NON-WOVEN PILE MATERIAL AND METHOD FOR MAKING SAME

Inventors: Lester Gidge, 61 Linwood St.; Valmor R. Poulin, Jr., 70 Forest Park Dr., both of Nashua, N.H.

Filed: Feb. 24, 1972

Appl. No.: 229,060


U.S. Cl. 156/72, 156/180, 156/250, 156/296, 161/62, 161/67, 161/89

Int. Cl. D04h 11/00

Field of Search 156/72, 156/180, 156/250, 156/296, 161/62, 161/67, 161/89

References Cited

UNITED STATES PATENTS
2,438,156 3/1948 Dodge
3,145,446 8/1964 Sussman
3,359,147 12/1967 Miller
3,390,034 6/1968 Hull
3,580,761 5/1971 Boultinghouse

FOREIGN PATENTS OR APPLICATIONS
1,040,286 8/1966 Great Britain
1,047,382 11/1966 Great Britain

Primary Examiner—George F. Lesmes
Assistant Examiner—Charles E. Lipsey
Attorney, Agent, or Firm—Pearson & Pearson

ABBSTRACT

A plurality of tows of parallelized strands are supplied to a stationary head to present a compacted, but unconnected, mass of fiber ends in a selected pattern. The exposed ends of the mass are then joined into a unified solidified backing by heat fusing or the like. The mass is then moved out of the head, in a pile length increment by engagement with the backing, to pull the strand mass and tension the fibre ends, whereupon the mass is then severed transversely, to form a pile-bearing piece, tile or block of the desired color pattern, density, and pile height.

10 Claims, 11 Drawing Figures
1 NON-WOVEN PILE MATERIAL AND METHOD FOR MAKING SAME

This is a division of application Ser. No. 849,828, filed 8/13/69, now U.S. Pat. No. 3,673,048.

BACKGROUND OF THE INVENTION

In the textile art, looms have long been used to weave a backing fabric from which an upstanding pile projects, often by providing floating yarns which are cut to create velvet, velveteen, or the like. Woven rugs are similarly made, and by the use of complicated, loom mechanism, particular color patterns can be obtained. It has also been possible to produce short pile non-woven fabric by flocking methods wherein the pile is erected vertically by static electricity with the tips embedded in a plastic backing. Color patterns are more difficult to achieve in flocking, and both weaving and flocking require costly machinery and considerable time of manufacture.

To achieve a more rapid and less costly non-woven pile material, there have been many proposals heretofore, wherein bundles of parallel strands, such as tow roving, roping, etc., are advanced along a path through a congealing zone, which may freeze the strands into a block, or impregnate the bundle with some other congealing, or hardening substance, whereupon slices are cut transversely from the congealed block, arranged on a backing and fused thereto and then unfrozen, or un-congealed, to become a backed pile fabric.

The frozen block, or slice, type system, is exemplified in U.S. Pat. No. 3,539,147 to Miller of Dec. 19, 1967, and involves the thorough wetting of the strands, the attempt to advance a frozen block of strands by friction engagement, and the attempt to satisfactorily cut the slices from the block, all of which are difficult to accomplish in a commercially acceptable apparatus.

The spraying of a binder, other than water, on the strands to cause them to congeal into a block capable of being severed transversely in exemplified in U.S. Pat. No. 2,491,258 and 2,516,559 to Fuhrhop who uses gels as a consolidating medium or other patent in which waxes, ammonium compounds, and the like are suggested as the consolidating medium.

Without using any consolidating medium, it has been proposed, as in U.S. Pat. No. 3,390,034 to Hull of June 25, 1968, to push or extrude the mass of filaments out of a tube, insert a false backing made of card clothing cut off the slice while supported on the false backing and apply the slide to an adhesive backing, and then remove the card clothing backing. Similarly in U.S. Pat. No. 2,438,156 to Dodge of Mar. 23, 1948, it was proposed to push the mass out of a tube, transversely sever the slice with a hot wire which also fused the tips into a film, and to cut the resulting slices centrally without heat to form individual pile pieces. The pushing of a compacted bundle of fibres through a mold and the attempting to accurately cut a projecting, unsupported mass of fibres, beyond the end of a molten tube, when the mass is free of consolidating medium, has been found to be difficult, especially if the pile is to be long and low in density.

SUMMARY OF THE INVENTION

This invention avoids the use of a zone in which the entire mass of strands is spread apart and sprayed, or otherwise exposed, to a liquid consolidating medium, and consequently avoids the problems of later removal of the consolidating medium. It also avoids any attempt to push a compact mass of flexible strands through a die, mold, or tube, whether congealed or un-congealed, by the use of fluid pistons, or rams, or by the use of sharp edged friction wheels.

Instead of these prior art proposals, in this invention, the parallelized strand material is supplied directly to a head, free of consolidating material, in such a manner that it can be withdrawn, or extracted by a pulling force. The tips of the compacted, unconnected fibres are exposed to form a planar surface which defines the desired pattern, and which may cover an area ranging from a one foot block to a small rug size.

A strand tip unifying element, preferably in the form of a barbed, suction plate, is then applied to the exposed fibre tips to fuse, bond, adhere, or otherwise unify the tips into a thin, coherent, integral film-like backing. A strand extraction means, preferably in the form of a barbed, suction plate, is then applied to the film-like backing, preferably while still viscous and tacky, to secure a grip on the mass and withdraw, or extract, it by a force applied to the backing. When the mass has been extracted from the mold head for the desired length of pile, and while the suction plate is still tensioning the fibres into taut condition, the severing means moves transversely to sever the fibre mass and form a pile carrying backing.

In principle, therefore, it will be seen that the feeding and slicing of the pile material of the invention are achieved by forming a film-like backing on the exposed tips of the fibres and then extracting and severing the mass by means of the backing, thereby eliminating the need for any consolidating medium. Using a large enough head, an entire patterned rug complete with backing, can be made in one operation in this invention. Usually, however, the apparatus will produce a succession of individual, identical rigid, or flexible, pile carrying blocks, slices, or pieces, which may be assembled into a composite rug, or other piled product. The invention runs contrary to prior methods in which discrete pile elements are formed and then surface bonded onto an adhesive backing in that, in this invention the mass is first surface bonded to create a backing, and the mass is then severed to divide off the so created discrete pile element with its built-in, film-like backing. The backing is formed from the tips while they are firmly held in the head, rather than being formed on a loosely held, limp, projecting mass of fibres to assure that the fibrous pile is normal to the film backing and not bent or distorted.

DESCRIPTION OF THE DRAWINGS

FIGS. 1 to 5 are diagrammatic side elevations showing the cycle of operation of the apparatus of the invention when the preferred fusion plate is used;

FIG. 6 is a similar view of an embodiment in which there is no fusion plate and the heated blade is both the fusion and the severing means;

FIG. 7 is a view similar to FIG. 6, showing an embodiment in which the fusion is accomplished by a foam or liquid spray and a chill plate;

FIG. 8 is an enlarged front elevation of a fusion plate having a grid of wire loops for incorporation into the film-like backing;

FIG. 9 is a side elevation of a sculptured, or contoured, face on the withdrawal suction plate;
FIG. 10 is a side elevation, in section, showing an extraction plate having a plurality of rotatable augers, or corkscrews; and FIG. 11 is an enlarged view of the spring-pressed braking means for applying tension on low density bundles of filaments so that they are taut when severed.

DESCRIPTION OF PREFERRED EMBODIMENT

As shown in the drawings, the apparatus 20 of the invention, for making non-woven pile fabric 21, includes the strand supply means 22, the strand end unifying means 23, the strand extraction means 24, the strand severing means 25, and automatic control means 26 for actuating the parts in synchronization.

STRAND SUPPLY MEANS

Strand supply means 22 is free of moisture chambers, single- or multiple-parallel strand spreading apparatus, chill jacketed molds or dies, and could be a creel stand supporting a plurality of different colored packages of tow, or other parallelized strand material, synthetic or natural, twisted or crimped, sufficient to continually supply running lengths of the strands 28 to the head 29. The head 29 comprises a battery of closely spaced, open-ended cells, 36, of polygonal rather than circular cross section to eliminate voids, the cells being formed by the terminal ends of a battery of thin walled tubes, or conduits, 31, curved as shown and preferably each at least two or three feet in length and about one-half inch in crosswise dimension.

A tow, or multiple parallel strand, 28, of synthetic filaments, preferably of the heat fusible type, such as nylon 6, or nylon 66, and in a length equal to the length of a tube 31, is threaded into the rearward open end 32 of the tube, which is preferably circular in cross section, by insertion of a hooked, or barbed wire, from the open forward end 33 of the tube and drawing each tow into the tube to fill it. Each tube 31 may be of progressively decreasing cross section to compact the unconnected, and unconsolidated, filaments into a mass of increased density, and it will be understood that it would be most difficult to push such a tow through a feed tube, or even to draw it through the tube without pinching it in a nip in the manner of draft rolls. The tubes 31 serve the purpose of not only storing, guiding, supporting, and compacting the strands, but also the inside faces 34 of the tubes produce the correct frictional braking, or retardation, on densely packed strands, so that when the extraction forces are applied thereto, the strands are pulled taut for severing. A spring bias force on the strand for tautening and cutting purposes would pull the strand rearwardly and right out of the tube, so that the retardation force is preferably frictional wall contact for high density strands such as two hundred ends per inch, and is a side-wise spring frictional contact for low density strands, such as one hundred ends per inch (FIG. 11). The tubes 31 may be of any desired length, depending on floor space, density of the ends, the height of the desired pile and other manufacturing considerations.

The face of head 29 forms a grid, or honeycomb, 35, of polygonal cells 36, which may be 9 or 12 inches square if a flexible block, or semi-rigid tile, or pile carrying material is to be made for inclusion in, for example, a rug or larger area in a repeat colored pattern. The head 29 and grid 35 may be several feet in dimension to form a small rug, or, preferably, may be about 1 foot in height and 10 or more feet in length to produce a series of elongated piled strips successively. Preferably a peripheral, projecting frame 37 is spring mounted on the head 29 to confine the mass of strands when withdrawn a pile length therefrom, but arranged to yield rearwardly out of the way when the fusion plate advances up to the head 29.

A particular tube 31 may be all one color of strand, or it may be several colors, and a partition may be inserted across the cell to keep the colors separate. Upon being threaded, the terminal ends of the strands in each cell of the grid 35 are exposed and form a planar face 38, the ends being unconnected but ready to be fused or otherwise unified into a film-like backing by the strand end unifying means 23.

STRAND END UNIFYING MEANS

Strand end unifying means 23 is preferably a plate 40, having a face 41 heated by suitable means, such as electric resistance units flexibly connected by cable 42 to a source of current not shown. The strands 28 are preferably of thermoplastic material having a predetermined melting point, for example, nylon 6, with a melting point of about 450°F., nylon 66 with a melting point of 509°F., or the like, and the face 41 is heated to well above that temperature, for example, to 850°F. This is for the reason that at such temperature, any accumulation of the nylon on the plate is burned off, and also to permit an instantaneous, short, contact of the face 41 with the planar face 38 of the exposed terminal tips of the mass of strands, to fuse the tips into a cohesive, film-like backing 43. It is the film-like backing 43 which unifies the mass of strands, and by which the strands may be subsequently handled, withdrawn from the head, held taut for severing, and constituting the backing for the pile 44 on the piece, block, or tile 21.

The melt viscosity of the selected material of strands 28, when nylon 6 is in the vicinity of 200-700 poises. Melt spun polyester filaments may have melt viscosities as high as 26,000 poises and be useable in the method disclosed herein.

The strands are made of heat fusible materials such as thermoplastic synthetic polymers. Examples of such polymers include polyethylene; polypropylene; polypropionates; polyurethanes; polyamides; copolymers of vinyl acetate and vinyl chloride; the copolymers of vinylidene chloride and a minor proportion of vinyl chloro-ride; linear polymers of aromatic dicarboxylic acids and dihydric compounds, such as polymeric ethylene terephthalate; linear polycarbonamides (generally known as nylons) such as polymeric hexamethylene adipamide (nylon-66) and polymeric 6-aminoacaproylic acid (nylon 6) and other fiber-forming thermoplastic polymers.

There are certain strands, such as cotton, wool, and the like, that are not melt fusible and hence, cannot be used alone. Furthermore, certain heat-fusible thermoplastic strands, such as "Acrilan" acrylic fiber made by Monsanto, are not entirely suitable in that due to their high melt viscosities, the molten materials do not readily spread into a desirable continuous unbroken sheet. For such fiber strands, this invention provides a supply 46 of thin plastic sheets, such as the nylon sheet 47, the sheets being stored in roll, fan-folded, or sheet magazine form, as at 48, and automatically fed downwardly to cover the planar face 38 of the tips of the
non-fusible strands just before the hot plate 40 reaches the tips of its fusion stroke. By this means the hot plate melts the nylon, or other sheet, while the exposed tips of the non-heat fusible strands embed themselves in the film to form the desired backing 43.

As best shown in FIG. 8, it has been found useful to apply a grille 50 of fine metal wire 51 to the planar face 38 of the exposed tips, so that the grille will be embedded in the film-like backing 43 when formed by the hot plate 40. The grille 50 is so dimensioned that it is of slightly greater area than the face 38, whereby the selvedge loops 52 extend outside the backing entirely around the periphery. Each resulting pile-carrying piece, or tile, 21, is thus flexible, and can be assembled into a larger rug by bending the adjacent wire loops 52 into a hooked connection. Replacement of a damaged portion is thus easy and no other backing is needed to unify the larger rug. In addition, wire 51 is preferably an electrical conductor so that it is useful as a means to avoid, and discharge, static electricity by suitably grounding the outside loops 52. The wire grilles 50 may be substituted for the nylon sheets in magazine 48, or may be contained in a similar magazine 53 ready for use when desired.

A semi-rigid, or rigid, pile-carrying piece, or block 21, is also obtainable by means of this invention. As shown in FIG. 1, a magazine 55 similar to magazines 48 and 53, is provided, or a fan-fold, or roll supply, if preferred, by which a plurality of relatively thick sheets 56 may be individually and successively fed downwardly to cover the face 38 just after the heat fusion stroke. Each sheet 56 is formed of a suitable material 57, such as asphalt, or rubber tile composition, or the like. Thus the hot plate 40 may be raised to the desired temperature and held in place for the required time to melt the face 38 and form a film backing 43. The face 58 of sheet 56 is then bonded to the melted tips of the strands to thereby form a pile-carrying tile useful in place of conventional tile to give a carpet-like floor or wall surface.

STRAND EXTRACTION MEANS

Strand extraction means 24 is preferably in the form of a plate 60 carried on the end of a piston rod 61, reciprocable in a double action, fluid cylinder 62 and actuated by fluid conduits 63 and 64 from a suitable fluid pressure source 65 controlled by automatic control means 66, which includes a cycle timer 66. For diagrammatic convenience the hot plate 40 has been shown gravity operated and with an inclined face 67 engaged by roller cam follower 68 carried by extraction plate 60. Thus, as the extraction plate 60 withdraws with a piece 21, the fusion plate 40 advances on its fusion stroke, and as the extraction plate advances to engage the film-like backing 43 formed by the fusion plate 40, the later is retracted. In one embodiment, the fusion plate 40 preferably advances normal to the planar face 38 to avoid wipping or bending the fibre tips side wise just prior to fusion. A dwell 69 in cam face 67 permits the extraction plate to halt at a pile length distance from face 38, while holding the strands taut for severance and while holding the hot plate out of the way.

Extraction plate 60 is preferably formed of a plurality of individual, metal strips, or bars, 71 and 72, extending horizontally and connected alternately in groups so that alternate bars 71 may be advanced beyond the stationary group of bars 72 and then retracted behind the bars 72 of that group. This constitutes a stripping mechanism and the bars 71 are moved by flexible cables 73 under the control of means 26 and timer 66 when the extraction plate is in its rearward position (FIG. 5). Narrow suction slots 74 are provided between the bars 71 and 72 and connected by flexible conduit 75 to a source of suction 76. Extending vertically on the planar extraction face 77 formed by bars 71 and 72 are a plurality of hooked barbs 78, formed by parallel projecting ribs 79 which have been undercut at 80 at spaced distances therealong to form the hooked barbs 78.

The barbed, suction face 83 of the extraction plate 60, as shown in FIG. 9, may be sculptured, or otherwise shaped, in a reverse pattern, as at 84, so that when it advances, subsequent to the heat fusion step, to engage and grip the still hot and tacky film-like backing 43, it will impress its shape on the planar face 38 to create the desired obverse sculptured design.

It should be especially noted that the barbed, suction face 83, upon being pressed against the tacky, hot-melt face 38, with suction being applied in the slots 74, not only draws the hot plastic film under the hooked barbs 78, for firm embedment over the entire surface area, but it also tends to orient the plastic in the film-like backing 43 into a stronger sheet than if heat alone were applied. For example, when the fibres are of nylon 6, and the hot plate 40 has been applied at about 850° F and retracted and the suction plate 60 is then applied within about one second at about 6-15 inches of suction, the backing is so tough that it is most difficult to tear it by an even pull or even to break it by bending it back upon itself. On the other hand, with all conditions the same, but in the absence of the suction, the backing is somewhat brittle and tends to break and tear more easily.

As shown in FIG. 10, an extraction plate 85 may be provided with a plurality of spaced rotatable cork-screws, or augers 86, projecting forwardly and power rotatable by the battery of emmeshed gears 87 and the flexible drive cable 88 powered from the control 66. The cork-screws 86 are arranged to turn just sufficiently to secure a good penetration in the film-like backing 43 which may be cold and solid, or hot and tacky, so that upon withdrawal they will extract the strand mass from the head for severing. The cork-screws 86 may be used on plate 60 in place of the barbs 78 if desired, and the holes made by the cork-screws 86 close over, upon reverse rotation thereof for stripping, although they may be open if breathing of the fabric is desired.

It will be understood that the suction, hooked-barb, plate 60, or the cork-screw carrying plate 85, both are for the purpose of withdrawing, or extracting the strands from the head by pulling on a film-like backing 43 formed by the fusion plate 40. In one modification of the invention, shown in FIG. 6, however, the inside face 90 of the film-like backing 91 is used for pushing the strand from the inside out of the head 92, this being an extraction force as far as the strands 28 are concerned. An open cellular grid 93 is mounted to reciprocate around and between the walls of the cells of a slightly smaller grid 94 formed by the terminal ends of the tubular conduits 31, so that when the exterior extraction grid 93 moves in the direction of feed, it engages the inside face 90 of film 43, just as do the hooked barbs 78 or the turned cork-screw 86, and pulls, or draws, the
strands 28 out of head for the desired length of pile 89. In the embodiment of FIG. 6, the strand end unitifying means 23 and the strand severing means 25 have been combined in one relatively wide endless band-saw blade 95, which is heated to the desired fusion temperature, such as 450° F. to 900° F. by passage through a heating zone 96, or by any other convenient means and forms a plate-like unitifying element similar to fusion plate 40 which melts the terminal ends 97 of the strands on both sides of the cut as it travels through the mass of strands. The blade 95 is not a hot wire, since it is intended to form the film-like backing 43 by wiping contact, and not merely to cut the strands. The hot, wide blade 95 is preferably dimpled as at 98, for best results, and is preferably followed by, or accompanied by, a cold, wide endless blade 99 for solidifying the backing 43. In the embodiment of FIG. 6 a film 43 is first formed by blade 95 while the terminal ends of the strands project only slightly from the head. The exterior grid 93 is then advanced, by flexible cable connection 100, to control 66, to advance the mass by film 43 a distance equal to twice pile length, whereupon grid 93 is retracted, a fluid such as air from source 101 jetted outwardly from head 92 to tauten the projecting mass, and blade 95 again traversed to sever a double film faced piece 102. The pieces 102 are later cut centrally into individual pile-carrying pieces 21.

STRAND SEVERING MEANS

As explained above, the strand severing means 25 is preferably a wide, endless band-saw blade 104, which may be heated and dimpled as at 95 if used to heat-fuse a film, but which otherwise is simply a sharp-edged wire, blade, or other cutter, and which could be a power disc saw, a laser beam, or any other suitable device. It is shown diagrammatically in FIGS. 1–7, as trained around sheaves 105 on a vertically movable frame 106 which is raised and lowered by fluid piston 107 and cylinder 108 from a suitable fluid pressure source, under the control of means 26 and timer 66. The blade 104, as shown in FIG. 4 moves transversely of the mass of fibres, in the space between the head 29 and the suction plate 60 to sever the fibres while held taut between the same. Upon being severed, the backing 43 and its piece 44 is carried rearwardly on extraction plate 60 (FIG. 5) to the rearward position, whereby the thinner bars 71 first advance and then retractor, to unhook the fabric block, or piece, 21, to fall into a hopper not shown.

Preferably, the air source 101, feeds jets of air outwardly from the head 29, from within the mass, by means of flat, elongated, nozzles, or narrow emission slots, 106, at high pressure to flush out the terminal ends of the fibres and maintain the same normal to the face 38 just prior to and during the fusion step, all under the control of valve 120, means 26, and timer 66.

While the prior art has taught various ways of handling tightly compacted bundles of parallelized fibres by pushing the same through a mold, placing a wrapper around the bundle and pushing it, etc., such devices and methods will only produce highly compacted dense pile, and this is not always commercially desirable. This invention therefore contemplates handling less densely compacted bundles, such as 100 ends to the inch, rather than 200 ends to the inch or more, and it will be understood that such a bundle is limp, non-self-supporting, and easily bent, or compressed sidewise. In order to provide a braking, or retarding, force even when the bundle of fibres in each cell, or tube, of head 29 is so loose and fluffy as to not be appreciably friction-retarded by the tube walls, the braking means 110 is provided. Braking means 110 is mounted in each cell 36 of head 29 and comprises a first pair of spring leaf clamp arms 111 and 112 which resiliently and yieldably compress the tow from two opposite sides, and a second pair of spring leaf clamp arms 113 and 114 which resiliently and yieldably compress the tow from the other two opposite sides. The less dense tows are thus capable of being pulled out of the cells but only against the adjustable retarding force of the spring arms.

In FIG. 7 another modification is shown, in which the freeze consolidation of the prior art is used, but not for the entire strand and not with sidewise application of chill molds. As in the case of the heat fusion plate 40, the chill plate 115 is applied endwise of the terminal tips 116 of the strands 28, forming the planar face 38, as a plate-like unitifying element, maintained at a predetermined temperature for joining the exposed strand ends to each other. Chilling occurs after the face 38 has been sprayed with a moist or liquid water spray from the orifices 117 carried by plate 115 and connected to a suitable source of freezable liquid 118. Chill plate 115 is connected to a suitable refrigerator mechanism 119, of a commercially available type and maintained at a temperature of about 40° below zero to instantly freeze, or frost, the water spray into a film-like backing 122, in which the tips 116 are temporarily embedded and anchored, the remainder of the strands being free of water and frost or ice. An internal, reciprocating grid, such as 93, may then extract by pushing from the inside against the frozen backing, or a barbed suction plate 60 may be used as shown to extract. The pile is then cut and the piece 121 deposited on a conveyor for attachment to a backing by melting a portion of the frozen backing and applying an adhesive in the manner of the Miller patent mentioned above.

It will be understood that the apparatus and method of this invention can be used with many other strand materials to make pile products, for example, polypropylene ribbon can be so used. It is for that reason that I use the term "strands" meaning thereby to include filamentary, man-made fibres, spun, natural fibre yarns, ribbons, tapes, or any other elongated, flexible material intended to form a pile, whether in tow, sliver, roping, roving, or other form, and whether the pile material is to be shag rug form, wig form, artificial lawn, or ski slope surface, or the like. Similarly, while the invention is especially intended to create colored pattern rug type designs, it is equally useful in making uncolored pile piece goods, for later dyeing into designs.

For materials not readily melt fusible, a melt fusible powder or a melt fusible liquid substance may be sprayed on the terminal tips forming the planar face 38, just prior to application of the fusion plate. A strippable adhesive can also be used, such as heat-activated adhesives and pressure sensitive adhesives. Such adhesive materials are made from a variety of complex chemical compositions. Typical ingredients used in pressure-sensitive adhesives generally include an elastomer, such as a rubber, tackifier, such as gum resin, a plasticizer, such as lanolin, fillers and antioxidants. "Teflon" (polymeric tetra fluor ethylene) can also be used as a coating on an unbarbed extraction plate, since the
piece may be easily stripped from the extraction plate when cooled.

The non-woven, pile fabric product of this invention differs from the products disclosed in prior patents, in that the outstanding portions of the strands, which form the pile, have not been subjected to, or exposed to, ice, or other solidifying mediums so that the medium must later be removed and may have damaged the fibres. Similarly the pile fabric of the invention can be made by the process thereof, without requiring a dense, compact mass, or bundle, and without requiring that the fibres be short so that they will project unsupported from a head while a knife blade cuts off a slice thereof.

By reason of the formation of the backing film 43, the suction plate support of the strands during severing and the tautening effect of the suction plate and retarding means 110, the pile strands 44 can be less dense, non-self supporting and normally limp, but still be held taut and precisely cut to form a smooth face. Similarly, even if the pile has a density of less than one hundred ends to the inch and each strand 44 is several inches in length, for example in a shag rug, it is held taut and precisely cut to form a novel fabric not heretofore obtainable by such a process without solidifying the mass prior to cutting.

The pile fabric product 21, may be of any desired area, depending on the area of the head 29, to form a rug, or to be assembled, in any known or desired manner, into a rug or other pile product.

What is claimed is:

1. The method of making a non-woven pile fabric, free of consolidating or solidifying binders, by means of an open-ended, stationary head, a fusion plate and a hook barred extraction plate, said method comprising the steps of:
   - first assembling parallelized bundles of continuous, filamentary strands, arranged in a predetermined pattern and supporting said bundles in said stationary head for axial, sliding advance with the ends thereof exposed in a compacted mass defining a planar face;
   - then causing said exposed ends to fuse into a cohesive, exposed, solidified film backing by applying said fusion plate thereto while said ends are supported in said head;
   - then axially, slidably advancing said bundles out of, and away from, said stationary head by applying said extraction plate thereto and embedding said barbs in said solidified film backing and then retracting said extraction plate to exert an extracting force on said backing to thereby pull a predetermined length of said strands out of said head;
   - then severing said withdrawn bundles at a predetermined distance from said backing while still under the tension of said pulling effect of said barred extraction plate to form outstanding pile of predetermined height on said solidified film backing; and then stripping the resulting pile-carrying backing from said extraction plate.

2. A method as specified in claim 1 wherein:
   - said step of applying said extracting force is accompanied by a suction application step, and said hooked barbs are embedded in said film, while said backing is still liquid, and prior to solidification thereof, to assure a firm engagement therewith.

3. A method as specified in claim 1 wherein:
   - said assembling step includes the step of assembling strands only of synthetic material having a predetermined fusion temperature, and said heat application step includes the step of plate applying said heat at a temperature greater in excess of said fusion temperature, but for a short time in the order of about one second, to fuse said ends while avoiding accumulation of said material on said heat application plate.

4. A method as specified in claim 1 wherein:
   - said assembly and support step includes the step of supporting said bundles each within an elongated tube of predetermined length and cross sectional area sufficient to continuously exert frictional retardation forces thereon and spring applying a braking and compacting force on said bundles to further retard the advance of said bundles.

5. A method for forming a colored pattern pile fabric by means of movable heating and barred extraction plates and a stationary open ended pattern die, said method comprising the steps of:
   - compacting a plurality of tows of different colored continuous filaments of fusible plastic material, free of any consolidating or solidifying medium, into said stationary die for slidable advance therein and exposing the compacted mass of ends thereof in a plane across the open end of said die; and then heating said mass of exposed ends into a thin, exposed, unified, solidified backing while said ends are supported in said stationary die by advancing and retracting said heating plate to apply heat temporarily to said ends;
   - then extracting a predetermined length of said strands from the open end of said stationary die by advancing said movable barred extraction plate into engagement with said backing to embed the barbs thereof in said backing while still viscous and then retracting said plate and barbs embedded in the solidified backing to pull said backing under tension further out of the open end of said stationary die;
   - then cutting said strands, proximate the plane of said open end of said die, to form said pattern pile fabric, while said backing is so engaged and under tension from the pull of the embedded barbs of said extracting plate;
   - and then stripping said pattern pile fabric from the barbs of said extraction plate.

6. A method of making a non-woven pile fabric, by means of a stationary head, a movable tip unifying heated plate and a movable, hooked barb extraction plate, said method comprising the steps of:
   - supporting a plurality of bundles of continuous strands in said head for slidable advance with frictional retardation therein and with the ends thereof forming an exposed face;
   - moving said tip unifying plate toward and away from said exposed face, said plate fusing the exposed ends of said strands and forming a solidified film backing unifying the exposed ends of said strands, while supported in said stationary head;
   - then moving said hooked-barb strand extraction plate toward and away from the exposed face of said solidified film backing, the hooked barbs of said plate piercing into and hooking onto said solidified backing and then retracting said extraction plate while pulling said backing away from said
11 head to thereby extract a predetermined length of said strands therefrom; then, while the hooked barbs of said extraction plate continue to exert tension on said strands opposed to the frictional retardation of said head to tauten said strands, severing said strands at a predetermined distance from said solidified film backing to form a block of outstanding pile fabric; and then stripping said severed block from the barbs of said extraction plate.

7. A method as specified in claim 6, plus:
   - the step of removably mounting a reinforcing wire grid on said tip unifying plate for incorporation into said solidified film backing;
   - and releasing said wire grid for embedment in said film backing during the step of applying said tip unifying plate to the ends of said exposed face.

8. A method as specified in claim 6, plus:
   - the step of applying suction to said strand extraction plate while said barbs are embedding in said film backing and before said backing completely solidifies to draw said solidified backing into firm hooking engagement therewith.

9. A method as specified in claim 6, wherein:
   - said extraction step includes the steps of piercing and hooking the exposed face of said film backing with selected areas of said extraction plate and then, after retraction of said extraction plate, advancing other adjacent areas of said plate to strip said film from said selected areas to release said block from the face of said plate.

10. A method for making a pile fabric by means of a heated plate and a hooked-barbed extraction plate, which comprises:
   - supporting a plurality of heat melttable strands within a plurality of stationary tubes with the tips thereof exposed at one open end of said tubes;
   - applying said heated plate to the exposed tips of said strands and simultaneously heat unifying said tips into a solidified, exposed film backing while supported in said tubes;
   - applying said extraction plate to the exposed face of said backing while said film backing is still unsolidified to pierce and hook the barbs thereon into said backing;
   - then, after solidification of said backing, retracting said extraction plate away from said tubes, with said barbs firmly embedded in said solidified backing, to pull said backing and strands a predetermined distance out of said tubes; and then, while the hooked barbs of said extraction plate continue to exert tension on said strands to tauten the same, severing said strands at a location between said retracted extraction plate and said tubes; and then stripping the resulting block of pile fabric from the hooked barbs of said extraction plate.

* * * * *