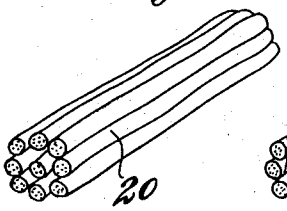
Sept. 3, 1963 R. WHITAKER 3,102,322

PROCESS OF PRODUCING CRIMPED YARN FOR USE IN HOUSE FURNISHING FABRICS

Filed Aug. 14, 1961 3 Sheets-Sheet 1

Fig. 1.



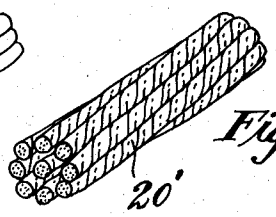


Fig. 1a.



Fig. 2.

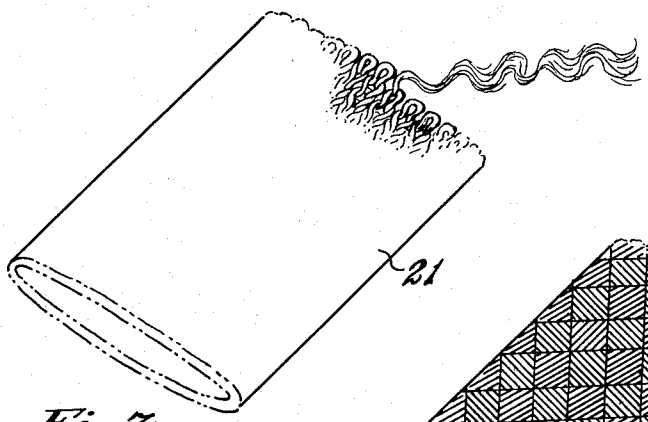


Fig. 3.

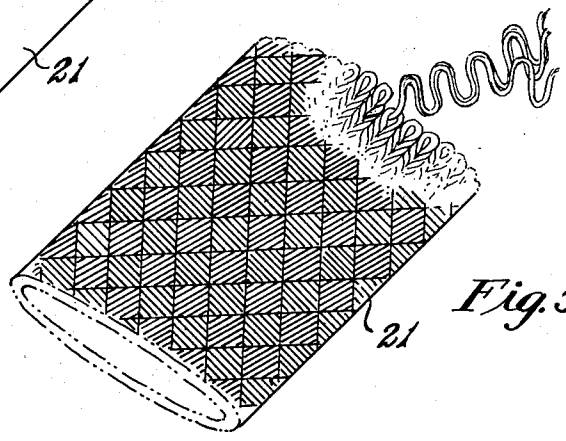


Fig. 5.

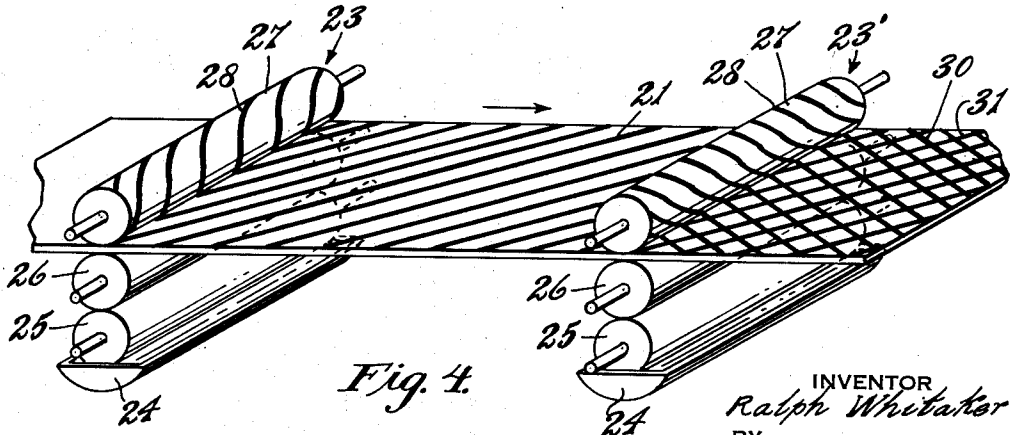


Fig. 4.

INVENTOR
Ralph Whitaker
BY
ATTORNEYS

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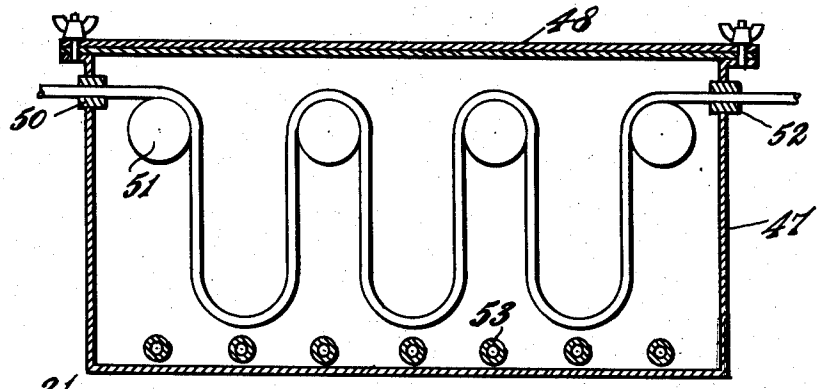


Fig. 8.

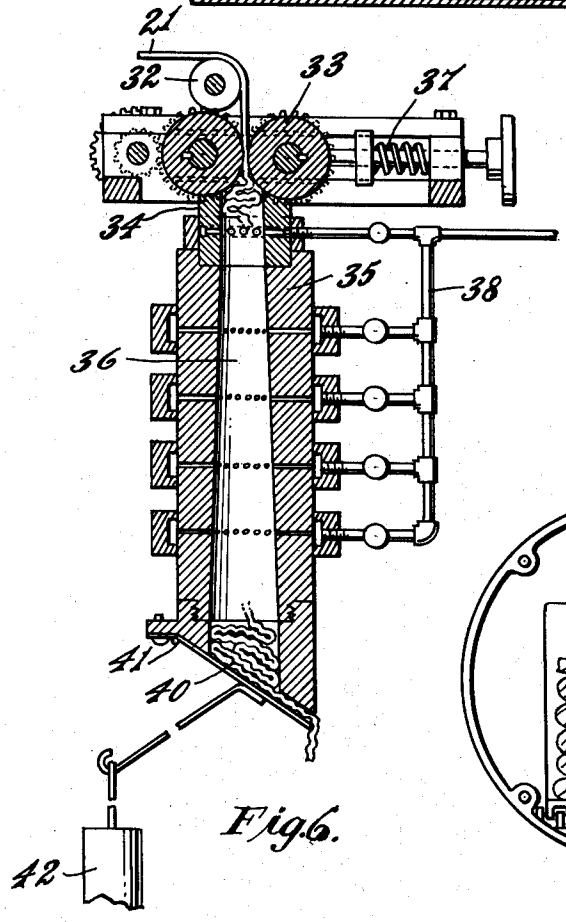
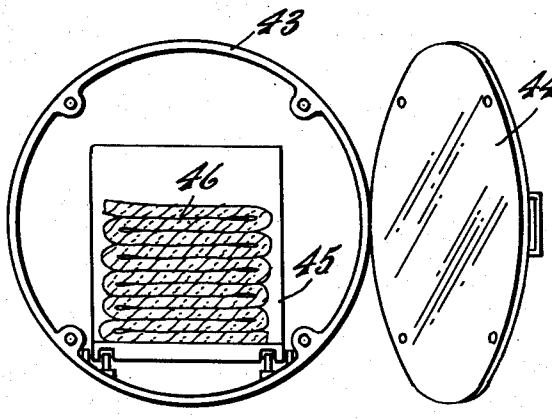


Fig. 6.

Fig. 7.



INVENTOR
Ralph Whitaker
BY
ATTORNEYS

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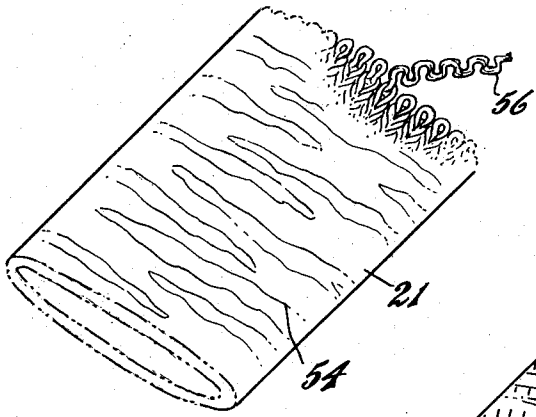


Fig. 9.

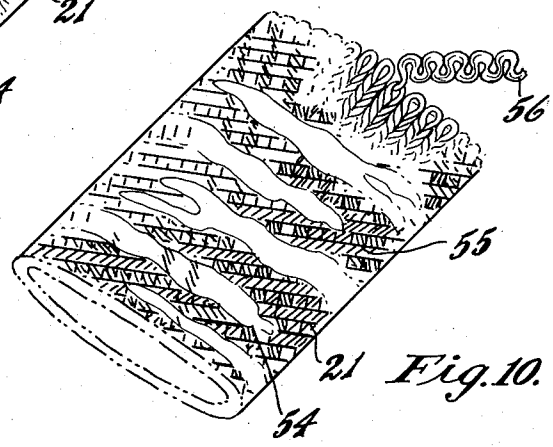


Fig. 10.

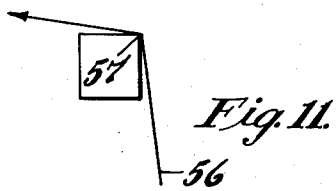


Fig. 11.



Fig. 12.

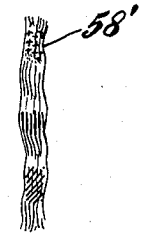
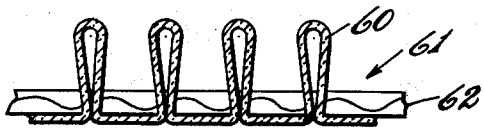


Fig. 13.

Fig. 14.



INVENTOR
Ralph Whitaker
BY
ATTORNEYS

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Patented Sept. 3, 1963

3,102,322

PROCESS OF PRODUCING CRIMPED YARN FOR USE IN HOUSE FURNISHING FABRICS

Ralph Whitaker, Philadelphia, Pa., assignor to Fred Whitaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed Aug. 14, 1961, Ser. No. 131,402
6 Claims. (Cl. 28—72)

The present invention relates to processes of producing crimped yarn from multifilament continuous filament thermoplastic textile fibers, particularly for use as face yarn of carpets and upholstery fabrics, including pile fabrics, and for clothing.

Carpets and upholstery fabrics are referred to herein as house furnishing fabrics.

A purpose of the invention is to obtain a very lofty crimped yarn from multifilament continuous filament thermoplastic synthetic fiber at reduced expense and with greater permanence of the crimp.

A further purpose is to obtain variegated dyeing effects in the yarn so as to secure at reasonable expense heather, mottled, nub and variegated coloring of a crimped yarn from continuous filament multifilament thermoplastic textile fibers.

A further purpose is to knit the yarn into a unravelable prefabric, preferably in tubular prefabric, to crimp the prefabric by forcing it through a stuffer crimp box, to heat set the crimp in an autoclave, to unravel the prefabric yarn, to open up and fluff the yarn, and then desirably to produce a house furnishing fabric in which the yarn forms the face or pile or to produce clothing.

A further purpose is to apply dye to localized areas of the prefabric before it is crimped and to heat set the dye in the autoclave while heat setting the crimp.

A further purpose is to permit control of the crimp by change of the tension employed in knitting the prefabric.

A further purpose is to eliminate lining effects in carpet and upholstery fabrics and clothing by applying stripes or other localized areas of dye of various colors across the prefabric, either in a direction angularly disposed to the direction of the yarn in the prefabric or in the direction of the yarn in the prefabric prior to the crimping of the yarn.

A further purpose is to redistribute the color applied at the stripes or localized areas by unravelling the prefabric and then opening up and fluffing the yarn, so as to create wide distribution of the different colors and so as to create more gradual gradation from one color to another along the length of the yarn.

A further purpose is to apply the color in localized areas to conform with a pattern which is to be formed on the face of the carpet or upholstery fabric or clothing.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the mechanisms which may be employed in carrying out the process of the invention.

FIGURE 1 is a fragmentary perspective of untwisted yarn which may be used in the present invention.

FIGURE 1*a* is a fragmentary perspective of twisted yarn which may be employed in the invention.

FIGURE 2 is a face view of a knitted flat prefabric illustrating the knitting of a prefabric in accordance with the invention.

FIGURE 3 is a fragmentary perspective showing the knitted prefabric produced according to FIGURE 2, and still undyed or in the grège.

FIGURE 4 is a fragmentary perspective showing the printing of color in stripes or other localized areas on

the prefabric of the invention. The color is actually applied on the lower side of the fabric but is shown on the top for convenience.

FIGURE 5 is a fragmentary perspective of the prefabric after printing with dye in localized areas in accordance with FIGURE 4.

FIGURE 6 is a diagrammatic central longitudinal section of a stuffer crimp box employed in processing the prefabric of the invention.

FIGURE 7 is a front elevation of an autoclave showing heat setting of crimp and of dye according to the invention.

FIGURE 8 is a diagrammatic central longitudinal section of a continuous autoclave for use in heat setting the prefabric of the invention to set the crimp and permissibly also set the dye.

FIGURE 9 is a fragmentary perspective showing the prefabric after crimping and heat setting and still in the grège.

FIGURE 10 is a fragmentary perspective of the prefabric which has been printed according to FIGURE 4 and then passed through the stuffer crimp box and heat set.

FIGURE 11 is a diagrammatic elevation showing the opening up of the unravelled yarn to fluff it.

FIGURE 12 is a side elevation of a short section of the crimped yarn of FIGURE 9 after opening up according to FIGURE 11.

FIGURE 13 is a side elevation of a short section of crimped and dyed yarn according to FIGURE 10 after opening up according to FIGURE 11.

FIGURE 14 is a diagrammatic longitudinal section showing a pile fabric, suitably a tufted carpet, employing the yarn of the invention.

Describing in illustration but not in limitation and referring to the drawings:

Various efforts have been made in the past to produce crimped yarn from continuous filament multifilament thermoplastic fiber such as nylon with satisfactory crimp to increase the coverage and bulk of the yarn. Yarn has heretofore been produced in an effort to obtain satisfactory crimp by knitting the nylon yarn into a prefabric, placing the knitted prefabric in an autoclave and subjecting it to steam at elevated temperature and then unravelling and opening up the yarn. The quality and character of the crimp obtained in this way has not always been desirable, particularly because of the regularity, and the tendency of the crimp to be too fine and not sufficiently pronounced.

I have discovered that greatly improved crimp can be obtained and that it is more persistent when the continuous filament multifilament thermoplastic yarn such as nylon is knitted into an unravelable prefabric and that prefabric is fed through a stuffer crimp box, which superimposes on the fabric itself independently of the knitted loops a macro-crimp which adds to what may be called the micro-crimp of the loops themselves. Steam is desirably introduced in the stuffer crimp box at a temperature of between 180° and 270° F., preferably about 200° F.

Then the crimped knitted prefabric while free from tension is heat set in an autoclave. The prefabric is then unravelled to produce crimped yarn, and the crimped yarn is opened up or fluffed. It is then available particularly for use in the face or pile of a house furnishing fabric such as an upholstery fabric or a carpet or rug, especially a tufted carpet, or in clothing.

The invention can to advantage be employed by dyeing the knitted prefabric and setting the dye while heat setting the crimp. While dyeing of the entire prefabric to a uniform color may be employed, the invention is to best advantage used in connection with printing of the prefabric prior to introduction into the stuffer crimp box

with a plurality of localized areas of different colors such as stripes, splotches or dots, the dye then being set by the heat setting in the autoclave.

The invention lends itself to giving improved coverage of the face of a fabric, reducing the tendency for lining effects to be visible when the fabric is shown in a large expanse on the floor or wall. The printing of localized areas also produces a yarn which has softened gradations or zones of demarcation between different colored areas and can produce very desirable heather, nub or slub effects.

The invention may also be applied to produce coloring in the yarn which will form a pattern on the face of the final carpet or upholstery.

The yarn of the invention is extremely lofty, has an improved face coverage, improved optical properties and a softer feel. The invention may be applied to yarn which has been previously textured or bulked by some other process if desired.

Considering now the invention in detail, I employ in making yarn according to the present invention multifilament continuous filament thermoplastic synthetic yarn. Nylon (linear polyamide) of any of the types is suitable. Other thermoplastic synthetic fibers may be used such as acrylic (Orlon, acrylan) and modified acrylic. The yarn should be of a size of 50 to 10,000 denier in the yarn, preferably 500 to 4500 denier. The number of filaments will be at least 10 and preferably at least 100. The individual continuous filaments are of a size between 1.5 and 30 denier and preferably between 1.5 and 22 denier.

The original yarn will have a twist of from 0 to 6 turns per inch, preferably ½ to 3 turns per inch, or it may be effectively without twist.

The yarn **20** in FIGURE 1 is without twist and the yarn **20'** in FIGURE 1*a* has a twist as above described.

The yarn above referred to is first knitted into a knitted prefabric **21**, preferably a tubular prefabric but permissibly a strip prefabric, having loops **22** as shown in FIGURE 2, which illustrates a weft knitted flat tubular fabric, in which each loop **22** in the body of the fabric is controlled by engagement with a loop at each side. When the fabric is later heat set, this tends to provide effective control of the micro-crimp, and avoids the possibility that flat spots might occur.

The knitting is conducted on a suitable knitting machine and it will be understood that the tension in the knitting can be varied to change the crimp which will ultimately be obtained.

It is not important in the invention whether the prefabric is flat or ribbed, but it should preferably be a tube.

It will also be evident that the crimp can be controlled by varying the number of stitches per inch and the gage of the knitting machine. After the prefabric is knitted, it may be used white or grège without dyeing, although in the preferred embodiment of the invention the prefabric **21** as shown in FIGURE 4 will be locally printed to apply stripes, dots or other localized areas of different colors, preferably at an angle to the direction in which the yarn in the prefabric extends, but permissibly in the same direction.

In FIGURE 4 I show the fabric **21** in the form of a tube moving in the direction of the arrow through a plurality of printing or padding stations **23** and **23'**, each applying a different color. As shown, each Vigoureux printer includes a dye trough **24**, a pickup roll **25** entering the dye trough, a takeoff roll **26** engaging the top of the pickup roll and the bottom of the fabric and a printing roll **27** above the fabric having projections **28** which follow a certain contour and determine the location of the application of the dye to the prefabric by pressing against the resilient takeoff roll **26**.

It will be understood that to print both sides of the tubular prefabric it will suitably be run through twice and the pattern of different colors shown at **30** and **31** is really on the bottom of the fabric where it is a tube and is only illustrated on the top for convenience in showing what happens.

The individual stripes or other localized areas of color may or may not be adjoining, and if desired there may be natural or white areas left unprinted between the individual stripes or splotches. It will be evident that the color may be applied by any suitable equipment.

It will be evident that color can be superimposed if desired and where it is superimposed the ultimate color will be the result of the superimposition.

A very convenient manner of applying the dye is the Vigoureux type of printing machine or the warp intaglio printing machine or the air brush.

The knitted prefabric whether it is white, as in FIGURE 3, or dyed, as in FIGURE 5, is next crimped by passing it through a stuffer crimp box as shown in FIGURE 6. The crimp box is intended to be of a conventional type, for example as shown in Pfau and Rainard U.S. Patent No. 2,575,833, granted November 20, 1951, for Method of Crimping Textile Fibers. The prefabric **21** passes over guide roll **32** between suitably driven integeared feed rolls **33** into the throat **34** of stuffer crimp box **35** having a progressively widening crimping chamber **36**. The feed rolls are resiliently urged together by adjustable spring mechanism **37**.

Steam and water are preferably introduced into the crimp box through piping **38**. At the bottom the crimp box has a discharge door **40** hinged at **41** and weighted or biased toward closure by weighting system **42**. The crimp box suitably subjects the knitted prefabric to a temperature in the range between 180° and 270° F., preferably about 200° F. The time in the crimp box is usually from one second to one minute.

From the stuffer crimp box of FIGURE 6, the knitted prefabric is taken to an autoclave where it is heat set. FIGURE 7 shows an autoclave **43** having a door **44** and a carrier **45** on which a pile of untensioned or relaxed crimped prefabric **46** is placed for treatment. Steam is suitably introduced into the autoclave and a temperature of 180° to 270° F. is obtained for a time of treatment of from 1 to 30 minutes. The heat setting causes the nylon or other synthetic fiber to set the microcrimps produced by the knitted loops and also the macrocrimps produced by the stuffer crimp box, accompanied by pronounced shrinkage which renders the yarn subsequently more stable.

If the knitted prefabric has been piece dyed or if it has been printed, the heat setting will also set the dye in the same operation. In the case of piece dyeing, however, this is preferably done after crimping.

While a batch type autoclave may be used as shown in FIGURE 7, a continuous heat setting autoclave may be employed as shown in FIGURE 8, comprising a pressure chamber **47** having a tight cover **48** having a sealed inlet opening for the prefabric at **50**, feed rolls for carrying the prefabric at **51**, and sealed outlet opening for the prefabric at **52**. Steam is admitted through pipes **53** into the autoclave and maintains a temperature of 180° to 270° F. It will be understood, of course, that suitable vestibules may be used at **50** and **52** to protect against leakage.

It will, of course, be evident that if desired the dyed prefabric can be scoured and dried.

FIGURE 9 shows the prefabric **21** which has been crimped and heat set and has numerous crinkly areas or folds **54**. FIGURE 10 illustrates the same crimped and heat set prefabric **21** with the wrinkles or seams **54** applied by the crimp box, but also with various colored areas **55** applied as by printing in FIGURE 4.

In either case the crimped and heat set knitted prefabric is unravelled to produce a yarn **56**. It is important that the prefabric be capable of unravelling. For this purpose single needle knitting is preferred. The yarn is next opened up or fluffed preferably as suggested in FIGURE 11 by passing it over a corner or edge **57**,

in connection with any suitable manipulating or winding mechanism.

The result is a white or grège yarn **58** or a yarn with various colored areas along its length as shown at **58'** in FIGURES 12 and 13, respectively. This yarn has microcrimps but it also has a generally overall macrocrimp which makes different areas respond differently in a manner very desirable in producing house furnishing fabrics.

The yarn is quite lofty, the effect of the opening up causing it to increase to several times its initial diameter.

Before actual use in the pile of a carpet, rug or upholstery fabric, the yarn may be twisted to achieve a twist or from 0 to 6 turns per inch and preferably from ½ to 3 turns per inch in the single and it may, if desirable, be plied. The twist in the ply can also be heat set, if desired.

The final yarn is wound on cones or tubes and is used in tufting, knitting or weaving to form the pile face **60** of a pile fabric **61** which has a suitable backing **62**, or to form clothing.

Example I

A yarn without twist having a size of 2100 denier in the yarn, consisting of continuous filament type 6 nylon of 15 denier, is knitted on a circular knitting machine having 10 gage butt needles, 54 needles in the circle, 9 stitches per inch in width and 10 courses per inch in length, to produce a 4 inch diameter cylinder.

The resulting prefabric is a tube.

The knitted tube is printed on both sides with diagonal stripes of green and brown, the stripes running at a slight angle and crossing the tube about every foot.

The brown printing or dyeing composition is as follows:

Irgalan Brown 2RL (Prototype Acid Brown 45)	41.7 grams per liter.
Ethylene glycol	33.3 cc. per liter.
Gum thickener (Keltex)	16.7 grams per liter.
Water	Balance.

31 liters of the brown printing formula is used to pad 156 pounds of the nylon knitted tube.

A green printing or dyeing formula is used as follows:

Lanasyn Brilliant Green BL Pat. (Prototype Acid Green 40)	8.3 grams per liter.
Ethylene glycol	33.3 cc. per liter.
Gum thickener (Keltex)	16.7 grams per liter.
Water	Balance.

21 liters of the green strip printing composition is used for 156 pounds of the nylon tube.

The fabric thus printed is passed through the stuffer crimp box of FIGURE 6 maintained at a temperature of 200° F., the time taken for the prefabric to go through the crimp box being approximately 3 seconds.

The prefabric is then placed in the autoclave of FIGURE 7 in relaxed condition and subjected to a temperature of 210° F. in the presence of steam for 10 minutes.

The prefabric is then removed from the autoclave, scoured, dried and unravelled. The unravelled yarn is then run over three corners in succession, twisted to one turn per inch, and plied into 3-ply yarn and twisted one turn per inch in the ply.

The yarn is then made into a tufted fabric of FIGURE 14 having uncut pile face loops.

A beautiful variegated effect with excellent yarn coverage is obtained.

Example II

The process of Example 1 is carried out except that the knitting machine is a 12 gage, 108 needle knitting machine in a 4¼ inch diameter cylinder. The results are similar to Example 1.

Example III

The procedure of Example 1 is carried out except that the yarn is 4200 denier, 15 denier per filament, having a twist of 1 turn per inch.

After the prefabric is crimped, heat set, unravelled and opened, the yarn is twisted to a twist of 1 turn per inch in the opposite direction and plied into 3 plies before making the carpet as in FIGURE 14.

Example IV

The procedure of each of the above examples is applicable also without dyeing to obtain yarn in the white.

Various localized dyes may be used, including Neutral Premetalized Dyes, Acid Premetalized Dyes, and Pigment Textile Printing Colors.

Suitable examples of dyes for use in the examples are:

Lanasyn Yellow GL	(Prototype Acid Yellow 114)
Cibalan Yellow FGL	(Prototype 713)
Capacyl Orange R	(Prototype Acid Orange 60)
Cibalan Orange RLN	(Prototype Acid Orange 86)
Cibalan Brown BL	(Prototype Acid Brown 19)
Capacyl Brown RD	(Prototype Acid Brown 29)
Capacyl Red B	(Prototype Acid Red 182)
Lanasyn Red 2GL Pat.	(Prototype Acid Red 216)
Cibalan Bordeaux GRL	(Prototype Acid Red 213)
Lanasyn Brilliant Blue GL	(Prototype Acid Blue 127)
Irgalan Grey BL	(Prototype Acid Black 58)
Lanasyn Brilliant Green BL Pat.	(Prototype Acid Green 40)
Capracyl Yellow 3RD	(Prototype Acid Orange 64)
Irgalan Brown 2RL	(Prototype Acid Brown 45)
Lanasyn Brown RL P.A.F.	(Prototype Acid Brown 28)
Capracyl Blue G	(Prototype Acid Blue 165)
Lanasyn Bordeaux RL Pat.	(Prototype Acid Red 217)

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the process shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. The process of making an improved fabric, which comprises starting with yarn of multifilament continuous filament thermoplastic synthetic fiber having a fiber size between 1.5 and 30 denier and a yarn size between 50 and 10,000 denier, and knitting this yarn into a prefabric and progressing the prefabric longitudinally through a stuffer crimp box and in the crimp box crimping the prefabric and superimposing prefabric crimps on the loop formation of the knitted prefabric, heat setting the prefabric in an autoclave in the presence of steam at a temperature between 180° and 270° F. to set both the loops in the prefabric and the crimps formed in the crimp box, unravelling the prefabric to produce crimped yarn which contains both crimps due to the loops in the prefabric and crimps formed in the stuffing box both superimposed on the yarn, and producing a fabric in which the yarn forms the face.

2. The process of claim 1, which comprises producing a house furnishing fabric from the yarn.

3. The process of claim 1, which comprises subjecting the yarn in the crimp box to steam at a temperature between 180° and 270° F.

4. The process of making an improved fabric which comprises knitting yarn into a prefabric, said yarn being composed of multifilament continuous filament thermoplastic synthetic fiber having a fiber size between 1.5 and 30 denier and a yarn size between 50 and 10,000 denier, progressing said prefabric through a stuffer crimp box and there crimping the prefabric to superimpose crimps on

the fabric, subjecting the prefabric while crimped in the stuffer box to steam at a temperature between 180 and 270° F. to set the loops and to set the crimp in the fabric, unravelling the prefabric to form yarn which has crimps due to loops and crimps due to the action of the stuffer box, and producing a fabric in which said yarn forms the face.

5. The process of making an improved fabric which comprises knitting yarn into a prefabric and thus providing in the prefabric loops of the yarn, said yarn being composed of multifilament, continuous filament, thermoplastic synthetic fiber in said loops having a fiber size between 1.5 and 30 denier and a yarn size between 50 and 10,000 denier, progressing said prefabric through a stuffer crimp box and there crimping the prefabric to superimpose crimps on said loops of said fiber in the yarn, subjecting said prefabric while said loops of the fiber of the yarn still have crimps of the stuffer crimp box to steam at a temperature between 180 and 270° F. to set said loops of the fiber and crimps superimposed upon said loops of the fiber, unravelling the prefabric to form yarn which has crimps due to loops and crimps due to the action of the stuffer crimp box, and producing a fabric in which said yarn forms the face.

6. The process of making an improved fabric which comprises knitting yarn into a prefabric and thus providing in the prefabric loops of the yarn, said yarn being composed of multifilament, continuous filament, thermoplastic synthetic fiber in said loops having a fiber size between 1.5 and 30 denier and a yarn size between 50 and 10,000 denier, progressing said prefabric through a stuffer crimp box and there crimping the prefabric to superimpose crimps on said loops of said fiber in the yarn, subjecting said prefabric while said loops of the fiber of the yarn still have crimps of the stuffer crimp box to steam at a temperature between 180 and 270° F. to set said loops of the fiber and crimps superimposed upon said loops of the fiber, unravelling the prefabric to form yarn which has crimps due to loops and crimps due to the action of the stuffer crimp box, opening up the yarn to readjust the set fibers with respect to each other and fluff the yarn, and producing a fabric in which said yarn forms the face.

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