

[54] **PROCESS FOR MAKING TUFTED PILE CARPET**

[76] Inventors: **Hilaire Marcel Turmel**, 260 Garceau St.; **Dorothy Ellen Lackie**, Hemmings Falls Rd., both of Drummondville, Quebec; **Sohinder Nath Chopra**, 1379 Aberdeen St., Hawkesbury, Ontario, all of Canada

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*Primary Examiner*—Louis K. Rimrodt

*Attorney*—Thomas J. Morgan and Stephen D. Murphy

[57]

**ABSTRACT**

The present invention relates to a carpet tufted with a fibrillatable yarn and a method of fibrillating the yarn in the carpet to thereby deluster and consolidate the pile. More particularly, the present invention relates to the discovery that a high velocity fluid stream directed at the pile of a carpet tufted of a fibrillatable yarn delusters, fibrillates, entangles and consolidates the pile thereof.

**8 Claims, No Drawings**

## PROCESS FOR MAKING TUFTED PILE CARPET

### BACKGROUND OF THE INVENTION

The trend towards thick, heavy pile carpet, i.e., closely woven pile wherein the individual loops are of relatively light denier and closely compacted, has evolved several substantial problems in the manufacture thereof, the most notable of which is the inherent difficulty of tufting relatively light denier yarns. Specifically, the reduced dimensions of light denier yarns coupled with the increased number of yarns required per unit of area to effect the necessary cover makes it difficult for the tufting needle to pick-up, properly position and control the yarn loop during the tufting operation. Use of fibrillated yarns for the pile has not been an entirely satisfactory solution to this problem notwithstanding their very desirable bloom and cover, since the low denier and consequential reduced dimensions of each of the ends of a particular fibrillated yarn loop does not alleviate the inherent difficulty associated with the tufting operation.

### SUMMARY OF THE INVENTION

The present invention addresses itself to this problem of producing thick compacted carpet pile tufted of relatively light denier yarns. The solution thereto as will be described in greater detail hereinafter, comprises first, tufting the carpet with a fibrillatable yarn and, thereafter, passing a high speed fluid jet over the tufted carpet to fibrillate the yarn.

Heretofore fibrillatable yarns were not believed practical or desirable for tufted carpet uses, specifically because of their tape-like appearance, high luster, and poor resilience. That is, the poor appearance caused by excessive shine and tendency of the pile made therefrom to mat all but eliminated consideration of these yarns for use in a carpet or carpet-type environment. The present invention has found, however, that after treatment, in a manner to be more fully disclosed hereinafter, these yarns not only have lost their luster and have become substantially resilient but they have all the advantages of a fibrillated yarn, such as desirable bloom and coverability per loop. Equally as important these changes are accomplished without any of the attendant disadvantages previously associated with fibrillated yarns, such as difficulty to control during the tufting operation. Thus, a two-fold advantage has been realized with the present invention; first, the fibrillatable yarns used in the tufting operation can be of relatively heavy denier making them very easy to work with and control during tufting; and, second, a thick, luxuriant pile can be obtained easily and inexpensively.

### DETAILED DESCRIPTION OF THE INVENTION

The desire for thick, heavy pile carpet comprised of closely compacted, relatively light denier yarns has presented considerable difficulty in the tufting operation, due primarily to the inability of the tufting needle to properly grasp, position and control these yarns. One possible solution, using fibrillated yarns which have excellent bloom and provide maximum cover per loop has not been entirely satisfactory. The principal disadvantage being that the individual fibrils or ends of each fibrillated yarn loop are of relatively light denier and are, thus, equally as difficult for the tufting needle to handle as unfibrillated, light denier yarns. The needs has thus arisen for a method of making thick, heavy pile

carpets without the attendant disadvantages of tufting the carpet of relatively light denier materials.

The instant invention addresses itself to this problem and has surprisingly discovered that relatively heavy denier yarns can be used to produce a desirable thick, heavy, compacted pile for a carpet if the tufting material is fibrillatable and, if, after tufting, the fibrillatable pile loops are subjected to fibrillation by a high velocity fluid stream. Heretofore, fibrillatable yarns were considered as impractical and undesirable for carpet use because of their very high luster or shine and low resilience, which often resulted in matting during use. With the present invention, however, not only is the undesirable luster of these materials significantly reduced but the pile is surprisingly resilient and remains resilient even after considerable use. This resiliency compares quite favorably and in some cases is superior to carpet pile tufted of a prefibrillated yarn. Subsequent investigation has shown that when the carpet is tufted with a fibrillatable material which is thereafter fibrillated, the foundations of the pile loops are not affected, thus giving greater support to the loops and enhancing resiliency. In addition, with the present invention the carpet may be tufted with an easy to handle heavy denier yarn and the resulting product, after fibrillation, has all the coverability and appearance advantages of a carpet tufted of a fibrillated yarn.

More specifically, any yarn capable of fibrillation, such as a bi-component, or a fiber prepared by extruding a thermoplastic resin with a foaming agent or otherwise containing a foaming agent, or a highly oriented tape, and the like can now be used as the tufting material for a carpet. The denier of the yarn in its unfibrillated form, i.e., as used during the tufting operation, is not critical, although it is preferred that it be of sufficient denier for the tufting needle to readily grasp, position and control it during the tufting operation. It is considered essential, however, that after tufting and fibrillation of the yarn each yarn loop contain at least four free fibril ends per linear inch, with a preferred range of free fibril ends per linear inch being between about 20 to about 200. It is also considered essential that the individual fibril ends have a relatively low denier, with a preferred range being between about 10 and about 100. It should be understood at this juncture that the process of the present invention does not merely encompass voluminizing of the yarn loops after tufting, although voluminizing does occur, nor does it pertain to fluid jets used in conjunction with the tufting needle to guide and control positioning of the pile loop. When fully understood it will be appreciated that the present invention comprises a complete restructuring of the individual yarn loops from substantially single unit structures having one end per loop to a multi-element structure having, as stated above about 20 to about 400 free fibril ends per loop. It will also be appreciated that there is a corresponding reorientation in the apportionment of denier substantially unitary structure to a multi-end structure, each end or fibril having a desired denier in the range of from about 10 to about 100.

The process, per se comprises tufting a carpet with a fibrillatable yarn in a manner well known in the art and then, directing a high velocity fluid stream at the pile of the carpet to fibrillate the individual yarn loops. The fluid stream may be, for example, air, preferably heated or super heated air or steam and the like. This high velocity fluid stream which may be passed over the carpet

pile or alternatively the carpet pile may be passed by the fluid stream, serves to fibrillate, entangle, consolidate and deluster the pile loops. In a preferred form of the present invention the velocity of the fluid stream is between about 500 to about 3000 feet per second, measured at the nozzle and the pressure is between about 20 to about 100 psi, also measured at the nozzle. It is also preferred that the fluid stream impinge on the face of the carpet at an eighty degree angle to the carpet, with a most preferred range being between about seventy to about ninety degrees. Quite surprisingly and unexpectedly this treatment imparts a very soft hand and desirable texture characteristics to the pile.

Desirably, the carpet structure is continuously passed through the region of the fluid jet forces about a relatively sharp angle, such that the individual pile loops are directly exposed to the application of relatively uniform fibrillative forces throughout their pile length. Thus, the carpet may be passed under a series of fluid jets applied to the face thereof while passing about, e.g., a freely rotating roll, through an angle of 15° to 105°, preferably less than 75°. Most effectively, the apex angle employed is acute.

Equally as unexpected it has been found that by adjusting the nozzle positions and movements on a multi-nozzle device it is possible to impose a new pattern on what was a patternless carpet or to super-impose a new pattern on a carpet already having a pattern. It has also been discovered that when the fluid stream comprises hot air or steam, the individual fibrils tend to curl or crimp in a helical pattern which further enhances the resilience and bloom of each individual pile loop. Especially desirable results with hot air or steam as the fluid stream are obtained when the fibrillatable yarn is a bi-component each component of which has a different crimp potential. These yarns may be prepared, for example, by dividing a polymer melt into at least two portions and subjecting the portions to different thermal and/or shear history prior to recombining the portions and extruding them through a common die. Additionally, if the fluids are super hot, for example, about 300°C., it is possible to controllably burn intricate patterns and designs into the face of the carpet concurrently with fibrillation of the loops.

The present invention has also discovered that additional delustering of the carpet pile can be accomplished in either of two ways or combinations thereof. A first method for additional delustering involves coating the carpet pile after treatment as described above with a resin emulsion such as polypropylene, polyethylene, polyvinyl chloride or an acrylic resin with preferred concentration of these emulsions being at the one percent to about 10 percent level based on the weight of the carpet pile. In a preferred embodiment of this process the carpet is placed in a drying oven, maintained at about 100° to about 150°C., for between about 15 to about 40 minutes, to dry and cure the emulsion. This process has the added advantage of enhancing the stiffness of the loops and correspondingly the resilience of the pile.

Alternatively, it has been found that additional delustering of the pile can be obtained by needle punching the carpet also after fibrillation of the fibrillatable yarn, as described above. This particular method produces an interesting three dimensional effect somewhat similar to a needle punch pad and has the added advantage of increasing the degree of fibrillation of the pile loops.

Thus, for example, if a particularly lusterous fibrillatable yarn is used to tuft the carpet so that additional delustering is desired; or, if the particular end use intended for the carpet necessitates increased resilience for the pile, then the pile can be additionally delustered and made more resilient by treating the pile with a suitable emulsion and baking, as described above. Similarly, if it is desired to substantially increase the amount of fibrillation, or the amount of fibrillation in selected areas of the carpet, this may be accomplished by needle punching the carpet where desired.

The following examples demonstrate without limiting preparation of carpets according to the present invention.

#### EXAMPLE I

A coarse fibrillatable polypropylene tape was produced by adding 1 percent of a blowing agent to a polypropylene resin and extruding the resin. 2-ply fibrillatable yarn (having two ends of 1,800 denier twisted one turn in the S direction) was used to produce a level loop pile carpet on a 5/32 inch gauge tufter with a stitch density of 8 stitches per inch and a pile height of 0.300 inches. The backside of the carpet was coated with a common latex compound in a standard carpet finishing machine. A sample of the carpet was exposed to a jet of steam at 80 psi, the nozzle having a rectangular opening of 1/16 inch by 1 inch. The nozzle was held over the carpet in touch with the pile face and the carpet was moved under the nozzle along the axis of the tufting lines at 1 foot per minute. After one pass, the same action was repeated over the adjacent area so as to cover the whole width of the sample. Fine fibrillation of the carpet face resulted in a soft woolen hand and delustered appearance.

#### EXAMPLE II

The fibrillated carpet produced above in Example I was then treated with a 5 percent concentration of polypropylene emulsion. The emulsion was applied with a brush to the extent of 1 percent by weight. The carpet sample was then inserted in an oven at 125°C. and was left there for 15 minutes. When cooled to room temperature, the carpet showed dull appearance and somewhat stiffer hand. This carpet was then subjected to floor traffic. After 30,000 treads, the carpet maintained excellent appearance, reduced gloss and good resilience.

#### EXAMPLE III

Before the carpet produced in Example I above was latexed, a sample was removed from the Greige carpet. The Greige carpet was exposed to the fibrillation action of the steam nozzles. The fibrillated pile carpet was then coated with an emulsion as in Example II, and then latexed at 145°C., staying in the drying oven for 20 minutes. It was found that the fibrils had curled and entangled with each other due to the high heat in the oven producing a fine wooly hand and appearance.

#### EXAMPLE IV

The Greige fibrillated carpet of Example III was passed through a needle loom and 500 needle insertions per square inch of the carpet face were applied. The carpet pile height was reduced by this action and a pad of uniformed thickness of 0.100 inches was obtained. The primary backing of the carpet which is gen-

erally on the back of the pile carpet had migrated to the center of the felt pad.

As this invention may be embodied in several forms without departing from the spirit or essential character thereof, the present embodiments are illustrative and not descriptive. The scope of the invention is defined by the appended claims rather than by the description preceeding them and all embodiments which fall within the meaning and range of equivalency of the claims are, therefore, intended to be embraced by those claims.

What is claimed:

1. A process for making a tufted pile carpet by tufting a carpet with pile loops of a fibrillatable face yarn and thereafter fibrillating said loops with a fluid stream, wherein said fluid stream impinges on said carpet's face at an angle of between about 70° to about 90° and said fluid stream has a velocity measured at the nozzle of between about 500 to about 3,000 feet per second, whereby some of said fibrils intertwine and entangle with each other.

2. A process as in claim 1 wherein the fibrillatable face yarn is a bicomponent, each component having a different crimp potential.

3. A process as in claim 1 wherein the fibrillatable face yarn is prepared by extruding a thermoplastic resin with a foaming agent.

4. A process as in claim 1 wherein the fibrillatable face yarn is a highly oriented tape.

5. A process as defined in claim 1 further comprising the step of coating said carpet pile with a resin emulsion.

6. A process as defined in claim 5 wherein said resin emulsion is selected from the group consisting of polypropylene, polyethylene, polyvinyl chloride or acrylic resin and is applied in concentrations of between about 1 to about 10 percent, based on the weight of the pile.

7. A process as defined in claim 5 further comprising the step of introducing the carpet to a drying oven maintained at between about 100° to about 150°C. for between about 15 to about 40 minutes to cure the emulsion.

8. A process as defined in claim 1 comprising the further step of needle punching the carpet pile subsequent to the fibrillation of said face yarn.

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