Aug. 27, 1963 G. S. HOOPER ETAL 3,101,522

THREE-PLY TWEED YARN

Filed Dec. 1, 1960

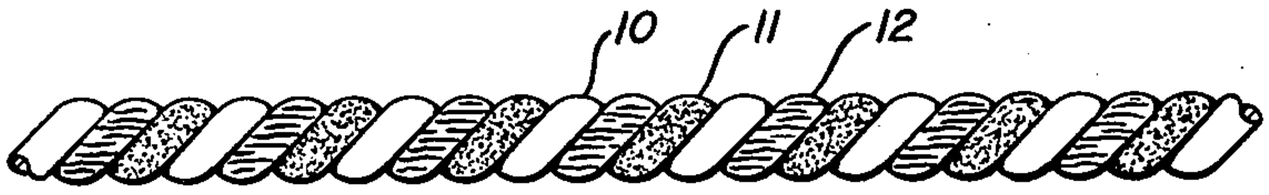

FIG. 1

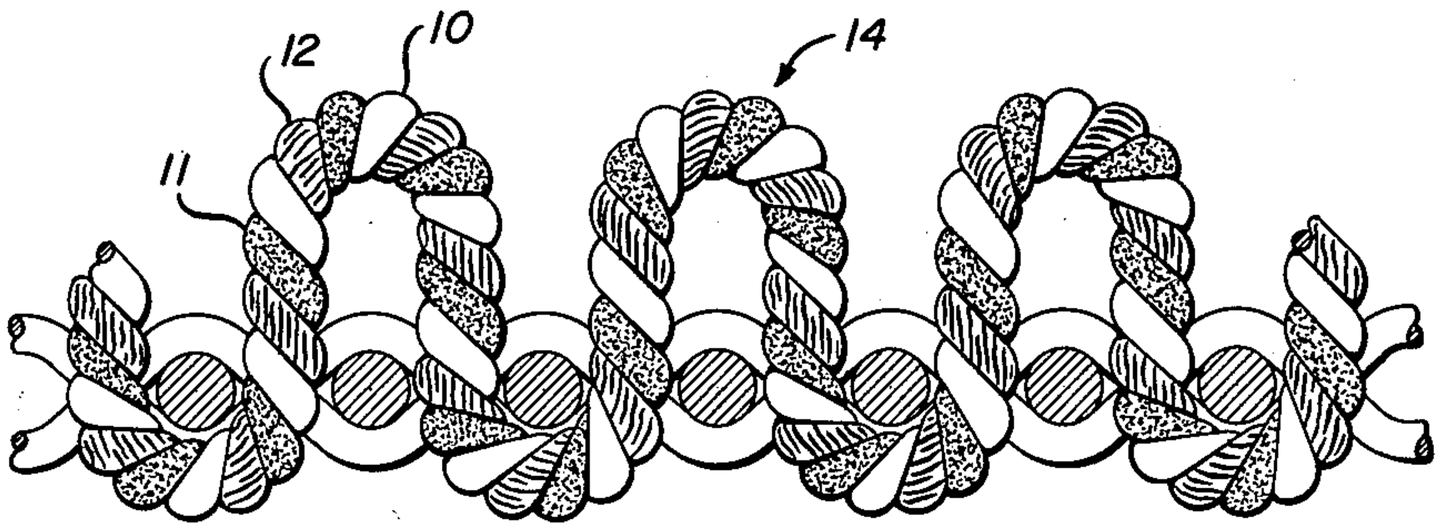

FIG. 2

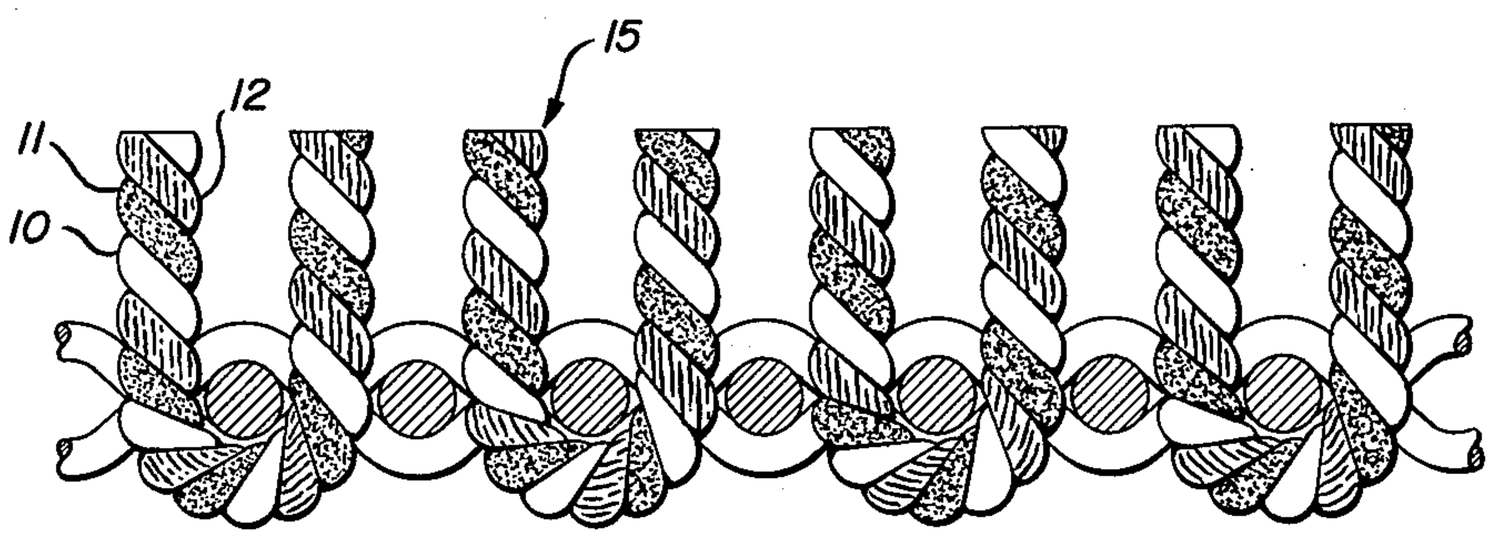

FIG. 3

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United States Patent Office

3,101,522
Patented Aug. 27, 1963

3,101,522
THREE-PLY TWEED YARN

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Filed Dec. 1, 1960, Ser. No. 72,997
12 Claims. (Cl. 28—74)

This invention relates to a composite strand of three yarns which when dyed in a single dye bath results in a variegated colored textile article. More specifically, this invention is concerned with a three-ply strand of yarns and pile fabrics made therefrom which can be dyed in the piece to produce variegated colored or tweed patterned textile articles.

In the production of fabrics such as pile fabrics, i.e., carpets, rugs, upholstery fabrics and other napped fabrics with which this invention is particularly concerned, it is advantageous to be able to dye these articles in the piece, i.e., after the yarn has been knit, woven, or tufted into the fabric. For example, dyeing in the piece minimizes the value of the waste occurring as a natural result of converting the yarn into the fabric and eliminates the necessity of matching the colors of yarns dyed in various dye lots. Piece dyeing of pile fabrics of artificial yarns, however, has not been entirely successful. During the processing of artificial yarns and particularly the bulking processing, slight variations in the yarn fibers occur which appear during dyeing as streaks, barré, and other undesirable and noticeable variations in color or shade.

In order to overcome these color variations, textile manufacturers have resorted to using artificial fibers in staple form so that they can be blended to equalize the differences in dyeing receptivity. Artificial staple yarns, however, require that after the polymer has been processed into a continuous yarn, it must be cut into staple, blended and, then, spun back into a yarn. These additional operations involve considerably more handling and losses and are, hence, economically undesirable. Also, the strength of a spun yarn is dependent upon the interfiber friction and, consequently, is much lower than that of a continuous filament yarn. It is, therefore, desirable to be able to use a continuous filament artificial yarn which can be dyed in the piece without the undesirable color streaks which now are a common problem.

One means presently used to reduce the appearance of streaks in pile fabrics made from continuous filament artificial yarns is the use of high-low fabrics, i.e., fabrics with varying pile heights. The shadows and highlights created by varying pile heights are often sufficient to hide any dye streaks that may be present. Fabrics of this type, however, due to varying consumer tastes, enjoy a rather limited market and are not always free from streaks.

Another method frequently employed to disperse the appearance of color streaks is the use of tweed color patterns wherein random variations are used in the fabric coloration. This method permits fabrication of pile fabrics of either uniform or high-low pile height and has found widespread acceptance. To obtain a tweed or variegated color pattern, however, requires dyeing the yarn prior to weaving, knitting, tufting or braiding such as in the skein and leads to all of the problems mentioned above with regard to color matching, waste, and additional expense.

In order to avoid the problems involved in skein dyeing, it has been suggested that two yarns having varying dye receptivity be combined, such as, cotton or wool with

acetate yarn. This method of producing a tweed pattern in which only two yarns have been used has resulted in somewhat harsh patterns. Also, since both yarns accept dye to some extent, there results frequent variations in the amount of dye that one yarn or the other takes up or resists giving the appearance of nonuniformities of shades and carry-over of shade from one yarn to the other.

Now it has been found that continuous filament artificial yarns can be fabricated into a strand for use in pile fabrics which when dyed in the piece produce a variegated colored article successfully avoiding color variation streaks. Since the strand contains only one yarn whose color is substantially changed by the dyeing, variations of color throughout the piece are minimized and shade carry-over is eliminated. Pile fabrics can, thus, be produced of a uniform pile height and dyed in the piece to give tweed pattern designs of muted color tones.

In accordance with this invention, a strand of three artificial yarns is formed using one artificial yarn which has been color pigmented, a naturally colored poly-α-olefin yarn having substantially no coloration and a dyeable artificial yarn. Subsequent dyeing of either the strand or a fabric constructed of the strand using accepted artificial yarn dyes produces a variegated colored textile article.

It is well known that poly-α-olefin yarns are highly resistant to the common dyes. They are particularly resistant to any of the dyes normally used on artificial yarns and, therefore, are well suited for combination with artificial yarns since they will resist taking on the coloration during subsequent dyeing in a dye which readily tints the artificial yarn. Methods of pigmenting artificial yarns and particularly poly-α-olefin and polycarbonamide yarns have been developed wherein the pigment is incorporated into the polymer prior to its formation into yarn. Deep shades in color-pigmented artificial yarns can be achieved which are little affected by subsequent dyeing. A strand produced by combining a pigmented artificial yarn, a dye resistant poly-α-olefin yarn and a dye receptive artificial yarn can, thus, be dyed as a strand or converted into a fabric which dyes to a muted toned, variegated colored textile article.

A great variety of tweed or "salt and pepper" effects can be obtained from a combination strand, such as that described herein, although the spun-dyed yarn is necessarily of a fixed color. For example, a strand such as that shown in FIGURE 1 consisting of a white poly-α-olefin yarn, 10, combined with a dyeable polycarbonamide yarn, 11, and a black spun-dyed poly-α-olefin yarn, 12, can be dyed with a suitable dye to any one of the numerous shades of red, blue, or gray to give highly desirable variegated effects. Similarly, when the spun-dyed yarn is brown in color, the strand may be dyed using various shades of green, yellow, or tan. Of particular advantage is the fact that piece dyeing can be carried out on a pile surface fabric, such as that shown in FIGURE 2 wherein the three-ply strand, 14, is formed into loops or that shown in FIGURE 3 wherein the three-ply strand, 15, is in cut-pile form, to produce a "tweed" patterned textile article, such as a carpet, rug, upholstery fabric or the like. Significantly, the dyes do not alter the color of the spun-dyed poly-α-olefin yarn and when other artificial yarns are spun dyed in the very deep shades the dyes have little or no effect in altering their colors, although proper selection of shade can result in highly desirable over-dyeing color effects.

The dye resistant poly-α-olefin yarn of the composite strand is advantageously made of a linear, fiber-forming poly-α-olefin having at least three carbon atoms per

monomer unit. Particular advantages have been found in the practice of this invention in using filamentary atricles of stereo regulated, highly crystalline, high molecular weight polymers of α-olefins of the formula $CH_2=CHR$ in which R is an alkyl group. Alpha-olefins when polymerized with the aid of certain catalysts result in a polymer mixture of crystallizable, isotatic and non-crystallizable atactic polymers having a preferentially higher content of the isotatic structure. The isotactic polymers are normally solid, linear, regular head-to-tail crystallizable polymers having substantially no branches longer than R and can be distinguished from the atactic polymers in that substantially all of the asymmetric tertiary main-chain carbon atoms of adjacent monomeric units have the same steric configuration such that the main chain of the macromolecule, when fully extended in a plane, shows substantially all of the R groups on one side of the plane and all of the hydrogen atoms bound to the tertiary carbon atoms on the opposite side. A fuller explanation of stereo regulation and the α-olefin polymers which are utilizable in this invention may be found in the article by G. Natta and P. Corradini, Rend Accad. Maz. Lincei 18, 19 (1955). Furthermore, it has been found particularly advantageous to use the articles and processes of this invention yarns formed of stereo regulated, fiber-forming polypropylene.

When poly-α-olefin materials are spun into yarn, the color of the resultant yarn depends upon the temperature of extrusion, the purity of the polymer and the like. Usually the yarn is white or off-white having a slight yellow tint to it. The term "naturally colored" as used herein is meant to include all of the shades of off-white along with white which occur in the yarn as it is spun. Of course it is preferred to use a perfectly white poly-α-olefin yarn as the dye resistant yarn in the strand of this invention but slightly off-white yarns are acceptable.

Color pigmentation or spin dyeing techniques wherein a pigment is incorporated within the material have been developed for many of the artificial yarns. By artificial yarns as used herein it is meant, those yarns produced artificially from both natural and synthetic polymers and includes the regenerated cellulose, cellulose esters, polycarbonamides, polyacrylonitrile, polyester, poly-α-olefin, and regenerated protein type polymers. The spin dyeing of these polymers is usually carried out by the addition of a pigment to the polymer solution whether it be an aqueous solution such as viscose, a melt such as a polycarbonamide, or a solvent solution such as utilized with acetate and polyacrylonitriles just prior to its being extruded into yarn. The pigment can, also, be added to the reactants before polymerization or to the solid polymer chips before they are remelted and spun into yarn. Coloration in this way produces yarns of exceptionally good colorfastness and permits the production of filaments having a wide variety of colors. Furthermore, this method permits the coloration of the difficultly dyed yarns such as poly-ω-olefins when incorporated in the manner described in copending U.S. patent application Serial No. 12,507, filed March 3, 1960, and now U.S. Patent No. 3,061,576. Usually deep shades can be obtained by the use of spin dyeing and novel effects can be created by subsequently overdyeing the yarn with some different shade of a dye which readily colors the yarn material. Although other spun-dyed artificially yarns can be used, it has been found particularly advantageous to use a spun-dyed yarn made from a fibre-forming synthetic polymer selected from the group consisting of poly-ω-olefins and linear polycarbonamides. In the preferred embodiment of the strand combinations of this invention, fiber-forming polypropylene yarns are utilized since they are substantially unaffected by the common dyes using conventional techniques and, thus, maintain their true spun-dyed color.

The dye receptive artificial yarn of the strand may

be any of artificial yarns generally considered to be dyeable including regenerated cellulose, cellulose ester, polycarbonamide, polyacrylonitrile and copolymers thereof, polyesters, and regenerated protein type fibers. The natural fibers might also be used under certain conditions but it has been found that, generally, due to their lower strengths and wide differences in their load elongations they are not satisfactory in comparison to the artificial fibers. It has been found particularly advantageous to use a dyeable yarn of a fiberforming, linear polycarbonamide. The term polycarbonamide is meant to include any long-chain synthetic polymerica carbonamide which has recurring amide groups as an integral part of the main polymer chain, and which is capable of being formed into a filament in which the structural elements are oriented in the direction of the axis. Generally, polycarbonamides may be formed either by the condensation of a diamine and a dibasic acid, the most common of which is hexamethylene diamine adipate, so called nylon 66, or by the polymerization of the lactam of ε-aminocaproic acid, so called nylon 6 and it is these members of the polycarbonamides which are preferred in the products and processes of this invention.

The selection of a suitable dye is dependent upon the dye receptive yarn used since the poly-α-olefin yarn is substantially dye resistant to all of the well-known dyes. Any of the dyes well known in the art as recommended for the particularly dyeable yarn contained in the strand can, therefore, be used. For example, when the dye receptive yarn is a polycarbonamide yarn, the dyeing of the strand of pile surfaced fabric can be carried out with acid dyeing premetallized dyes, acid dyes, and selected direct cotton dyes. None of these types of dyes substantially permanently tint the poly-α-olefin yarns. In the preferred embodiment of this invention in which the spun-dyed yarn is a poly-α-olefin and the dyeable yarn is nylon, particular advantages have been found in using the acid dyeing premetallized dyes.

The application of the dye can be accomplished through the use of any of usual dyeing techniques. Here again the dyeing technique is dependent upon the type of dyeable yarn in the strand and the dye type used and, hence, follows those procedures which are well known in the art. Usually, these techniques require the strand or fabric to first be scoured in a aqueous detergent solution after which dyeing is carried out in demineralized water having its pH adjusted and containing a suitable wetting agent along with the dye. The article is then rinsed to remove any unattached dyestuff and dried. Pile surface fabrics made from the three-ply strand of this invention when dyed in a single dye bath in this manner exhibit a distinctive over-all tweed color pattern.

This invention now will be more fully described by the following examples, although it is understood that the invention is not ot be limited to the specific conditions contained therein.

Example I

A 1050 denier, 70 filament, black spun-dyed polypropylene yarn having 0.2 twist per inch is combined with a 1050 denier, 70 filament naturally colored polypropylene yarn and a 1050 denier, 70 filament nylon 6 yarn. The three-ply strand is given 1.5 ply twist and tufted on a jute backing into a loop pile carpet construction.

A sample of the carpet fabric containing 300 grams of yarn is immersed in a dye solution, at room temperature, containing 16 liters of water; 4 grams of Triton X–100, Rohm & Haas Company's alkylaryl polyether alcohol detergent; 1 gram of acetic acid; 0.2 gram of Gycolan Red BRE manufactured by the Geigy Chemical Company; 0.005 gram of Gycolan Blue 2 GL, also made by the Geigy Chemical Company; and 0.010 gram of Neolan Yellow G.R. (Color Index—acid yellow No. 99), made by the Ciba Company Incorporated. Following introduction of the fabric into the dye bath, heat is applied and

solution is raised to a temperature of 100° C. within 45 minutes. Boiling is continued for 30 minutes after which the fabric is withdrawn and rinsed with water.

The dyed fabric is a tweed pattern containing blending shades of black, rose and white and having substantially the same appearance as tweed carpeting in which the component yarns were dyed separately prior to tufting.

Example II

A bulked, continuous filament nylon 66 yarn of 1050 denier and 70 filaments, having 0.2 twist per inch, is combined with a dark-red spun-dyed nylon 6 yarn and a white polypropylene yarn, each of a similar construction. The combined yarns are ply twisted to a total of 1.3 twists per inch, heat set, and tufted and cut on a jute backing material to produce a cut-pile carpet fabric.

A portion of the carpet fabric containing 200 grams of yarn is dyed in the same manner as described in Example I using, however, a dye solution containing 8 liters of water; 2 grams of Triton X–100; 2 grams of ammonium acetate; 0.06 gram of Erio Anthracene Grey 2 BLN (Color Index—acid black 48), a dyestuff manufactured by the Geigy Chemical Company; and 0.08 gram of Polar Brown 2 GL also manufactured by the Geigy Chemical Company.

The dyed fabric is comprised of muted tones of gray, red and white wherein the polypropylene yarn has resisted dyeing.

Example III

A 1100 denier, 75 filament regenerated cellulose yarn having 0.25 twist per inch is ply twisted with a dark-brown spun-dyed polypropylene yarn and a white polypropylene yarn of the same denier, twist and filament count. The three-ply strand is put up in skeins and scoured preparatory to dyeing.

A 200 gram skein is dyed in the manner described in Example I in a dye solution containing 10 liters of water; 2 grams of Triton X–100; 10 grams of sodium sulfate; 0.28 gram of Solophenyl Fast Blue Green BL (Color Index—direct green No. 27) manufactured by the Geigy Chemical Company; and 0.07 gram of Solophenyl Orange TGL (Color Index—direct orange No. 34) also manufactured by the latter company.

The dyed skein exhibits variegated brown, green and white colors muted to blend together giving an over-all tweed effect. The multicolored strand may be woven, knitted, braided, or tufted into textile articles of enhanced colorful appearance.

Although the deniers of the three yarns shown in the examples are the same, very interesting effects can be achieved by varying these deniers so that varying amounts of each of the colors will appear in the final article. Also, the denier of the strand may be adjusted to suit the textile article into which it is to be converted. For carpets, the denier of the strand is usually about 3000 denier when nylon yarns are used, but variations in the density and bulking qualities of the yarn may vary this requirement depending upon the coverage desired. Preferably, continuous filament yarns are used since they exhibit higher strengths, abrasion resistances and the like and, also, they are the types of yarn most susceptible to color imperfections. Staple yarns, however, could also be used in the products and processes of this invention.

The application of this invention to bulked yarns is particularly advantageous since this is a principal source of the introduction of imperfections which show up in dyeing. A large number of methods of bulking continuous artificial filaments have been suggested in recent years including crimping, looping, twisting, and the like. It is particularly desirable to bulk continuous filaments for pile surface fabrics to improve their covering power. The term "pile fabric" or "pile surface fabric" as used herein means any fabric or material which has a napped or pile conformation and includes rugs, upholstery materials, furs and the like. The crimps, twists or loops in the bulked filaments, however, create differences in the yarn dye receptively in an uncontrolled manner resulting in undesirable color variations during dyeing. The strand and pile surface fabrics made from it, in accordance with this invention, successfully randomize these dye variations to produce appealing variegated color patterns.

The twist in the three-ply strand may be varied depending upon the end use to which it is to be put. The process does not necessarily require twist but it has been found that it is easier to handle the strand if it has at least some ply twist. As for twist in the individual yarns, they need have only a minimum amount to keep their individuality distinct in the finished colored strand.

Since certain changes in the practice of this invention may be readily made without substantially departing from its spirit or scope, it is to be understood that all of the foregoing is to be interpreted as being merely illustrative and is not to be construed as limiting or restricting the invention as particularly pointed out and defined in the appended claims.

What is claimed is:

1. A three-ply strand of yarns consisting essentially of a color-pigmented artificial yarn, a naturally colored yarn of a fiber-forming poly-α-olefin and a dyeable artificial yarn; said yarns twisted together thereby forming a three-ply strand capable of subsequent dyeing in the piece to a variegated colored textile article.

2. A three-ply strand of yarns consisting essentially of a color-pigmented yarn of a fiber-forming synthetic polymer selected from the group consisting of poly-α-olefins and linear polycarbonamides; a naturally colored yarn of a fiber-forming polyα-olefin and a dyeable yarn of a fiber-forming, linear polycarbonamide; said yarns twisted together thereby forming a three-ply strand capable of subsequent dyeing in the piece to a variegated colored textile article.

3. A three-ply strand of continuous filament synthetic yarns consisting essentially of a color-pigmented yarn of a fiber-forming polypropylene, a naturally colored yarn of fiber-forming polypropylene and a dyeable yarn of a fiber-forming, linear polycarbonamide; said yarns twisted together thereby forming a three-ply strand capable of subsequent dyeing in the piece wherein only the fiber-forming, linear polycarbonamide yarn is dyed thereby forming a variegated colored textile article.

4. A fabric having a pile surface composed of tufts of a three-ply strand of yarns consisting essentially of a color-pigmented artificial yarn, a naturally colored yarn of a fiber-forming poly-α-olefin and a dyeable artificial yarn; said pile surface capable of being dyed in the piece to a variegated colored textile article.

5. A fabric having a pile surface composed of tufts of a three-ply strand of yarns consisting essentially of a color-pigmented yarn of a fiber-forming synthetic polymer selected from the group consisting of poly-α-olefins and linear polycarbonamides, a naturally colored yarn of fiber-forming poly-α-olefin and a dyeable yarn of a fiber-forming, linear polycarbonamide; said pile surface capabie of being dyed in the piece to a variegated colored textile article.

6. A fabric having a pile surface composed of tufts of a three-ply strand of yarns consisting essentially of a color-pigmented yarn of fiber-forming polypropylene, a naturally colored yarn of fiber-forming polypropylene and a dyeable yarn of a fiber-forming, linear polycarbonamide; said pile surface capable of being dye in the piece wherein only the fiber-forming, linear polycarbonamide yarn is dyed thereby forming a variegated colored textile article.

7. A method of making a variegated colored pile fabric comprising twisting three yarns into a three-ply strand consisting essentially of a color-pigmented artificial yarn, a naturally colored yarn of a fiber-forming poly-α-olefin and a dyeable artificial yarn; forming said strand into a pile fabric; and dyeing said fabric in the piece thereby producing a variegated colored pile fabric.

8. A method of making a variegated colored pile fabric comprising making a pile fabric from a twisted three-ply strand consisting essentially of a color-pigmented yarn of a fiber-forming synthetic polymer selected from the group consisting of poly-α-olefins and linetar polycarbonamides, a naturally colored yarn of fiber-forming poly-α-olefin and a dyeable yarn of a fiber-forming, linear polycaronamide; and dyeing said fabric in the piece thereby producing a variegated colored pile fabric.

9. A method of making a variegated colored pile fabric comprising making a pile fabric from a twisted three-ply strand of yarns consisting essentially of a color-pigmented yarn of fiber-forming polypropylene, a naturally colored yarn of fiber-forming polypropylene and a dyeable yarn of a fiber-forming, linear polycarbonamide; and dyeing said fabric in the piece wherein only the fiber-forming, linear polycarbonamide yarn is dyed thereby producing a variegated colored pile fabric.

10. A method of making a three-ply strand of yarns comprising twisting together yarns consisting essentially of a color-pigmented artificial yarn, a naturally colored yarn of a fiber-forming poly-α-olefin and a dyeable artificial yarn into a three-ply strand; said three-ply strand being capable of being dyed in a single dye bath to produce a variegated colored textile article.

11. A method of making a three-ply strand of yarns comprising twisting together yarns consisting essentially of a color-pigmented yarn of a fiber-forming, synthetic polymer selected from the group consisting of poly-α-olefins and linear polycarbonamides, a naturally colored yarn of fiber-forming poly-α-olefin and a dyeable yarn of a fiber-forming, linear polycarbonamide into a three-ply strand; said strand being capable of being dyed in a single dye bath to produce a variegated colored textile article.

12. A method of making a three-ply strand of yarns comprising twisting together yarns consisting essentially of a color-pigmented yarn of fiber-forming polypropylene, a naturally colored yarn of fiber-forming polypropylene and a dyeable yarn of a fiber-forming polycarbonamide into a three-ply strand; said three-ply strand being capable of being dyed in a single dye bath wherein only the polycarbonamide yarn is dyed to produce a variegated colored textile article.

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