United States Patent [19]

Hoey

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[54] **METHOD OF MAKING NON-WOVEN PILE FABRIC**

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[52] **U.S. Cl.** **156/72,** 156/247, 156/289, 156/435, 161/66, 161/67

[51] **Int. Cl.** **B32b 5/02,** D04h 11/00

[58] **Field of Search**.....156/72, 306, 247, 210, 204, 156/226, 227, 435, 289; 161/65, 66, 67; 136/210

[56] **References Cited**

UNITED STATES PATENTS

2,639,250	5/1953	Reinhardt	161/66
3,411,966	11/1968	Couquet	156/72
2,052,071	8/1936	Banister	161/66
3,525,662	8/1970	Padgett et al.	161/66 X
3,542,613	11/1970	Fox et al.	156/72
3,560,284	2/1971	Wisotzky et al.	161/66 X

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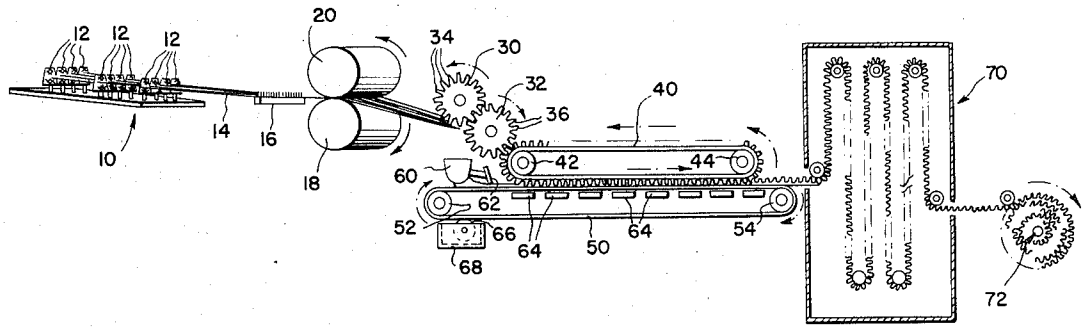
[57] **ABSTRACT**

Continuous strands of yarn are formed into loops defining upper and lower bight portions. A body of liquid resinous backing material is formed, and the lower bight portions of the loops of yarn are moved into the liquid backing material so that these lower bight portions are substantially embedded within and penetrated by the backing material. The backing material is then solidified.

5 Claims, 5 Drawing Figures



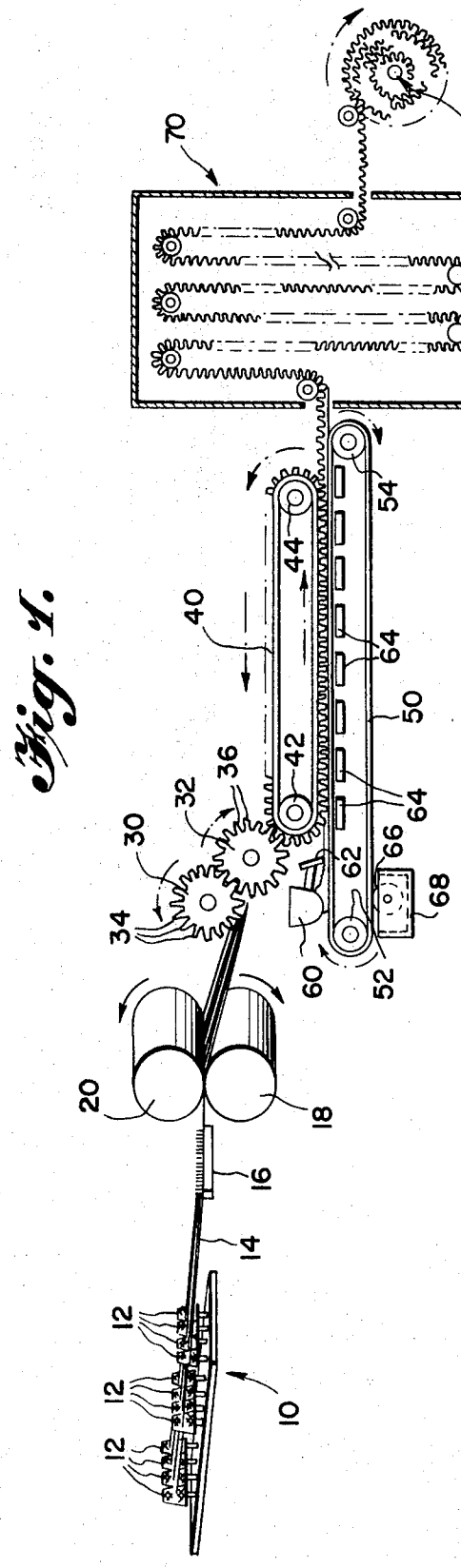


Fig. 1.

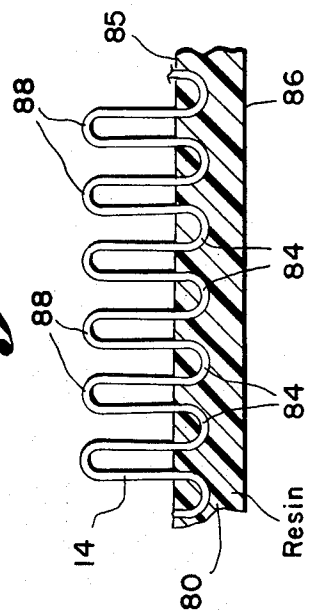


Fig. 3.

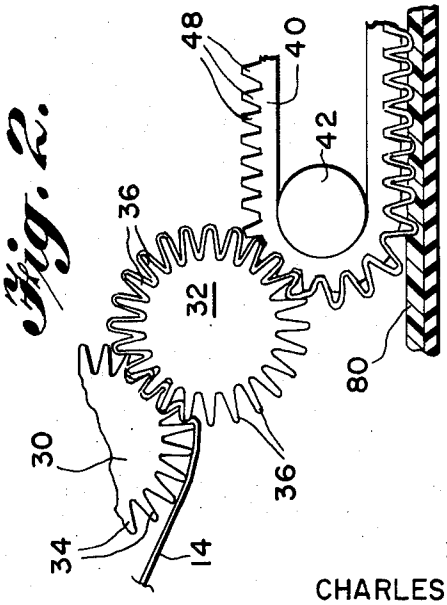


Fig. 2.

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Fig. 4.

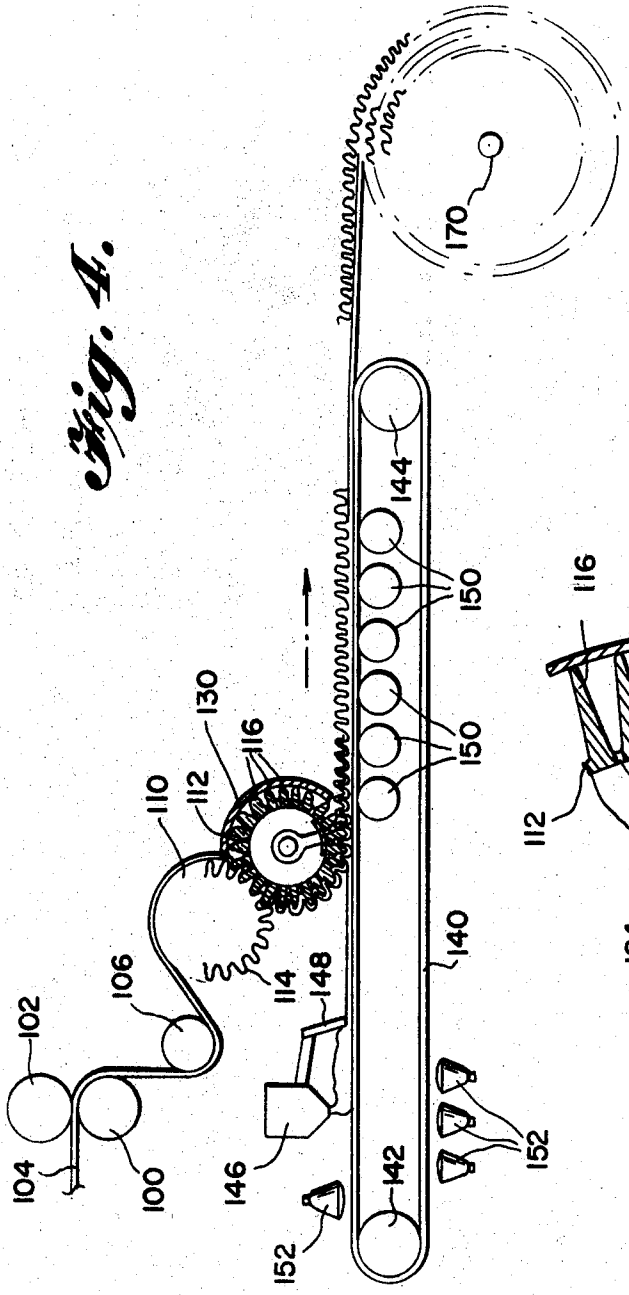
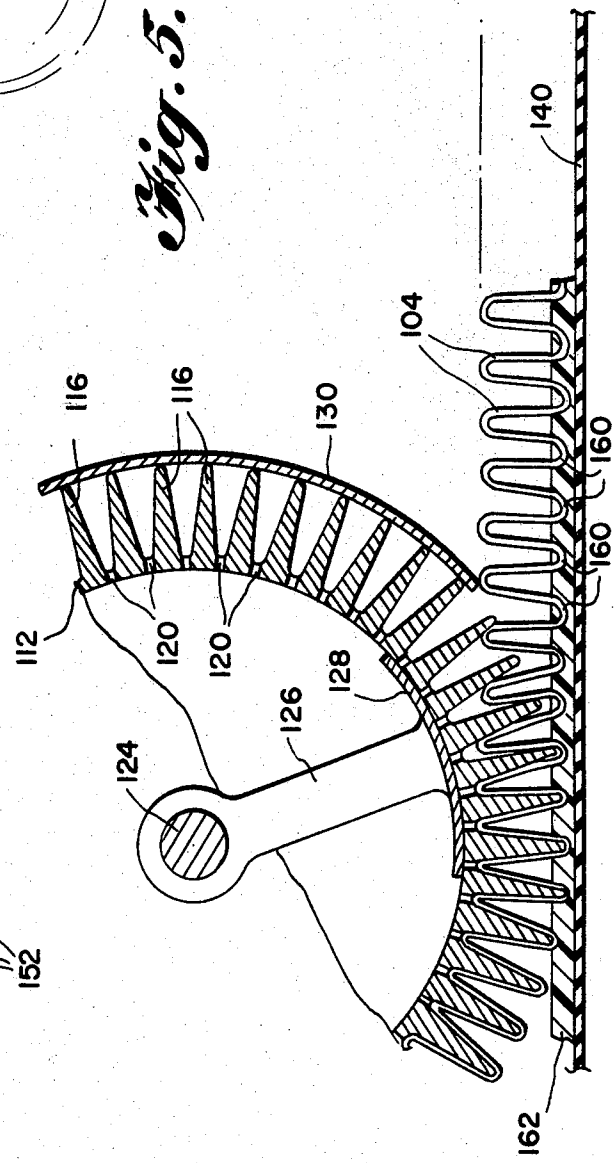


Fig. 5.



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METHOD OF MAKING NON-WOVEN PILE FABRIC

BACKGROUND OF THE INVENTION

The present invention relates to a non-woven pile fabric which is particularly useful in the carpet industry.

In the past, carpets were made solely by weaving. In recent years, tufted carpet has replaced woven carpet to a substantial extent because of the low cost of the tufting operation. In the manufacture of a tufted carpet, yarns from a creel are reeded into a warp and these warp yarns are then formed into loops into a base fabric usually formed of jute or cotton. In order to lock the base yarns in position, the fabric is backed with filled latex. After backing, further strength is achieved by laminating a reinforced scrim to the carpet. Additionally, foam may be drop coated onto the carpet back to provide an underlay. Weaving and tufting are both slow and laborious operations, and a woven or tufted carpet requires additional handling such as back-coating and scrim reinforcement.

Known methods are provided in the prior art to manufacture flocked pile fabrics without weaving, but yarns cannot be employed in this process nor can loop pile fabrics be produced.

U.S. Pat. No. 3,206,343 discloses an arrangement wherein a viscous foamed composition is applied to a pile construction to form a flexible backing for the completed pile fabric. The arrangement as shown in this patent does not provide sufficient anchorage between the yarn and the backing material. Strong anchorage is a paramount importance particularly when the loops are not cut because of the possibility that a penetrating object such as a woman's high heel shoe might accidentally become caught in a loop and exert considerable pulling action on the yarn which would tend to cause it to separate from the backing material if an adequate interlock is not provided between the yarn and the backing material. This problem is also encountered where domestic animals such as dogs and cats dig their claws into the carpeting. Furthermore, a certain amount of scale weight is desirable in floor coverings to make them lie flat, and in the case of area rugs, stay put.

Many carpet yarns are made from relatively short fibers which are rather loosely twisted. If the backing material is adhered merely to the surface of the yarn and the yarn is subsequently subjected to pulling action, the fibers in contact with the backing material will separate from the rest of the yarn which is then free to pull away. This problem is avoided in woven carpeting by actually placing backing or stuffer yarns over the bight portion of the loop so that it cannot escape. In tufted carpeting, the bight portion of the loop is pinched between the interstices of a base fabric and then well anchored by means of viscous backing resins and in many cases further stabilized by the laminations of a second fabric or scrim. The low density of a foamed resin as suggested in the aforementioned U. S. patent would not be adequate to provide the necessary anchorage. The foaming action of such backing material does not serve to sufficiently embed and surround the bight portions of the yarn in the backing material so that a good mechanical interlock is provided in addition to the chemical fusing action.

This patent further suggests the use of alternating rods to form the loops, these rods remaining in place during the resin application and foaming. The rods prevent the resin from embedding and surrounding the bight portions of the yarn so that it is impossible to obtain a good interlock. A slight amount of build-up of material on the rods will also result in serious problems of rod extraction and distortion of the pile fabric.

U.S. Pat. No. 3,142,604 discloses an arrangement for making non-woven pile fabrics wherein yarn is formed into a plurality of loops and the backing material is extruded onto the upper surfaces of the loops and subsequently compressed into place. Here again, the bight portions of the loops in the yarn are not sufficiently embedded and surrounded by the backing material so as to provide the desired mechanical interlock.

SUMMARY OF THE INVENTION

In the present invention, a body of liquid backing material is provided. The yarn is then formed into loops having upper and lower bight portions. The lower bight portions are then moved into the liquid backing material such that these lower bight portions are substantially embedded in and penetrated by the backing material. The backing material is then caused to solidify to provide the finished product.

The pile fabric formed according to the present invention includes a substantially continuous sheet of resinous backing material. The yarn associated with the backing material defines a plurality of spaced curved bight portions which are substantially embedded within and penetrated by the backing material so as to provide not only fusion between the yarn and the backing material but also a good mechanical interlock within the yarn structure to prevent the yarn from pulling away from the backing material when in use. Such an embedded pile fabric is inherently flexible in both the warp and filling directions as well as being strong and durable.

An embedded pile fabric according to the present invention is superior to the heat sealed or otherwise adhered arrangements as heretofore provided in the prior art since such known arrangements sealed only the surface fibers of a yarn to the substrate and these surface fibers often separate from the body of the yarn when the tuft or loop is pulled. In contrast to such conventional arrangements, the embedded bight portions of the product of the present invention, penetrated by the substrate material, hold the yarn firmly in place.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a somewhat schematic illustration of a first form of apparatus for performing the method of the present invention;

FIG. 2 is an enlarged view of a portion of the apparatus shown in FIG. 1;

FIG. 3 is an enlarged sectional view through the finished product;

FIG. 4 is a somewhat schematic illustration of a further form of apparatus for carrying out the method of the present invention; and

FIG. 5 is an enlarged sectional view through a portion of the structure shown in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings wherein like reference characters designate corresponding parts throughout the several views, a first form of apparatus for carrying out the present invention is illustrated in FIGS. **1** and **2**. A creel indicated generally by reference numeral **10** includes a plurality of individual cones of yarn **12**. The strands **14** are fed from the cone and normally pass through individual yarn tubes to prevent the parallel yarns from becoming entangled and to form a warp. After passing through such tubes (not shown), the yarn passes through a conventional reed **16**, and thence through a pair of nip rolls **18** and **20** which are driven in the direction of the arrows so as to provide a feed means for drawing the yarn from the creel and into the loop-forming means comprising a pair of rolls **30** and **32**, these two rolls having teeth **34** and **36** formed thereon respectively which cooperate with one another as seen most clearly in FIG. **2** so that yarn passing between the two rolls will be formed into a plurality of loops. The yarn may be overfed by the nip rolls **18** and **20** so that there is no tendency of the yarn to pull out from between the rolls **30** and **32**. Roll **30** is preferably formed of a highly polished metal while the other roll **32** may be formed of a relatively soft rubber. This facilitates retention of the yarn by the rubber roll due to friction. Roll **32** may also comprise a vacuum roll to hold the yarn thereon after the teeth **36** of roll **32** move away from the teeth **34** of roll **30**.

A conveyor means is provided for the yarn having loops formed therein, the conveyor means including an endless flexible belt **40** which is driven around a pair of spaced rolls **42** and **44**. This conveyor belt is formed of a suitable resilient substance such as rubber and is relatively thick. The belt includes a plurality of spaced, tapered or parallel ribs **48** formed along the length thereof. As the conveyor belt moves around the guide rolls **42** and **44** in the direction indicated by the arrows, the ribs tend to separate from one another like a pair of jaws. As the belt moves around roll **42**, the ribs open up to receive the loops in the yarn from roll **32**. As conveyor belt **40** moves around the bottom of roll **42** into a horizontal plane, the ribs again move toward one another to pinch the yarn therebetween and to hold it in place as the yarn moves lengthwise of the apparatus. When the conveyor belt subsequently passes around roll **44**, the ribs will be separated from one another so as to release the loops of yarn.

A second conveyor means comprises a continuous belt **50** which moves around a pair of rolls **52** and **54**, the belt being driven in the direction of the arrows as indicated on the drawings. A supply hopper **60** is provided for supplying liquid backing material to the upper surface of the conveyor belt **50**. A doctor blade **62** or other suitable means is provided for adjusting the thickness of the body of liquid backing material on the upper surface of the conveyor belt.

A plurality of heating units **64** are provided immediately beneath the upper part of the conveyor belt **50** for heating the liquid backing material to cause solidification thereof as it moves along the apparatus. A kiss roll **66** engages the belt **50** and is adapted to apply a suitable release agent carried within open top container **68** disposed beneath the conveyor belt.

After the pile fabric leaves the conveyor belt, it passes through a drying oven indicated generally by reference numeral **70** and then is wound upon a take-up roll **72**.

The yarn employed in the present invention may be any typical yarn as utilized in carpets and, for example, may comprise wool, cotton, nylon 6, nylon 66, polyester, etc. The backing material may comprise any suitable resinous substance: (a) which can be knifed or otherwise metered onto the conveyor belt **50**, (b) which, in liquid form, (e.g., as a melt or latex) will wet the selected yarn sufficiently to effect penetration thereof, and (c) which, in its final form, meets the specifications for the end use application. Suitable substances are resins which can be liquefied and later solidified through temperature changes (hot melts and modifications thereof), products which polymerize such as polyurethanes (not necessarily of a foamable variety), chemicals which gel (such as latices with gelling agents incorporated or N-methylol bis-acrylamide manufactured by American Cyanamid) or thickened latices (including acrylic emulsions) which can be dried to continuous film. In most cases, the resin system is filled with clay or other inert materials such as calcium carbonate, titanium dioxide and the like to provide economy, physical reinforcement of the resin and scale weight. With regard to the use of acrylic emulsions or blends or acrylic emulsions with natural or synthetic rubber latices, it is also possible to use nitrogeneous thermosetting resins to promote chemical reaction and gelation.

In the embodiment illustrated in FIG. **1**, the backing material may comprise a liquid latex which is dried to a continuous film as it moves along the conveyor belt.

In operation of the apparatus shown in FIG. **1**, the yarn is formed into loops as it passes between the rolls **30** and **32** and is then picked up by the conveyor belt **40**. The yarn is moved downwardly by conveyor belt **40** and forced into the upper surface of the body of resinous material provided on the upper surface of conveyor belt **50**. This body of resinous material is indicated by reference numeral **80** in FIGS. **2** and **3** of the drawings. It will be noted that the lower bight portions formed by the strands of yarn are thereby embedded within the backing material **80** so that a substantial amount (e.g., from about 25 percent to all) of each individual strand of yarn is embedded in and penetrated by the backing material **80**. The relative position of the yarn and the backing material is retained since the conveyor belts **40** and **50** are moved parallel with one another at the same rate of linear movement. As the backing material moves from left to right as seen in FIG. **1**, it is solidified due to the heating effect produced by heaters **64**. At the right-hand end of conveyor belt **40**, the yarn is released, and at the right-hand end of conveyor belt **50**, belt **50** separates from the backing material **80**, whereupon the backing material **80** and the yarn **14** continue through the drying oven **70** to complete the formation of the pile fabric. The loops of the pile fabric may subsequently be sheared to provide a cut pile fabric if so desired.

In the embodiment of FIG. **3** of the drawings, the lower bight portions **84** of the fabric are completely embedded within and surrounded by the backing material **80**. The bottom edges of these bight portions are disposed substantially in a horizontal plane as seen

in this figure, and are disposed a substantial distance from the opposite surfaces **85** and **86** of the backing material. The upper bight portions **88** may be sheared as mentioned previously. It is apparent that by so embedding the lower bight portions **84** of the yarn in the backing material, a very good mechanical interlock is provided between the yarn and the backing material in addition to the fusing or bonding provided between the backing material and the yarn.

Referring now to FIGS. **4** and **5** of the drawings, a further modified form of the invention is illustrated. As seen in these figures, a pair of drive nip rolls **100** and **102** are provided and correspond to the nip rolls **18** and **20** previously described. Suitable strands of yarn **104** are fed between the nip rolls and thence about a guide roll **106** to a pair of loop-forming rolls **110** and **112** having teeth **114** and **116** formed thereon respectively. The nip rolls may provide a certain degree of overfeed as mentioned previously.

The teeth of the loop forming rolls **110** and **112** cooperate in the same manner as aforedescribed. However, in this form of the invention roll **112** is a vacuum roll. As seen most clearly in FIG. **5**, roll **112** has a plurality of holes **120** formed therethrough which are positioned between the teeth **116** formed thereon. Suitable means is provided for drawing a vacuum within the roll. A central shaft **124** extends through the roll, and a fixed radially extending support element **126** has a curved plate **128** formed thereon which is adapted to engage the inner surface of the roll and to block off the holes at the bottom of the roll so that the yarn will be released from the roll after it has been forced into the body of liquid backing material hereinafter described.

In addition, a curved plate **130** is provided adjacent the outer ends of the teeth **116** formed on the roll. This plate extends from a point adjacent the upper bights of the loops of yarn which are embedded in an associated body of backing material to a point adjacent the yarn as it enters the teeth of roll **112**.

It is apparent that the yarn moving beneath the two rolls **110** and **112** is provided with suitable loops including upper and lower bight portions. The looped yarn material is then retained on roll **112** and is carried down and forced into the body of backing material adjacent thereto, whereupon it is released.

A continuous flexible conveyor belt **140** passes around rolls **142** and **144**. A hopper **146** provides a supply of liquid backing material, and a doctor blade **148** or other suitable means is provided for adjusting and maintaining the desired thickness of the layer of backing material on the conveyor belt which receives the looped yarn.

A plurality of cold rolls **150** engage the undersurface of the conveyor belt immediately adjacent roll **112** and serve to cool the conveyor belt and to solidify the backing material. The conveyor belt is made of a substance which has a good heat transfer characteristic. A plurality of heat lamps **152** are provided for heating the belt just prior to its receiving backing material from supply means **146**.

In operation of the apparatus shown in FIGS. **4** and **5**, the looped material is carried downwardly by roll **112** and the lower bight portions **160** of the yarn are embedded within and penetrated by the backing material **162** disposed on the upper surface of conveyor belt **140**. As the backing material and embedded yarn moves in the direction of the arrows shown in FIG. **4**, the backing material is solidified to form the finished product. This solidified backing material has no adhesion for the cold endless belt **140** so that the material will readily separate from the endless belt at the right-hand end thereof whereupon the finished pile fabric is wound up on a take-up roll **170**.

In the arrangement shown in FIG. **4**, a suitable backing material is chosen such as a hot melt of resinous material which is adapted to solidify upon cooling as it moves along the conveyor belt.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiments are therefore illustrative and not restrictive, and since the scope of the invention is defined by the appended claims, all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents are therefore intended to be embraced by those claims.

I claim:

1. The method of making a non-woven pile fabric comprising continuously moving a supporting surface through an endless path, applying a release coating to the surface at one point along its path, applying a liquid solidifiable backing material to the release coating at another point in its path, continuously advancing a plurality of yarns side by side to the liquid backing material, forming loops including upper and lower bight portions in the yarns as they advance to the liquid backing material, moving the lower bight portions of the looped yarns downwardly into the body of liquid backing material to embed such bight portions therein, then causing solidification of said backing material while such bight portions are still embedded therein, and then continuously removing the resulting solidified backing having the yarn loops secured thereto from the supporting surface.

2. The method as defined in claim **1** wherein the backing material is thermosettable and solidification thereof is caused by heating it.

3. The method as defined in claim **1** wherein the backing material is thermoplastic and solidification thereof is caused by cooling it.

4. The method as defined in claim **1** wherein the body of liquid backing material is produced by heating a normally solid backing material.

5. The method as defined in claim **4** wherein the backing material comprises a resinous substance.

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