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TUFTED ARTICLES AND METHOD FOR MAKING SAME

Filed Sept. 22, 1966

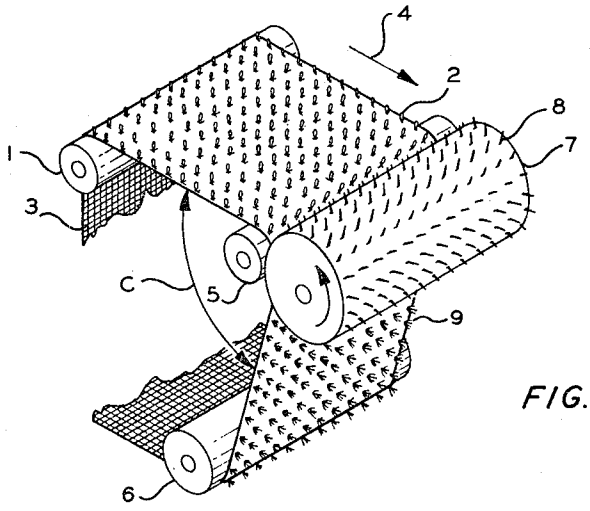


FIG. 1

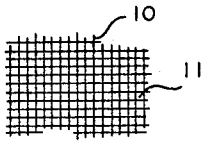


FIG. 2

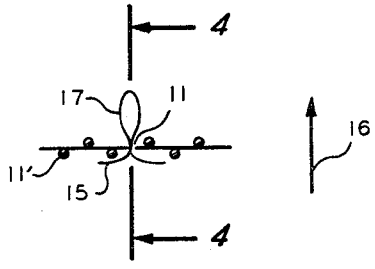


FIG. 3

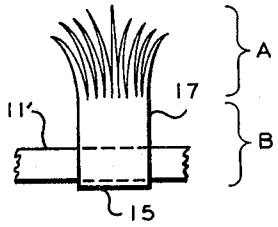


FIG. 4

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TUFTED ARTICLES AND METHOD FOR MAKING SAME

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ABSTRACT OF THE DISCLOSURE

A tufted article is formed by employing as the tufting material a substantially nonfibrous, fibrillatable material, and then fibrillating the tufts formed from said tufting material.

This invention relates to a method for making tufted articles and the articles themselves. In one aspect this invention relates to a method for making closed or cut-loop tufted rugs or carpets and the articles produced thereby.

Heretofore rugs and similar tufted articles have been made by pushing a yarn through a backing material to produce loops of the yarn on one side of the backing. Heretofore multifibrous yarns used in making tufted articles have required several process steps for their production. For example, in one case, the yarn filaments have been cut into staple, crimped, carded, and then formed into the yarn used for making the tufted article.

It has now been found that the process steps practiced heretofore in making a multifibrous yarn can be obviated and a more simple yet less expensive process for making a tufted article achieved if the tufting material employed is a polymer that is in a solid, nonfibrous form and has been molecularly oriented sufficiently to make same fibrillatable, forming the tufted article using this nonfibrous polymeric material, and, after the tufted article is formed, fibrillating a portion of the tufts formed from the nonfibrous polymeric material thereby converting at least a portion of each tuft into a multifibrous member.

By this invention a nonmultifibrous polymeric material such as a film, ribbon, monofilament or the like of molecularly oriented polymer is used in making the tufted article, thereby obviating all the process steps heretofore employed in making a multifibrous yarn to be used in making a tufted article. Then, after the tufted article is made, a portion of the tufts formed by the polymeric film or filament is fibrillated to form the desired multifibrous surface or pile on the tufted article.

By this invention there is produced a tufted article wherein a portion of the tufts adjacent to and/or in contact with the backing material is fibrous whereas the outer ends of the tufts that are furthest removed from the backing are multifibrous in nature and have a soft, warm feel desired for tufted articles.

Even though a simpler, less expensive method for making tufted articles is effected by this invention by eliminating the prior art multifibrous yarn forming steps, the tufted articles of this invention have improved physical characteristics in that the multifibrous ends of each tuft are carried by a solid, nonfibrous base portion adjacent to and/or around the backing. Thus, the tufts of this invention are supported in a very strong manner because of the solid base portion of those tufts. Further, because of the solid base portion, the tufts are generally more resilient than if the base portion were also multifibrous, as is conventional. In additional, since the solid base portion is also molecularly oriented, as the multifibrous ends of each tuft are worn down by normal wear and use the solid base portion itself will tend to fibrillate, e.g. under normal wear of walking, and the like, and additional fresh multifibrous portions are formed from the solid base. Thus, the tufted articles of this invention, particularly in the form of rugs, and the like, will generally show greater apparent durability since additional multifibrous portions are formed from the tufts during the use of the tufted article.

Accordingly, it is an object of this invention to provide a new and improved method for making tufted articles and the articles produced by that method. It is another object of this invention to provide a method for making new and improved carpeting and the carpeting produced thereby.

Other aspects, objects, and the several advantages of this invention will be apparent to those skilled in the art from the description, drawings, and appended claims.

FIGURE 1 shows apparatus embodying the invention.

FIGURE 2 shows a top view of conventional backing material.

FIGURE 3 shows a side view of a loop tuft formed according to this invention.

FIGURE 4 shows a side view of the loop of FIGURE 3 after it has been cut and fibrillated.

By fibrillation what is meant is the molecular orientation of a plastic film, filament, and the like by conventional means and techniques after which the molecularly oriented polymer is split up in a conventional manner to produce a plurality of individual fibers and/or a network of integral fibers composed of longitudinally extending stem fibers integrally joined to adjacent stem fibers by a plurality of shorter and smaller diameter cross fibers, the cross fibers extending between adjacent stem fibers at random points along the length of the stem fibers.

By molecular orientation what is meant is deforming, e.g. stretching the film below that temperature at which the film is substantially in the molten state, to thereby increase of the film at least in the direction in which it is deformed.

Film, filaments, and the like can be in any uniaxially or other multiaxially oriented condition that allows fibrillation thereof. The film can be oriented in any conventional manner including super-cooling the film and then orienting same by stretching and the like or heating the film at a temperature below that at which the film is in the molten state and then stretching same.

Full and complete disclosures of molecularly orienting and fibrillating plastic materials can be found in U.S. Patents 2,954,587; 3,003,304, and 3,165,563, the disclosures of which are hereby incorporated herein by reference. Full and complete disclosures of molecularly orienting plastic materials can be found in U.S. Patents 3,048,895; 3,233,029; and 3,235,644, the disclosures of which are hereby incorporated herein by reference. Generally, any conventional orienting and fibrillating process can be employed.

FIGURE 1 shows roll 1 of a tufted article wherein tufts 2 are formed from an oriented and therefore fibrillatable plastic material and are carried on a conventional backing 3. The tufted article passes in the direction of arrow 4 around idler roller 5 and is then wound on roll 6.

While passing around idler 5 the tufts are brought into contact with rotating drum 7 which carries around its periphery a plurality of needles 8. Drum 7 is rotating in a counterclockwise direction at a peripheral speed greater than the peripheral speed of the tufts around idler 5 so that needles 8 contact and move through the tufts 2. This brushing of the tufts with the needles of drum 7 fibrillates same, i.e. breaks the tufts up into a multifibrous material wherein the fibers are separate, joined to one another by cross fibers, or mixtures of both. The fibrillated tufts 9 thereby form the pile or surface of the tufted article.

Backing 3 is passed around idler 5 to define an acute angle C thereby exposing a greater portion of tufts 2 too

needles 8. Tufts 2 can be fibrillated with the use of needles 8 by passing the backing 3 in a straight line past drum 7 but in that case needles 8 will not reach as deeply as when acute angle is used. Therefore, when the backing is passed in a straight line by drum 7 less of the length of tufts 2 will be fibrillated in a single pass by drum 7. Various modifications will be obvious to one skilled in the art for varying the length of tufts 2 that is actually fibrillated. The length of the tufts that is actually fibrillated can vary from substantially all of the tufts to only a very small portion of the top of the tufts. As later pointed out with respect to FIGURE 4, it can be desirable to leave some of the tufts unfibrillated to thereby provide a more resilient base for the tuft and at the same time leave material for subsequent fibrillation under wear.

Any conventional means for fibrillating the tufts of the articles of this invention can be employed. For example, instead of rotating drum 7 counterclockwise it can be rotated clockwise so that needles 8 move against tufts 2. Also, the needles on drum 7 can be pointer or blunt ended and can be securely fixed to the drum or carried in a free swinging manner on the drum so that the rotation of the drum causes the needles to stand away therefrom and the speed of rotation of the drum will determine the degree of fibrillation of the tufts 2. The tufts can be fibrillated by other conventional methods such as by impinging a high pressure fluid stream, e.g., air, or small shot or other particulate material against the tufts. Substantially any means which will fibrillate all or part of tufts 2 can be employed in this invention. More than one fibrillating means in series and at different speeds can be employed.

The tufting material of this invention can be formed from any orientable and fibrillatable plastic such as homopolymers of 1-olefins having from 2 to 8 carbon atoms per molecule, inclusive, as well as bends and copolymers of these 1-olefins with each other and with polymers such as polyamides, polyesters, polyvinyl alcohol, acrylic polymers, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, and the like. Homopolymers of the 1-olefins and the other polymeric materials described can be employed as well as copolymers.

Generally, the films and/or filaments and the like employed as tufting materials in this invention should be oriented by stretching in at least one direction so that the film after stretching is at least 3 times longer in the direction of stretching than it was before stretching, i.e., a draw ratio of at least 3 to 1. When the polymer is polyethylene which has a density of at least 0.94 gram per cubic centimeter at 25° C., the draw ratio should be at least 4 to 1 and when polypropylene is employed, the drawing should be at least 6 to 1. The polymers employed in this invention can be formed in any conventional manner, a particularly suitable method for the preparation of polymers of 1-olefins being that disclosed in U.S. Patent 2,853,741. The films and filaments employed as the tufting material in this invention can be made in any conventional manner such as by extrusion, casting, flattening blown tubing, and the like.

The films and/or filaments and the like employed as the tufting material in this invention can be used "as oriented" or can be partially fibrillated in order to facilitate subsequent fibrillation of the tufts after the tufted article is made. In general, a partially fibrillated material employed will be fibriated to the extent of no more than 50 percent of that of the final fibrillated tufts.

Oriented film employed as the tufting material in this invention can vary from very narrow ribbon on the order of ⅛ inch widths to very wide film on the order of 3 to 10, preferably 4 to 6 inches. However, when wide film, i.e., at least 3 inches in width, is employed it is preferable that the film be laterally compressed or bunched such as by twisting or passing the film through an eyelet before using the film as tufting material. The diameter of the eyelet employed or other means used for laterally compressing a film can vary widely but will generally be of 1 to ⅛ inch or less. The thickness of the film or diameter of the filaments employed can vary widely, the film thickness generally being at least one mil, preferably in the range of ½ to 20 mils, and the diameter of the filaments being at least 1 mil and preferably in the range of 1 to 100 mils.

If desired, the oriented film can be crimped in any conventional manner such as by the use of a stuffer box. Conventional crimped film can give a rougher surface to the final product.

The backing for the tufted article can be any conventional material such as burlap, felt, needle punched layers of fibrillated polymer film, hemp, jute, rubber, plastic, and substantially any woven fabric, and the like. The backing, after formation of the tufted article, can be coated with a conventional rubber and/or adhesive for sealing the tufted material to the backing and for making the backing non-slipping if desired. Generally, any conventional carpet backing can be employed in this invention.

The tufted article can be formed in any conventional manner such as by the use of conventional tufting machines well known in the art. The tufted article can be either a cut pile or a loop pile article, fibrillation of the cut pile or the loop pile being readily achievable. The tufted artice can be shaved, i.e. a top portion of all the loops or cut loops cut off to produce a short dense pile. A full and complete disclosure of suitable tufting processes and the machinery therefor are described in considerable detail in an ASME publication identified as 66–TEX–2 entitled "Mechanical Development in Tufting Machinery" by Max M. Beasley, released for general publication on April 20, 1966, and available from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, N.Y., the disclosure of which is hereby incorporated herein by reference.

This invention is applicable to making a large number of tufted articles such as clothing (e.g. sweaters, coats, gloves, etc.), towels, draperies, tapestries, hats, bedspreads, powder puffs, furniture covering, and the like.

FIGURE 2 shows a conventional woven backing such as burlap carpet backing. The carpet backing is formed from a plurality of intertwined fibers or back strands **10**, the fibers defining interstice **11**.

FIGURE 3 shows an oriented plastic film **15** pushed through an interstice **11** of the backing of FIGURE 2 in the direction of arrow **16** thereby forming a loop **17**. Loop **17** can be left closed in which case the article produced will be known as a closed loop article. Loop **17** can then be fibrillated in the manner shown in FIGURE 1 to produce the multifibrous tuft **9** of FIGURE 1.

Loop **17** can also be cut at the top thereof, as shown in the above-referenced ASME publication, and then fibrillated.

FIGURE 4 shows one-half of loop **17** after it has been cut and fibrillated. FIGURE 4 shows a backing strand **11'** around which is wrapped film **15**. The upper portion A of cut loop **17** has been fibrillated, i.e. transformed into a plurality of individual and/or interconnected fibers. The base portion B of cut loop **17** is still a single, continuous, solid, nonfibrous piece of material, i.e. nonmultifibrous.

Portions A and B of cut loop **17** constitute a tuft such as tuft **9** of FIGURE 1. It can be seen that the solid base portion B of loop or tuft **17** is wrapped about the backing strand **11'** and, because of its solid form, cannot readily be pulled away from that backing. Further, because base B is a solid material, it will be resilient to a greater extent than if it were a multifibrous material such as portion A of cut loop **17**.

It can also be seen that as the multifibrous portion A is worn down by normal wear such as by walking on a rug, the solid base portion B will be more directly exposed to such wear. Since base portion B has also been oriented, it can also be fibrillated by physical means such as simply walking or otherwise scuffing base portion B. Thus, as

multifibrous portion A wears down, the base portion B is exposed to more direct wear and base B will be fibrillated thereby forming additional multifibers and thereby substantially increasing the apparent durability of the article.

The tufting material can be carried by the packing for the tufted article in any desirable manner. For example, besides looping the tufted material through interstices in a woven or otherwise porous backing, short lengths, e.g. ½ to 6 inches or more if desired, of oriented tufting material can have one end embedded in a rubbery or similarly elastomeric material that can be handled. Thereafter, before, after, or during or any combination thereof curing the backing material the upstanding tufting material can be fibrillated in any manner as indicated hereinabove. The backing material can vary widely, for example from a silicone rubber per se to conventional burlap carpeting backing coated with an epoxy resin, liquid latex rubber, and the like. Substantially any conventional backing coated with a suitable adhesive and the like can be used, a presently primary requirement being that the adhesive or other holding material be of sufficient thickness to hold the short lengths of tufting material during fibrillation and use of the final tufted product. By this aspect of the invention oriented plastic film as disclosed hereinabove having widths and thicknesses as discolsed hereinabove, e.g. 4 inches wide and 2 mils thick, is prebunched by passing through a small diameter eyelet and thereafter cut into the desired lengths, e.g., 2 inches. Thereafter, one or more of the short length, prebunched film is stuck into the adhesive or other holding material associated with the backing or forming the backing. Substantially any density of pile per square inch of wearing surface can be achieved since the individual lengths of prebunched film can be spaced from one another when stuck into the holding material any distance apart including in a substantially contiguous side by side relationship. Thereafter, preferably, the adhesive or backing is allowed to set or is cured or otherwise handled and the upstanding tufts formed from the prebunched film fibrillated in any conventional manner as disclosed hereinabove. The lengths of the tufts can be adjusted by either or both of controlling the length of the cut, prebunched film stuck into the backing or shearing a top portion of each tuft after being embedded in the holding material. This type of process can also produce a tufted product wherein a part of the tuft is fibrillated while the remaining portion of the tuft is solid and capable of subsequent fibrillation under wear, and the like.

The precut and prebunched polymer film that is to form the tufts in the final article can be embedded in the backing material in any manner, for example the individual films can be sewn together in a side by side relationship and fed to a reciprocating clamping means that moves into contact with one or more of the sewn together films, clamps same, and then pulls and clamps films embedded in the backing material.

The tufting material used in this invention can be in a foamed or unfoamed condition and can be of a single or a plurality of colors depending upon the effect desired for the final tufted product.

Example I

A film 2 mils in thickness formed from a homopolymer of polypropylene having a melt flow of from 2.5 to 4 (ASTM D–1238–62T, condition L, grams per 10 minutes) and a flexural modulus equal to or greater than 200,000 (ASTM D790–63, 73° F., p.s.i.) was oriented by heating at 250° F. and stretched using a draw ratio of 12 to 1 to form a longitudinally molecularly oriented polypropylene film 4½ to 5 inches wide.

This film was laterally compressed to a solid, nonfibrous yarn about ¼ inch in diameter by passing the film through a ¼ inch internal diameter eyelet.

The yarn was tufted through standard burlap carpet backing using conventional tufting needles to form a closed loop rug having 12 loops per square inch of surface.

The loops of the rug were then cut and brushed with a drum carrying around its periphery sixteen equally spaced bars 5⅜ inches in length, each bar carrying 80 steel, 3 inch long, 16 gauge upholstery needles ¼ inch in diameter. The upholstery needles were carried on the bar so that they could rotate freely about the bars and the drum was rotated at about 1000 r.p.m. in order to make the needles stand out away from the periphery of the drum and to fibrillate the loops as they came in contact therewith.

The rug, after brushing with the needle carrying drum, had an extremely soft but yet resilient pile, the surface of the rug exhibiting a very large number of extremely fine fibers over substantially the entire surface.

Example II

Polypropylene film of Example I is laterally compressed to a solid, nonfibrous yarn in the same manner as disclosed in Example I. The yarn was then cut into stapling lengths of 2 inches. An uncured, self-curing, silicone rubber backing material of a thickness of about ⅛ inch was provided and one end of the yarn staple was embedded in the silicone rubber to a depth of about 1/16 to ⅛ inch at a density of about 12 staples per square inch of surface of the silicone rubber backing. Thereafter, the rubber backing was allowed to cure by standing at room temperature for about 12 hours and the upstanding staple was fibrillated in substantially the same manner as set forth in Example I.

The tufted article resulting therefrom had an extremely soft and resilient pile, the surface of each exhibiting a very large number of fine fibers thereby resembling a very dense and deep pile rug.

Reasonable variations and modifications are possible within the scope of this disclosure without departing from the spirit and scope thereof.

I claim:

1. In a method for making a tufted article wherein the tufting material is formed onto a backing and allowed to extend from said backing, the improvement comprising molecularly orienting a nonfibrous polymer sufficiently to make same fibrillatable, tufting the molecularly oriented, nonfibrous polymer into said backing, and fibrillating the tufts formed from said nonfibrous tufting material after the tufted article has been made thereby converting the nonfibrous tufts into multifibrous tufts.

2. The method according to claim 1 wherein the tufting material is in the form of at least one of a film having a width of at least ¼ inch and filaments having a diameter of at least 1 mil.

3. The method according to claim 1 including partially fibrillating said tufting material before the tufted article is made.

4. The method according to claim 1 wherein said polymer is formed from at least one molecularly oriented homopolymer, copolymer, or blend thereof of 1-olefins having from 2 to 8 carbon atoms per molecule, inclusive, and drawing the polymer to molecularly orient same using a drawing ratio of at least 3 to 1.

5. The method according to claim 1 wherein the fibrillation of the tufts is carried out by brushing the tufts with a multibristled brush means.

6. The method according to claim 1 wherein the tufting material is a polypropylene film and including molecularly orienting said film using a draw ratio of at least 6 to 1, the backing is burlap carpet backing, fibrillating the tufts by contact with a rotating drum carrying a plurality of freely swinging needles thereon, rotating the drum sufficiently so that centrifugal force causes said needles to substantially point away from said drum and to fibrillate said tufts when moved thereagainst.

7. A tufted article comprising a backing material carrying a plurality of polymeric tufts, a substantial number of said tufts being characterized by the base thereof adjacent said backing being a substantially nonfibrous, mo-

lecularly oriented, fibrillatable portion, and being further characterized by the portion of each of said tufts that is adjacent to said substantailly nonfibrous base but on the opposite side of said base from said backing being a multifibrous fibrillated portion.

8. The article according to claim **7** wherein said tuft is formed from at least one molecularly oriented homopolymer, copolymer, or blend thereof of 1-olefins having 2 to 8 carbon atoms per molecule, inclusive, and said fibrillatable base having been molecularly oriented using a draw ratio of at least 3 to 1.

9. The article according to claim **7** wherein said tuft is at least one of closed loop and cut loop, and said base portion is at least one of a film at least ¼ inch in width and a filament at least one mil in diameter.

10. The article according to claim **7** wherein said backing is conventional carpet backing and the tufts are formed from a homopolymer of propylene, the multifibrous portions of the tufts being composed of at least one of separate fibers and adjacent fibers integrally connected to one another at random points along their length by at least one shorter and smaller diameter cross fiber.

References Cited

UNITED STATES PATENTS

2,980,982	4/1961	Costa et al.	161—169
3,034,194	5/1962	Priester et al.	
3,081,519	3/1963	Blades et al.	161—169
3,332,828	7/1967	Faria et al.	

JAMES R. BOLER, *Primary Examiner.*

U.S. Cl. X.R.

161—65, 169

Disclaimer and Dedication

3,431,875.—*Harold D. Boultinghouse*, Bartlesville, Okla. TUFTED ARTICLES AND METHOD FOR MAKING SAME. Patent dated Mar. 11, 1969. Disclaimer and dedication filed Dec. 28, 1971, by the assignee, *Phillips Petroleum Company.*

Hereby disclaims said patent and dedicates to the Public the remaining term of said patent.

[*Official Gazette April 11, 1972.*]