Jan. 19, 1960 B. H. FOSTER ET AL 2,921,360

PILE FABRIC AND METHOD OF MAKING SAME

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Fig. 1

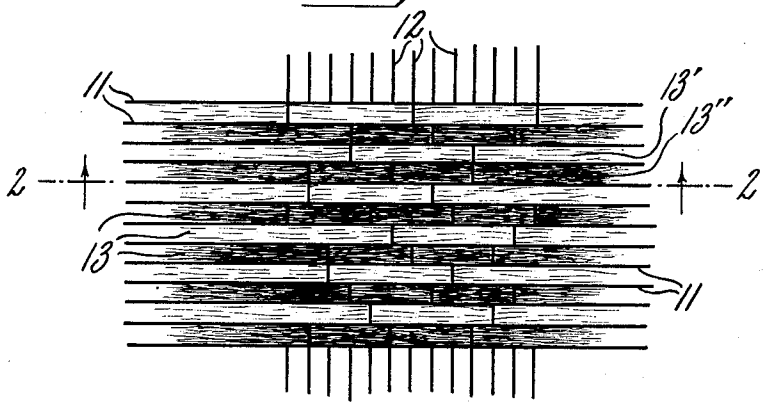




Fig. 2

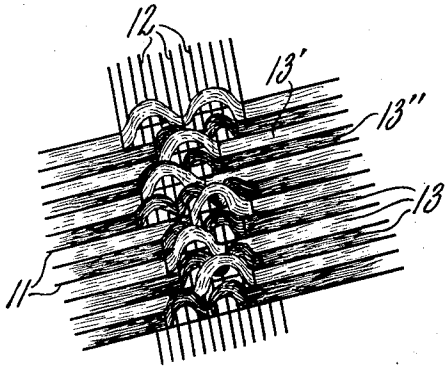
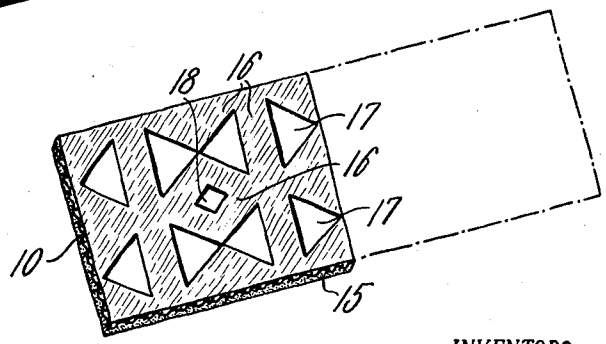


Fig. 3

Fig. 4



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PILE FABRIC AND METHOD OF MAKING SAME

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This invention relates to a novel looped pile fabric suitable for upholstery and allied purposes and to a method of making such a fabric.

Looped pile fabrics suitable for upholstery purposes have been made heretofore in constructions which are costly and by the use of methods which require special cumbersome and expensive machinery. For example, looped pile fabrics are made on a plush loom in which a series of weftwise wires enter the fabric to form the warp loops and to keep them in place while the fabric is being woven, after which the wires are detached and withdrawn. Looped pile fabrics are also made by means of a needle punch mechanism which pushes loops of yarn through a ground fabric by means of reciprocating needles. Jacquard looms in which each individual warp strand is controlled independently may also be used for making looped pile fabrics. The looped pile fabrics produced by these methods of the prior art have one salient feature in common: they are costly because the machinery used is expensive, and the production from this machinery is low.

The object of this invention is to provide a novel looped pile fabric which is inexpensive to manufacture. The fabric in accordance with this invention is such that it can be woven on a simple loom, and by suitable treatment the off-the-loom fabric can be transformed into a looped pile fabric suitable for use in upholstering and similar applications. It is a further object of this invention to provide a method of making such a looped pile fabric.

In accordance with this invention a flat fabric is first woven on any suitable loom such as the ordinary plain loom. This flat fabric is woven in the form of a ground fabric which comprises any desired textile strands running in one direction thereof, and highly contractile thermoplastic strands capable of shrinking from 30 to 60% running in the other direction thereof. These strands may be interwoven in any suitable weave such as a plain weave. The flat fabric also includes an additional system of lofty yarns that are non-contractile. These lofty yarns extend in a direction parallel to the thermoplastic strands, and they are interwoven with the ground fabric in a weave in which they form a series of floats extending over 2 to 6 or more crossing strands on one side only of the ground fabric.

The flat fabric is then treated to cause the contractile yarns to shrink from 30 to 60%. As these strands shrink, the spaced apart points at which the system of lofty yarns are woven to the ground fabric will be drawn more closely together by the shrinkage of the ground fabric. As these points are drawn more closely together, the soft, lofty yarns in the floats will buckle to form upstanding loops extending from one surface of the ground fabric, and these loops will populate densely this surface to form a looped pile. Thereafter the opposite surface of the ground fabric may be coated or impregnated with a flexible organic coating material such as natural or synthetic rubber, vinyl resin, etc., which coating serves to anchor

the non-contractile loop yarns to the ground fabric to prevent pulling out or pushing through of the loops in these non-contractile yarns under stresses exerted on the fabric.

Any suitable thermoplastic strands may be used for the heat contractile strands in the fabric of this invention. Many such strands and their shrinking characteristics are well known in the textile industry. For example, strands of polyethylene, or strands of vinylidene chloride polymers known commercially as saran, or strands of vinyl chloride/vinyl acetate copolymers such as those known commercially as Vinyon, Rhovyl, etc., may be used. The crossing strands of the ground fabric may be formed of any natural or synthetic fibers, either in staple or continuous filament form. Many soft lofty yarns suitable for the pile yarns are well known to the textile industry.

Looped pile fabrics in accordance with this invention may be made in which the loops are arranged on the surface of the fabric to form many pleasing and attractive designs by varying the weave pattern in which the floats are woven to the ground fabric. Thus the loops may be formed in rows extending transversely of the fabric by suitably aligning the points at which the looped yarns are interwoven with the ground fabric. If desired the loops can be disposed in the surface of the fabric in a twill, herringbone, or other pattern by weaving the floats to the ground fabric in similar weaves.

If desired fabrics having multi-planar surfaces may be produced in accordance with this invention by suitably varying the weave pattern in which the floats are tied to the ground fabric. Thus, for example, any individual float yarn may be made to pass over first a greater number of crossing strands, for example 4 to 6, then be interwoven with the ground fabric, and next made to pass over a lesser number of crossing strands, for example 2 to 3, before being again tied to the ground fabric. When such an off-the-loom fabric is shrunken, the longer and shorter floats will form loops of different heights. By suitably weaving all of the strands in the system of float yarns, a fabric can be produced having areas with relatively tall loops therein and other areas with somewhat shorter loops therein to produce fabrics having multi-planar surfaces.

Many varied colored effects may also be achieved in the looped pile fabric in accordance with this invention. Thus the system of float yarns may contain differently colored yarns, so that the fabric after shrinking will have different colors in its pile surface. Or yarns which are dye receptive may be interwoven with yarns which are dye resistant, and the fabric may be subsequently dyed to produce variegated effects in the finished fabric. It will be readily apparent that fabrics in accordance with this invention can be piece dyed after they are formed. When such a procedure is used the piece dyeing operation and the shrinking operation can be combined so that as the fabric is subjected to the dye bath it also is shrunk to form the raised pile loops of the finished product.

For a better understanding of the nature of this invention, reference should be had to the following detailed description thereof and of specific embodiments of the invention, and to the accompanying drawings forming a part of this specification.

In the drawings,

Fig. 1 is a greatly enlarged plan view of an off-the-loom fabric embodying this invention.

Fig. 2 is a sectional view of the fabric of Fig. 1 along the line 2—2 of Fig. 1.

Fig. 3 is a view illustrating the formation of loops in a part of a fabric such as that shown in Fig. 1.

Fig. 4 is a perspective view of a fabric embodying

this invention illustrating one of the designs which this invention permits.

In the looped pile fabric in accordance with this invention, a flat fabric is first woven on any suitable loom such as the ordinary loom. This flat fabric comprises a woven ground fabric which includes heat contractile thermoplastic strands capable of shrinking from 30 to 60% extending in one direction thereof and any other suitable textile strands extending in the other direction thereof. In addition to the yarns forming this ground fabric, the flat fabric includes a system of float yarns which extend in a direction parallel to the heat-shrinkable strands. The float yarns are non-shrinkable, soft and lofty, and as the ground fabric is woven, the floats are interwoven simultaneously therewith in a weave pattern in which they repeatedly float over 2 to 6 or more crossing strands of the ground fabric. The float yarns are tied to the ground fabric at spaced apart points by any suitable stitches such as the well known woven V-stitch or the W-stitch.

These features are illustrated in Fig. 1 of the drawings wherein the off-the-loom fabric will be seen to include a woven ground fabric having heat shrinkable strands **11** extending in one direction thereof and the crossing strands **12** extending in the other direction thereof. These strands **11**, **12** may be interwoven in any suitable weave, and in the embodiment shown in the drawing they are interwoven in a plain weave. There is interwoven with this ground fabric a system of non-contractile float yarns **13** extending in a direction parallel to the heat shrinkable strands **11**. In the drawings, alternate ones of these float yarns are shown in light and dark shading respectively to illustrate the principles of the specific embodiment shown. These non-shrinkable yarns **13** float over a plurality of crossing strands **12**, and are interwoven with the ground fabric **10** at intervals. Thus the yarn **13'** passes under a crossing strand **12**, thence over five of these crossing strands, and then passes under another crossing strand. The adjacent float yarn **13''** floats over three of the crossing strands **12**.

After the fabric having such a construction is shrunk, the yarns **13'** and **13''**, as well as all the other float yarns, will be found to buckle and form the looped configuration illustrated in Fig. 3 in the drawings. These loops will populate densely one entire surface of the finished fabric to constitute a looped pile. In a finished fabric which is constructed as illustrated in Figs. 1 to 3, the smaller loops formed by the yarns **13''** will underlie the larger loops formed by the yarns **13'** and tend to support them again matting in use.

The heat shrinkable strands **11** which extend in a direction parallel to the float yarns should be such that they are capable of shrinking from 30 to 60% upon subsequent treatment. These strands **11** are either oriented monofilaments or multifilament yarns made of thermoplastic synthetic resin. They range in diameter typically from .005'' to .030'' for the monofils, or are of 100–1600 denier in the case of multifilament yarns. Strands of polyethylene; or of vinylidene chloride polymers, such as saran; or of vinyl chloride/vinyl acetate copolymers, such as Vinyon, Rhovyl, and others, etc. are suitable. The crossing strands **12** may be formed of any suitable non-shrinkable natural or synthetic fibers either in staple or continuous filament form. If it is desired, these crossing strands may be made of heat shrinkable yarns of any desired shrinking characteristic, so that when the off-the-loom fabric is treated to form the pile loops therein, the crossing strands **12** may be shrunk also to tighten the weave of the fabric transversely of the float yarns.

There are many soft, lofty, non-shrinkable yarns well known in the textile industry which are suitable for the non-shrinkable float yarns. Thus these yarns may comprise either long-fiber staple yarns of natural or synthetic fibers, or they may comprise multifilament yarns of continuous natural or synthetic filaments in which the individual filaments are from about .50 to 20 denier. If desired specific soft, lofty non-shrinkable yarns may be selected for the float yarns for additional characteristics. Thus a crimpable type of rayon yarn, sold under the name "fiber E" by E. I. du Pont de Nemours and Company, becomes curly or crinkled when treated with hot aqueous alkali solution, such as aqueous 5% sodium hydroxide. The method of manufacture of this yarn, and its properties, are described in greater detail in "Artificial Fibres" by Moncrieff (second edition) at pages 180–185. When fabrics utilizing such floats are suitably treated, the looped pile fabric will be found to consist of loops in which the individual yarns are somewhat curly or crinkled.

The heat required for shrinking the flat, off-the-loom fabric may be supplied in various ways, but it is most practical to use hot water. A hot water bath may be provided through which a length of the fabric is led continuously to shrink the strands from 30 to 60%. Although the heat shrinkable strands **11** may extend either warpwise or weftwise of the fabric, it is found that if these strands are made to extend warpwise of the fabric the resultant fabric lends itself more easily to a continuous controlled shrinking operation. Thus if the heat shrinkable yarns extend warp-wise of the fabric, the fabric may be led through the nip of a pair of rolls continuously, thence into the shrinking bath and thence out through a nip of a second pair of rolls. By suitably controlling the rotational speed of the several pairs of rolls, the shrinkage of the heat shrinkable strands may be thereby controlled, and consequently the unit weight of the finished fabric and the height of the loops may be controlled as desired. If the heat contractile strands extended in the weftwise direction, a tenter frame could be used in an obvious manner to control the shrinkage in the weftwise direction.

As pointed out above, the length of the floats may be varied to achieve various functional or design characteristics in the finished looped pile fabric of this invention. In Fig. 4 of the drawing there is illustrated one of the myriad designs which this invention makes possible in looped pile fabrics. The fabric of this figure was shrunk 50%, as indicated by the broken lines, to produce the above described loops. This fabric includes the ground fabric **10** and a coating **15**. In the shaded areas **16** the loops are relatively high, because the floats in the flat fabric were relatively long. In these areas the floats extended over from 4 to 6 of the crossing strands in the ground fabric whereas in the plain areas **17** the floats extended over 2 to 3 of the crossing strands, and consequently the loops were shorter. If desired the floats may be interwoven in a plain weave in other areas, as at **18**. Many other attractive designs of this or similar character will occur to those skilled in the art, it being only necessary to vary the length of the floats of the several yarns in accordance with the height of pile desired.

The following examples further illustrate the fabric of this invention. A flat fabric is woven consisting of 32 warp ends per inch of polyethylene monofilaments having a diameter of .012'', and 13 wefts per inch of 6's/1 cotton yarn in a plain weave, and warp float yarns of multi-filament 2200 denier rayon, 32 warps to the inch. In weaving the flat fabric, alternate warp ends of these rayon yarns are made to float repeatedly over 5 and 3 weft threads, respectively, in a fancy twill weave. The weight of the flat fabric off-the-loom is 9.1 ounces per square yard. The fabric is then immersed in water at 200–205° F. for ½ minute and its shrinking controlled to achieve a 50% warpwise shrinkage. The fabric after shrinking has 26 wefts per inch and 32 polyethylene and 32 rayon warps per inch. The rayon warps form upstanding soft loops in which the loops in alternate rows stand ⅜'' and ⅛'' respectively from the ground fabric. The fabric after shrinking weighs 18 ounces per square yard. The smaller loops in this fabric tend to support

the larger loops, and the entire surface of the fabric is populated by the loops. The loop yarns are tied to the ground fabric with V-stitches.

A further example of a fabric constructed in accordance with this invention is the following. A flat fabric is woven of 37 warps per inch of polyethylene monofilaments having a diameter of .012", and 13 wefts per inch of 6's/1 cotton in a plain weave and constituting the ground fabric, and 37 warps per inch of 900 denier 100 filament rayon woven to the ground fabric in a double sateen weave with the rayon floating over four wefts and being tied to the ground fabric with V-stitches. The weight of the fabric off-the-loom is 8.8 ounces per square yard. The flat fabric is then shrunk in hot water at 200–205° F. for ½ minute or less to shrink the fabric approximately 50%. After shrinking there are 26.3 wefts per inch and 36 polyethylene and 36 rayon warps per inch. The weight of the shrunken fabric is 17.1 ounces per square yard. The fabric was then piece dyed in a dye bath at a slightly higher temperature than the shrinking temperature, and the shrinkage was increased slightly so that the resultant fabric had 28.5 wefts per inch.

If desired, the unit weight and the height of the loops may be decreased somewhat when stretchable thermoplastic strands, such as polyethylene, are used, by stretching the shrunken fabric while it is subjected, as by hot drums or steam, to a temperature at which plastic flow can take place in the heat contractile yarns while the fabric is held under tension, and thereafter cooling it. If desired the finished fabric can be shrunk still further by subjecting it to heat at a higher temperature than that at which the earlier shrinking took place. For example, an upholstery fabric may be installed on an article of furniture, and then heated in place to shrink the fabric to remove wrinkles and insure a snug fit.

The stability of the loops in the fabric of this invention is greatly aided by the shrinking of the highly contractile thermoplastic strands, for the stitches of the pile yarns are pinched between the crowded crossing threads. The stability of the pile loops is also aided somewhat by the lateral crowding of the contractile yarns which takes place during the heat treatment as a consequence of the lateral expansion of these yarns accompanying their longitudinal contraction. As pointed out above, the crossing strands may similarly consist of contractile strands to increase this lateral pinching effect and generally to tighten the weave of the ground fabric, if desired.

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

1. A looped pile fabric, comprising a woven ground fabric including contractile thermoplastic synthetic strands extending in one direction thereof and crossing strands, a system of lofty float yarns extending in a direction parallel to said thermoplastic strands, said float yarns being interwoven with the ground fabric at intervals and forming a pattern of longer and shorter floats, said longer floats extending over 4 to 6 and said shorter floats extending over 2 to 3 crossing strands in the ground fabric, said thermoplastic strands being shrunken from 30 to 60%, said float yarns rising from the surface of said ground fabric in raised pile loops of different heights, and the lower loops underlying the larger loops to support them.

2. A method of making a looped pile fabric which comprises, weaving a ground fabric having thermoplastic strands capable of shrinking at least from 30 to 60% extending in one direction thereof and crossing strands, simultaneously interweaving with the ground fabric a system of non-contractile lofty float yarns in a direction parallel to the shrinkable strands and interspersed among them in a weave pattern wherein the lofty yarns form longer and shorter floats with the shorter floats interspersed among the longer floats, the longer floats extending over 4 to 6 and the shorter floats extending over 2 to 3 crossing strands in the ground fabric, and heating the resultant fabric to shrink the thermoplastic strands from 30 to 60% to cause the floats to buckle and form loops rising a substantial distance from the surface of the ground fabric in a pattern of higher and lower loops.

3. A flat fabric adapted to be converted into a looped pile fabric, comprising in combination with a ground fabric including contractile thermoplastic synthetic strands capable of shrinking from 30 to 60% extending in one direction thereof and crossing strands interwoven therewith, a system of non-contractile, lofty float yarns parallel to said thermoplastic strands and interspersed among them, said float yarns being interwoven with the ground fabric at intervals and forming a pattern of longer and shorter floats with the shorter floats interspersed among the longer floats, said floats being arranged to form a dense looped pile on one surface of the ground fabric when said contractile strands are shrunk from 30 to 60%.

4. A fabric having upstanding yarn loops from a surface thereof, comprising a woven ground fabric including contractile thermoplastic synthetic strands extending in one direction thereof and crossing strands, a system of heavy float yarns extending in a direction parallel to said thermoplastic strands, said float yarns being interwoven with the ground fabric at intervals and forming a pattern of relatively long floats and intermediate spaces along the length of the float yarns, said relatively long floats extending over at least 4 crossing strands in the ground fabric, the float yarns in the intermediate spaces between the relatively long floats interlacing with the crossing strands in the ground fabric at least every third crossing strand throughout the length of the float yarn in the intermediate spaces, said thermoplastic strands being shrunken from 30 to 60%, said float yarns rising from the surface of said ground fabric in raised loops where they are interlaced as relatively long floats.

References Cited in the file of this patent

UNITED STATES PATENTS

2,189,370	Shiranezawa	Feb. 6, 1940
2,215,563	Ogilby	Sept. 24, 1940
2,231,388	Kahil	Feb. 11, 1941
2,319,073	McElhaney	May 11, 1943
2,401,829	Kahil	June 11, 1946
2,401,830	Kahil	June 11, 1946
2,607,104	Foster	Aug. 19, 1952
2,627,644	Foster	Feb. 10, 1953
2,632,230	Neisler	Mar. 24, 1953
2,635,648	Foster	Apr. 21, 1953
2,656,585	Jackson	Oct. 27, 1953
2,766,506	Rice	Oct. 16, 1956

OTHER REFERENCES

Textile World, March 1950. "Pile Fabrics Possible From Ordinary Box Looms" (pages 131–133) by Arthur Johnson.