks the requisite amount under this treatment is selected for the heat shrinkable synthetic yarns, the following fibers may be used for the low shrink yarns: nylon; saran—the so-called "regular" type; Dacron (an oriented polyester of terephthalic acid with ethylene glycol); etc.

In the embodiment shown in the drawing, it will be noted that one high shrink yarn alternates with one low shrink yarn in the warp direction of the fabric whereas in the weft direction of the fabric two high shrink yarns alternate with two low shrink yarns. If desired one high shrink weft may alternate with one low shrink weft, al-

though this would require a pick and pick loom to weave the fabric.

The low shrink warp yarns 10, 30, 50 and 70 float first on one side of a plurality of high shrink weft yarns 115, 114, 111 and 19 in one discrete area 31 of the fabric, and at the contiguous discrete area 32 float on the other side of a plurality of high shrink weft yarns 16, 15, 12 and 11. Similarly the low shrink weft yarns 117, 116, 113 and 112 float on the same side of a plurality of high shrink warp yarns 20, 40, 60 and 80 in the discrete area 31 with the low shrink warp yarns 10, 30, etc.

At the contiguous discrete area 33 the low shrink weft yarns 117, 116, 113 and 112 float on the other side of a plurality of high shrink warp yarns 100, 120, 140 and 160.

Similarly at the discrete area 32, other low shrink weft yarns 18, 17, 14 and 13 float on the same side of a plurality of high shrink warp yarns 20, 40, 60 and 80 as the low shrink warp yarns 10, 30, etc.; and in the adjacent discrete area 34 the low shrink weft yarns 18, 17, 14 and 13 float on the other side of a plurality of high shrink warp yarns 100, 120, 140 and 160.

Similarly additional low shrink warp yarns 90, 110, 130 and 150 float on the same side of high shrink weft yarns 115, 114, 111 and 19 as the low shrink weft yarns 117, 116, 113 and 112. In the contiguous discrete area 34 the low shrink warp yarns 90, 110, 130 and 150 pass to the other side and float over a plurality of high shrink weft yarns 16, 15, 12 and 11 on the same side with low shrink weft yarns 18, 17, 14 and 13.

In the embodiment shown, the interlacing plan is such that if the high shrink warp and weft yarns were all removed, the remaining low shrink warp and weft yarns would be found to interlace with each other in a plain weave. Conversely, if all of the low shrink warp and weft yarns were removed, the remaining high shrink warp and weft yarns would interlace with each other in a plain weave also.

The fabric is divided into a multiplicity of discrete areas, e.g. 31, 32, 33 and 34, etc. In any given discrete area, e.g., 31, the high shrink longitudinal yarns, 20, 40, 60 and 80 and the high shrink crossing yarns, 115, 114, 111 and 19 are disposed on the same side of the low shrink yarns, i.e., in area 31 the reverse side as seen in FIG. 1, of the low shrink crossing yarns, 117, 116, 113 and 112 and the low shrink longitudinal yarns, 10, 30, 50 and 70 respectively. Each of the high shrink yarns in each discrete area floats over a plurality of, in the embodiment shown four, low shrink orthogonal yarns.

At the upper and lower border of discrete area 31 the high shrink longitudinal yarns 80, 60, 40 and 20 pass to the other side of the low shrink crossing yarns. Thus, where the high shrink longitudinal yarns appeared in area 31 under the four low shrink crossing yarns, in the area 32 immediately above area 31, they appear above the four low shrink crossing yarns 18, 17, 14 and 13. Similarly, on the left and right borders of area 31, the high shrink crossing yarns 115, 114, 111 and 19 which in area 31 appear under the low shrink warp yarns pass to the face of the fabric seen in the drawing to float over a plurality of low shrink longitudinal yarns. In the discrete area 33, yarns 115, 114, 111 and 19 float over four yarns 90, 110, 130 and 150.

Thus in the discrete area 31 the low shrink yarns float primarily on the face of the fabric seen in the drawing, and in the contiguous area 33 [and in the contiguous area (not shown) to the right of area 31] and in the contiguous area 32 [and in the contiguous area (not shown) beneath area 31] the low shrink yarns float on the back of the fabric as seen in FIG. 1.

The fabric illustrated generally has a checkerboard appearance, but it will appear to have twill lines of puffs extending diagonally through areas 31 and 34 from lower left to upper right and the puff of discrete area 31 will appear to be connected to the next puff at each corner along the diagonal because low shrink yarn 10 interlaces

with low shrink yarn 112 and low shrink yarn 18, of two different discrete areas, at the same side of the high shrink yarns before passing to the reverse side. The reverse side of the fabric will appear to have a twill line of puffs which runs through the point that is the lower left-hand corner of area 33 and through the point which is the upper right-hand corner of discrete area 32.

The fabric so produced, as it is received from the loom is subjected to a suitable shrinking treatment to contract the high shrink warp and weft yarns. Upon contraction of the high shrink warp and weft yarns, the low shrink yarns are buckled alternately on opposite surfaces of the fabric so that any given warp or weft low shrink yarn is spaced a substantial distance from the high shrink yarns first on one surface of the fabric and then is spaced a substantial distance from the high shrink yarns but on the other surface of the fabric.

The following specific embodiment will further illustrate the fabric of this invention. A fabric was woven with the weave shown in the drawing with an average of 21.2 warp yarns per inch of .010" monofilament so-called regular saran and an average of 21.2 warp yarns per inch of .008" monofilament so-called branched polyethylene. These warp yarns were interlaced with an average of 13.5 wefts per inch of .010" monofilament so-called regular saran and with an average of 13.5 wefts per inch of .008" monofilament so-called branched polyethylene. The fabric as it came from the loom weighed 5.08 ounces per square yard; the saran weft crimp and the polyethylene weft crimp each was 3%, the saran warp crimp was 8% and the polyethylene warp crimp was 4%. The fabric was 0.0608" thick at 0.1 pound per square inch applied load.

The fabric received from the loom was immersed in hot water at a temperature of from 186-189° F. and shrinkage in the warp direction was controlled so as to permit it to shrink 20% in the warp direction. After the fabric was removed from the first shrinking bath, it was re-immersed in boiling water (approximately 205° F.) and its shrinkage was controlled to permit it to shrink an additional 25% of its original length (approximately 31% of its length after the first shrinking treatment). During both shrinking operations, the shrinkage in the weft direction was not controlled.

After this treatment it was found the fabric had shrunk 44% in length (compared with a theoretical of 45%), and had shrunk 48% in width. The fabric, after shrinking, weighed 16.7 ounces per square yard, its thickness at 0.1 pound per square inch applied load was 0.166", its compressibility and resilience (measured as specified in Patent Re. 24,007) was 13.1% and 52.1% respectively, and its air permeability measured according to the method of ASTM test D737-46 was 597 cubic feet per square foot per minute at .1" of water.

The resultant fabric is a light, open weight fabric of great thickness. It resembles somewhat a checkerboard on each surface of the fabric, in which one square of the checkerboard is formed of puffed or corrugated interlaced warp and weft low shrink yarns, and the contiguous squares are flat areas of high shrink yarns. The area which is a flat square on one surface of the fabric is a puffed or corrugated square on the other surface of the fabric.

Preferably the low shrink yarns are monofilament synthetic yarns having a cross sectional dimension of from .001" to .050", e.g. a round yarn with this diameter, or an oval yarn with a major axis less than .050" and a minor axis greater than .001", to give the fabric the resultant compressibility and resilience desired for a spacer fabric.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A fabric which comprises, first shrinkable yarns extending in one direction of the fabric, other yarns extending unidirectionally with said first shrinkable yarns, said other yarns being such that they will be longer by at least

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15% of their original length in the fabric than said first shrinkable yarns after a given shrinking treatment, crossing shrinkable yarns crossing said first shrinkable yarns, additional crossing yarns extending unidirectionally with said crossing shrinkable yarns, said additional crossing yarns being such that they will be longer by at least 15% of their original length in the fabric than said crossing shrinkable yarns after said given shrinking treatment, said first shrinkable yarns floating over a plurality of said additional crossing yarns first on a first side of said crossing yarns and then floating over a plurality of said additional crossing yarns on a second side of said crossing yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said additional crossing yarns, said crossing shrinkable yarns floating over a plurality of said other yarns first on said first side of said other yarns and then floating over a plurality of said other yarns on said second side of said other yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said other yarns, whereby said other yarns and said additional crossing yarns are capable of being buckled when said fabric is subjected to said given shrinking treatment to produce a spacer fabric.

2. A fabric which comprises, first heat shrinkable synthetic yarns extending in one direction of the fabric, other monofilament yarns extending unidirectionally with said first shrinkable yarns, said other yarns being such that they will be longer by at least 15% of their original length in the fabric than said first shrinkable yarns after a given shrinking treatment, crossing heat shrinkable synthetic yarns crossing said first shrinkable yarns, additional monofilament crossing yarns extending unidirectionally with said crossing shrinkable yarns, said additional crossing yarns being such that they will be longer by at least 15% of their original length in the fabric than said crossing shrinkable yarns after said given shrinking treatment, said first shrinkable yarns floating over a plurality of said additional crossing yarns first on a first side of said crossing yarns and then floating over a plurality of said additional crossing yarns on a second side of said crossing yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said additional crossing yarns, said crossing shrinkable yarns floating over a plurality of said other yarns first on said first side of said other yarns and then floating over a plurality of said other yarns on said second side of said other yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said other yarns, said fabric being divided into a multiplicity of discrete areas, said first shrinkable yarns and said crossing shrinkable yarns passing from one side to the other of said additional crossing yarns and said other yarns respectively at the boundaries of said discrete areas, said first shrinkable yarns and said crossing shrinkable yarns being disposed at the same side of said additional crossing yarns and said other yarns within said discrete areas, whereby said other yarns and said additional crossing yarns are capable of being buckled when said fabric is subjected to said given shrinking treatment to produce a spacer fabric.

3. A fabric in accordance with claim 2 wherein said first shrinkable yarns and said crossing shrinkable yarns interlace with each other where they appear on the same side of the fabric in said discrete areas.

4. A fabric in accordance with claim 3 wherein the first shrinkable yarns and the crossing shrinkable yarns interlace with each other in a plain weave, said other yarns and said additional crossing yarns interlace with each other in a plain weave, and wherein each shrinkable yarn in the fabric floats over four less shrinkable yarns repeatedly on one side and then the other of the fabric along its length.

5. A fabric which comprises, first shrunk yarns extending in one direction of the fabric, other yarns extending unidirectionally with said first shrunk yarns, said

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other yarns being longer by at least 15% of their original length in the fabric than said first shrunk yarns, crossing shrunk yarns crossing said first shrunk yarns, additional crossing yarns extending unidirectionally with said crossing shrunk yarns, said additional crossing yarns being longer by at least 15% of their original length in the fabric than said crossing shrunk yarns, said first shrunk yarns floating over a plurality of said additional crossing yarns first on a first side of said crossing yarns and then floating over a plurality of said additional crossing yarns on a second side of said crossing yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said additional crossing yarns, said crossing shrunk yarns floating over a plurality of said other yarns first on a first side of said other yarns and then floating over a plurality of said other yarns on a second side of said other yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said other yarns, said other yarns and said additional crossing yarns being buckled by the shrinking of said shrunk yarns.

6. A fabric which comprises, first heat shrunk synthetic yarns extending in one direction of the fabric, longitudinal synthetic monofilament yarns extending unidirectionally with said first heat shrunk synthetic yarns, said synthetic monofilament yarns being longer by at least 15% of their original length in the fabric than the first synthetic yarns, crossing heat shrunk synthetic yarns crossing said first heat shrunk synthetic yarns, crossing monofilament synthetic yarns extending unidirectionally with said crossing heat shrunk synthetic yarns, said crossing monofilament yarns being longer by at least 15% of their original length in the fabric than the first crossing synthetic yarns, said first heat shrunk synthetic yarns floating over a plurality of said crossing monofilament synthetic yarns first on a first side of said crossing monofilament synthetic yarns and then floating over a plurality of said crossing monofilament synthetic yarns on a second side of said monofilament synthetic yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said crossing monofilament synthetic yarns, said crossing heat shrunk synthetic yarns floating over a plurality of said longitudinal monofilament synthetic yarns first on a first side of said longitudinal monofilament synthetic yarns and then floating over a plurality of said longitudinal monofilament synthetic yarns on a second side of said monofilament synthetic yarns and passing back and forth in this way repeatedly along their length to a first side and then to a second side of said longitudinal monofilament synthetic yarns, said fabric being divided into a multiplicity of discrete areas, said first shrunk synthetic yarns and said crossing shrunk synthetic yarns passing from one side to the other of said crossing monofilament synthetic yarns and said longitudinal monofilament synthetic yarns respectively at the boundaries of said discrete areas, said first shrunk synthetic yarns and said crossing shrunk synthetic yarns being at the same side of said crossing monofilament synthetic yarns and said longitudinal monofilament synthetic yarns within said discrete areas, said first shrunk synthetic yarns and said crossing shrunk synthetic yarns being interlaced with each other where they appear on the same side of the fabric in said discrete areas and said longitudinal monofilament synthetic yarns and said crossing monofilament synthetic yarns being interlaced with each other where they appear on the same side of the fabric in said discrete areas, said monofilament synthetic yarns being buckled by the shrinking of said heat shrunk synthetic yarns.

7. Fabric in accordance with claim 6 wherein said monofilament yarns have a cross sectional dimension of from .001" to .050".

8. Fabric in accordance with claim 7 wherein the first

shrunk yarns and the crossing shrunk yarns interlace with each other in a plain weave, the longitudinal monofilament yarns and said crossing monofilament yarns interlace with each other in a plain weave and wherein each said shrunk yarn in the fabric floats over four said monofilament yarns repeatedly on one side and then the other of the fabric along its length.

9. Fabric in accordance with claim 8 wherein the first shrunk yarns and said crossing shrunk yarns are monofilaments.

10. The method of producing a fabric which comprises weaving heat shrinkable synthetic warps with alternate monofilament synthetic warps, said monofilament synthetic warps being such that they will be longer by at least 15% of their original length in the fabric than said heat shrinkable synthetic warps after a given shrinking treatment, interlacing heat shrinkable synthetic wefts and additional monofilament synthetic wefts, said monofilament synthetic wefts being such that they will be longer by at least 15% of their original length in the fabric than said heat shrinkable synthetic wefts after said given shrinking treatment, interlacing said warps and said wefts to produce a multiplicity of discrete areas in the fabric at each of which said monofilament synthetic warps and said monofilament synthetic wefts appear at the same side of the fabric and in which areas substantially all of said monofilament synthetic warps and said monofilament synthetic wefts float over a plurality of said heat shrinkable synthetic wefts and said heat shrinkable synthetic warps respectively, passing said monofilament synthetic warps and said monofilament synthetic wefts to the other side of said heat shrinkable yarns at the boundaries of said discrete areas, and heating the fabric so produced to shrink said heat shrinkable synthetic warps and wefts at least 15% more than said monofilament synthetic warps and wefts to buckle said monofilament synthetic warps and wefts.

11. A fabric which comprises heat shrunk synthetic yarns extending in one direction of the fabric, longitudinal synthetic monofilament yarns extending unidirectionally with said heat shrunk synthetic yarns, said synthetic monofilaments being longer by at least 15% of

their original length in the fabric than the first said synthetic yarns after a given shrinking treatment, crossing monofilament synthetic yarns crossing said heat shrunk synthetic yarns, said crossing monofilaments being longer by at least 15% of their original length in the fabric than the first synthetic yarns after said given shrinking treatment, said heat shrunk synthetic yarns floating over a plurality of said crossing monofilament yarns first on a first side of said crossing yarns and spaced therefrom along the length of the shrunk yarns then on a second side of said crossing yarns, said crossing yarns floating over a plurality of said heat shrunk synthetic yarns first on a first side thereof and then floating over a plurality thereof on a second side of said heat shrunk yarns, said fabric being divided into a multiplicity of discrete areas, said longitudinal monofilament yarns and said crossing monofilament yarns both appearing at the same side of the fabric in each discrete area and said longitudinal monofilament yarns and said crossing monofilament yarns both appearing at the opposite side of the fabric in the next adjacent discrete area along their length, said longitudinal monofilament yarns and said crossing monofilament yarns being interlaced with each other where they appear on the same side of the fabric in said discrete areas, said monofilament synthetic yarns being buckled by the shrinking of said heat shrunk synthetic yarns.

12. Fabric in accordance with claim 11 wherein said monofilament yarns have a cross sectional dimension of from .001" to .050".

13. Fabric in accordance with claim 12 wherein said monofilament yarns are interlaced with each other in a plain weave at the discrete areas.

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