United States Patent

Carpenter

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[54] **PILE FABRIC AND METHOD OF MAKING THE SAME**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 731,221, May 22, 1968, abandoned.

[52] **U.S. Cl.** **156/73,** 156/72, 156/178, 156/298

[51] **Int. Cl.** **B32b 5/08**

[58] **Field of Search** 156/210, 178, 72, 73, 298

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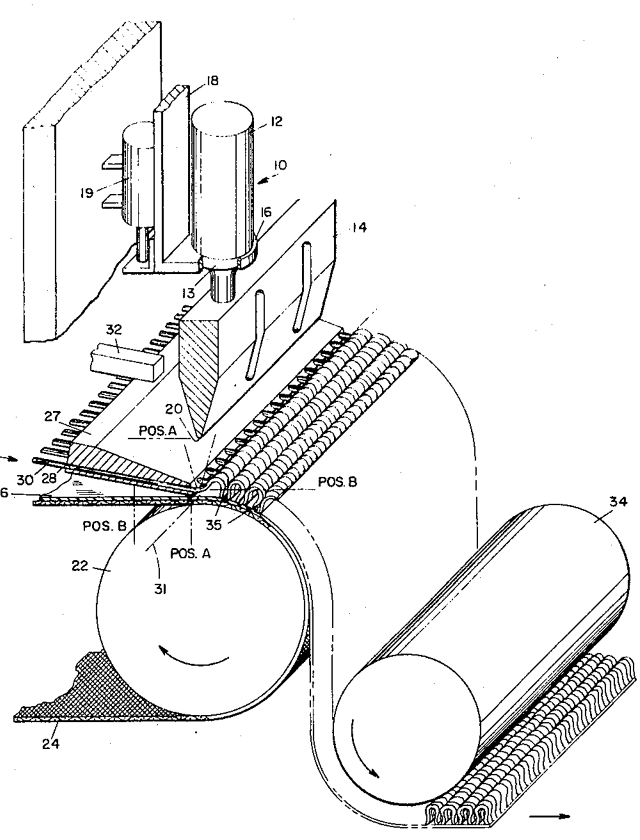
[57] **ABSTRACT**

This invention relates to a method of making pile fabrics wherein thermoplastic pole yarn is fusion-bonded to a thermoplastic backing by means of sonic energy, thereby effecting localized heating of the pile yarn and backing at the points of contact without loss of orientation in either the pile yarn or the backing, if an oriented backing is used, between the bond points.

7 Claims, 4 Drawing Figures



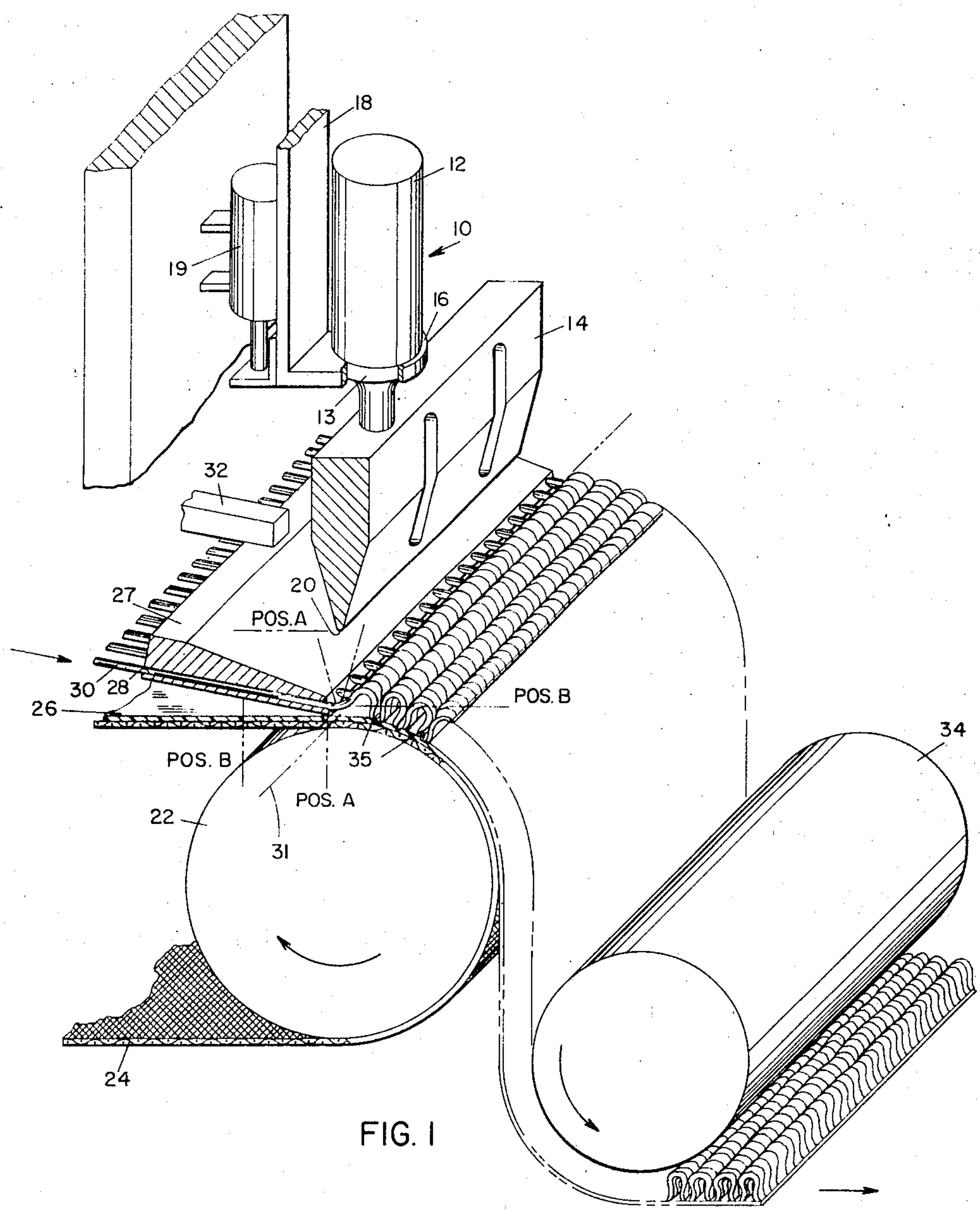


FIG. 1

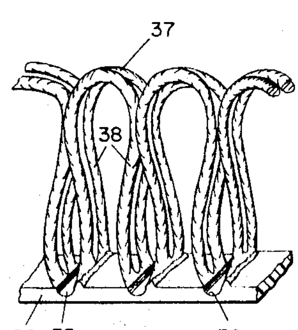


FIG. 2

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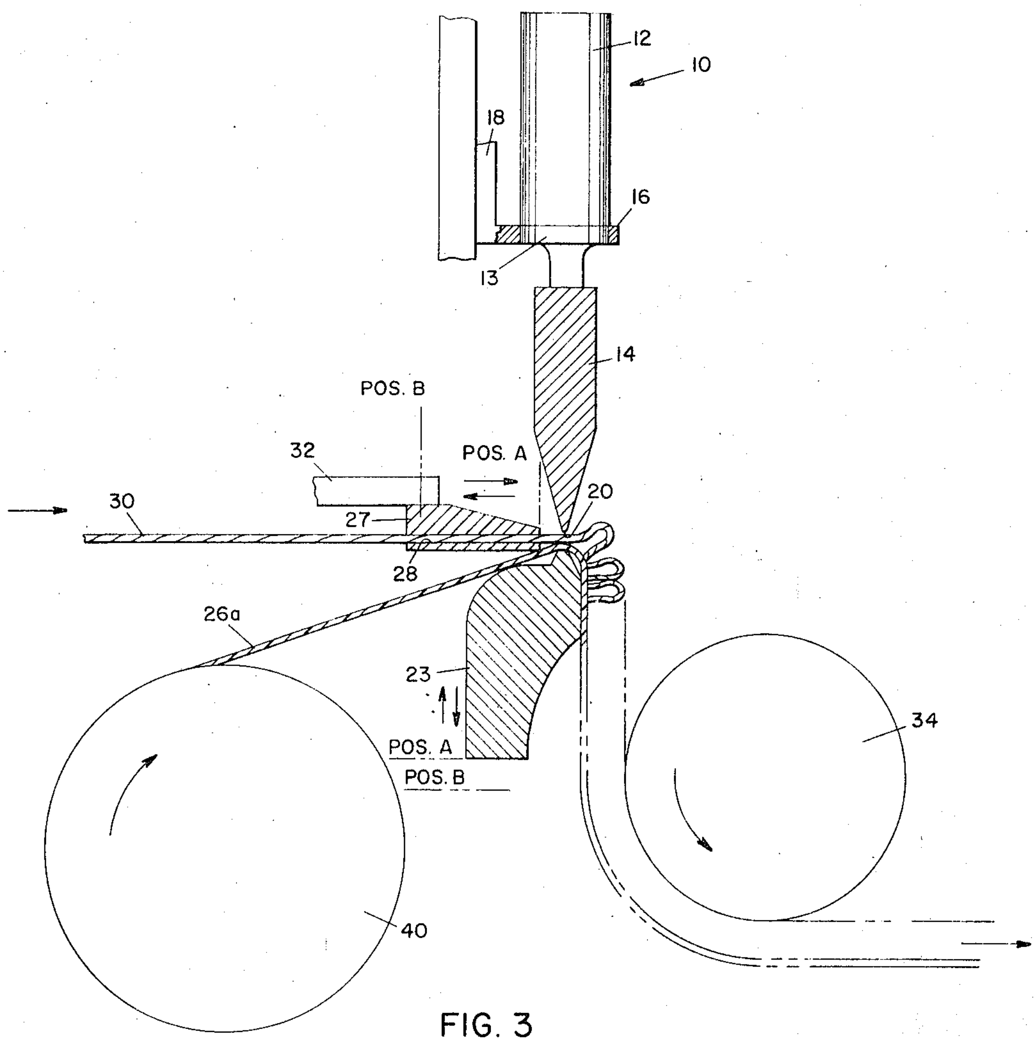

FIG. 3

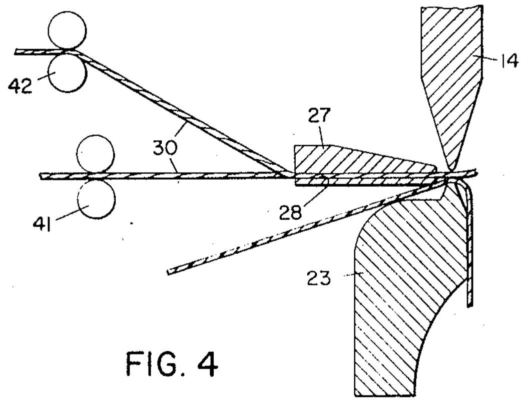

FIG. 4

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PILE FABRIC AND METHOD OF MAKING THE SAME

This application is a continuation-in-part of my prior application, Ser. No. 731,221, filed May 22, 1968, and abandoned upon filing this application.

The present invention relates generally to pile fabrics and, more particularly, to fusion-bonded pile fabrics, and to a method of making the same.

Pile fabrics useful for example as carpeting are conventionally manufactured either by weaving wherein a face or pile yarn is woven into a backing, or by tufting wherein the pile yarn is needle-tufted through a backing at spaced points to form upstanding loops or tufts projecting from the face of the backing and with the so-called back stitch extending along the back or underside thereof between the spaced loops or tufts. In both weaving and tufting, the portion of the pile yarn between the successive loops or tufts is consumed in the backing. Tufted fabrics also require means such as an adhesive coating over the underside of the backing to hold the pile against being pulled out, which coating is applied in a separate operation that represents an additional expense in the manufacture of the fabric. Also, in the course of the tufting operation, the backing, and particularly a weft or filler element in the form of strips or ribbons of oriented plastic material, may be ruptured by the tufting needles resulting, inter alia, in a pile fabric of poor tensile and tear strength.

Accordingly, it is an object of the present invention to provide a pile fabric and a method for making the same which avoid the disadvantages of tufting and weaving. A further object is to provide a pile fabric wherein the pile yarn and backing are fusion-bonded and wherein there is no substantial loss of the orientation or crimp in the pile yarn or backing between the bonded points. A still further object is to provide a pile fabric and method of making the same wherein there is a substantial reduction in the pile yarn required for a given coverage and surface effect. Another object is to provide a pile fabric and method wherein the strength of the backing is not unduly weakened in the course of incorporating the pile yarn therewith. Yet another object is to provide a process of making fusion-bonded pile fabrics wherein there is a minimum shrinkage of either the pile yarn or the backing and wherein the pile yarn is securely fastened to the backing and will not pull out in normal use.

The process of the invention comprises continuously forming a series of U-shaped tufts of oriented thermoplastic yarns upon the surface of a thermoplastic backing such that the ends of the legs of each tuft contact the backing, and applying sonic energy at the points of contact of the yarn and backing to heat and fusion-bond the yarn to the backing at such points.

The pile fabric of this invention is characterized by a thermoplastic backing and an oriented thermoplastic pile yarn that is fusion-bonded sonically to the backing. A feature of the fabric of this invention is that, by virtue of the yarn-to-backing bonding by sonically induced fusion, only the bond points are caused to undergo any significant rise in temperature, thereby avoiding any loss in the original levels of orientation between bond points in the yarn and in the backing if the backing is also oriented. Because the orientation levels are thus preserved, the resulting pile fabric exhibits improved properties, such as resilience, tensile strength, and the preservation of any previously introduced bulk or crimp and the consequent coverage. The construction provides substantial savings in pile yarn, does not involve the use of adhesives or solvents, requires no binding along a cut edge, is runproof in that each loop or tuft is integrally fused to the backing, is of high tensile strength, and better masks or covers the backing member by virtue of the fact that the pile yarn is bonded on rather than tufted through the backing.

As employed herein, the term "fusion bonding" normally denotes a bonding by melting the yarn and backing at the points of contact. However, the bond may comprise both fusion and mechanical interlocking, wherein those portions of the bond receiving the most intense sonic excitation are in fact fused and the less excited portions are partially softened and plastically deformed. Where the two components that are to be joined, that is, the yarn and backing, have more than a small difference in melting points, the bonding operation can be controlled to provide a high proportion of mechanical interlocking wherein a softened or melted portion of the lower melting component, which is preferably the backing, is deformed about and thus interlocks with the higher melting component. Such an arrangement would be useful, for example, with yarn composed of a blend of filaments.

Ultrasonic welding devices usually comprise an alternating current generator having an output with a frequency in the ultrasonic range (for example, about 20,000 c.p.s), a transducer assembly or sonic converter, and a sonic amplifier or horn. The transducer assembly comprises a transducer element which is preferably a piezoelectric crystal or a magnetostrictive device wherein the electrical output of the generator is converted by the endwise expansion and contraction of the transducer element in response to the varying voltage placed across it into mechanical vibrations at the same frequency as the electrical output of the generator. The sonic amplifier is connected to the output end of the transducer element and is operative to amplify the magnitude of the vibrations transmitted longitudinally therethrough.

In the fusion bonding of two or more thermoplastic elements by the use of a sonic device of the above type, the horn is vibrated perpendicularly to an anvil surface and against the thermoplastic elements interposed therebetween to effect alternately compression and relaxation of the thermoplastic material at the indicated sonic frequency. This working of the thermoplastic material generates heat at the points of contact between the thermoplastic elements sufficient to fuse the same without raising the temperature of the thermoplastic elements in the area that is not directly between the horn and the anvil. The rate at which the temperature of a given mass of thermoplastic elements is raised and the level to which it is raised is determined by the pressure between the thermoplastic elements, which is determined in turn by the bias on the horn and the geometry of the horn tip, by the properties of the thermoplastic elements such as their thermal conductivity, modulus of elasticity and coefficient of friction, and by the sonic energy imparted to the thermoplastic elements as measured by the force, magnitude and velocity at which the horn tip is driven.

For a more detailed understanding of the present invention, reference is made to the accompanying drawings, in which:

FIG. **1** is a schematic illustration in perspective and partly broken away and in section of an embodiment of the present invention especially adapted for processing non-self-sustaining backings, such as a noncoherent or unbonded mat of thermoplastic filaments or fibers.

FIG. **2** is a fragmentary view in perspective of a pile fabric made by the embodiment of the invention illustrated in FIG. **1**.

FIG. **3** is a view similar to FIG. **1** of another embodiment of the invention, which embodiment is especially adapted for processing self-sustaining backings.

FIG. **4** is a view similar to FIG. **1** of another modification of the invention.

Referring now to FIG. **1**, there is shown a sonic device or tool **10** which includes a housing **12** enclosing a sonic transducer (not shown) and a sonic amplifier **13** having a horn or sonic head **14**. Since the details of the transducer do not constitute a critical part of the present invention and are in themselves well known, it is not believed to be necessary that the transducer be any further disclosed herein.

The sonic device **10** is carried by a support means comprising a bracket **16** on a bar **18** that is adapted to be moved endwise to raise and lower the sonic device **10** into and out of operative position relative to the work. The actuating means for the sonic device **10** comprises for example supporting means (not shown) mounting the bar **18** for endwise movement and a double-acting pneumatic cylinder **19**. The cylinder **19** is preferably operated by a cycling mechanism (not shown) that provides an adjustable dwell of the bar **18** at both ends of its stroke and that also energizes the sonic transducer in timed relation to the movement of the sonic device **10**. For example, in operation, the horn **14** may be moved into engagement with the work and energized for a brief interval to effect a bond, after which there is a brief dwell to allow partial cooling of the bond before the horn is moved out of engagement with the work.

In the embodiment of the invention illustrated in FIG. **1**, backing member **26** comprises an elongated thermoplastic sheetlike member having an indefinite length and having a width corresponding to the desired width of the pile fabric. The backing member **26** is supported and advanced endwise by feed means comprising an endless belt **24**, preferably in the form of a screen that is entrained about a drive drum **22** disposed below the horn **14**. The drum **22** may be heated if desired in order to preheat the elements being joined and thereby increase the speed of the operation. The belt **24**, together with the drum **22** which backs up the belt **24**, serve not only to advance the backing member **26** to the bonding line, that is, the area or line **31** on the anvil member that is opposed to the working face **20** of the horn **14**, but also serve as the anvil member against which the work is compressed by the horn **14** during bonding.

A tuft-forming mechanism for forming tufts in a pile yarn **30** is disposed above the belt **24** and in advance or upstream of the horn **14**. This mechanism comprises a bar **27** having a plurality of bores that define individual yarn tubes **28** through which the individual pile yarns **30** are threaded. The spacing between the tubes **28** determines the gauge or spacing between the pile yarns in the fabric. Each of the bores **28** is dimensioned relative to the respective yarn **30** to impose a frictional drag upon the yarn threaded therethrough whereby the yarns will be pulled through the tubes **28** when the bar is moved away from the bonding line since the yarns are then anchored to the backing member by the bond that was just formed, but will be gripped by the bar **27** when it is moved toward the bonding line so that, insofar as it is not restrained by a tension exceeding the frictional grip thereon, it will be advanced with the bar **27**. The bar **27** is carried by a bracket **32** which in turn is supported by supporting means (not shown) for reciprocation of the bar **27** in a direction to move the yarn output ends of the tubes **28** toward and away from the bonding line **31**.

After being discharged from the belt **24**, the pile fabric is advanced endwise over guide means such as the idler roll **34** to a takeup (not shown).

In operation, the pile yarns **30** are supplied from a suitable source (not shown) and are guided in a sheetlike array to and threaded through the tubes **28** of the bar **27**. In the starting point of a loop-forming cycle, each of the pile yarns **30** is secured to the backing member **26** along the bonded line **35** that was formed in the immediately preceding bonding operation, and the bar **27** is disposed in its bonding position, i.e., position A in FIG. **1** wherein the output ends of the tubes **28** are adjacent to the bonding line **31**. The bar **27** is then retracted relative to the bonding line **31**, that is, moved to position B in FIG. **1**, so that, with the yarns **30** secured to the backing member **26** at the bonded line **35**, the yarns are pulled through the tubes **28**.

Immediately upon completion of the tuft-forming cycle and as the bar **27** is being withdrawn, the horn **14** is raised from position B, which is its bonding position, to position A, and the drum **22** is indexed to advance the backing material endwise a distance equal to the desired tuft spacing, that is, the distance between successive bonded lines **35**. The bar **27** is then advanced toward the bonding line **31** from position B to position A, during which movement the frictional engagement between the tubes **28** and the yarns **30** threaded therethrough causes the yarns **30** to be advanced with the tubes. Thus, the lengths of the yarns **30** between the output ends of the tubes **28** and the preceding bonded line **35**, which are the lengths of yarn that were pulled through the tubes **28** when the bar **27** was retracted, and bowed upwardly from the backing member **26** to provide tufts of yarn, each of which is in the form of an inverted U upstanding from the backing member **26** with the one leg thereof secured at its end to the backing member **26** at the bonded line **35** that was just formed and the other end held adjacent to the backing member **26** at the bonding line **31** by the respective tube **28**. Assuming that the yarns **30** are supplied in a substantially tension-free condition or under a tension that is sufficiently low that it will not cause the yarns **30** to slip in the tubes **28**, the length of the retracting stroke of the bar **27** determines the length of yarn that is drawn through the tubes **28** and thus the height of the tuft to be formed.

In the final step of the tuft-forming cycle, the horn **14** is lowered from position A to position B to engage the yarns and to force them against the backing member along the bonding line under the predetermined bonding pressure, and is energized to form a new bonded line **35**.

The cycling mechanism for the horn **14** is adjustable to provide for adjustment of the time that the sonic transducer is energized. The energization of the transducer is initiated as soon as the horn **14** has been moved to its bonding position, that is, to position B in FIG. **1**, and may be initiated for example by switch means that responds to movement of the horn **14**. With a horn that is biased to the bonding position, for example by pneumatic means, when the horn **14** arrives at the end of the stroke, it also exerts a bias on the work and thus provides a bonding pressure which can be adjusted by adjustment of the line pressure. With a given bonding pressure, the length of time that the transducer must be energized to produce the desired bond is determined essentially by the energy input and the physical characteristics of the yarn and the backing member. The yarn beneath the working face **20** of the horn **14** may be completely fused to the backing member **26** so that it has in effect lost its identity as yarn, as illustrated at the bonded line **35** in FIG. **2**, or may be surface- bonded. At the same time, that portion of the backing member **26** that is beneath the working face **20** of the horn **14** was also heated and was displaced by the working face **20** to provide a groove **36**.

In accordance with the above, the pile fabric that is formed consists of a plurality of pile yarns **30** arranged in a spaced parallel manner lengthwise of the backing member **26** and fusion-bonded thereto at the bonded lines **35** extending transversely of the backing member **26** in a spaced parallel arrangement. For a uniform appearance and performance, the pile yarns **30** and the bonded lines **35** are both preferably equally spaced. Arranged in this manner, the pile yarns **30** define a series or rows of tufts **37** extending lengthwise of the fabric and consisting of the successive tufts formed in the individual pile yarns between the successive bonded lines **35** upon successive tuft-forming cycles, and series or rows of tufts extending transversely of the fabric and consisting of the tufts that are formed in the individual yarns in one tuft-forming cycle.

As illustrated in FIG. **2**, each of the tufts **37** is upstanding from the backing member **26** and has legs **38** spaced apart endwise of the backing member **26** the distance through which the backing member **26** is advanced upon each cycle, which is herein termed the tuft spacing, and secured at their ends to the backing member **26** along the bonded lines **35**.

At each bonded line **35**, the thickness of the backing member **26** is reduced by the groove **36**. Since the grooves **36** weaken the backing member **26** and in an extreme case may be so deep as to sever or substantially sever the backing member **26**, they are preferably kept at a minimum consistent with the effective bonding of the yarns **30**.

In the illustrated embodiment, the cycling mechanism for the horn **14** is also designed to provide an adjustable dwell of the horn **14** in the bonding position after the sonic transducer has been deenergized in order to provide for cooling and setting the bonds between the yarns and backing member.

One of the significant features of this invention is that the heating of the work is localized and occurs essentially at the interfaces of the thermoplastic elements or in other words is focused precisely in the area in which the bond is formed. This not only minimizes power requirements, but also enables the materials to be brought very quickly to their bonding temperatures and minimizes the amount of heat that must be dissipated to reduce the temperature of the bond and thus set the same. Cooling and setting of the bond is accomplished more rapidly by the heat dissipation effect of the horn **14** which is not heated and thus remains cool during the bonding so that it can adsorb and thus conduct heat from the bond. The heat sink capacity of the horn **14** is sufficient to cool the bond to setting temperature within a very short dwell period after bonding. During this time, the horn **14** remains in its bonding position to hold the yarns **30** in place and thus to insure that they will set properly.

The crown or working face **20** of the horn **14** is preferably as narrow as possible, for example, in the neighborhood of from about 0.010 to about 0.025 inch in width, in order to minimize the sonic energy that is required to produce the desired bond and the width of the bonded line **35**. With the pile yarns **30** bonded to the backing member **26**, the strength of the connection is not a function of the width of the bonded line **35**. The appearance and performance of the fabric are also improved by a bonded line **35** of minimum width. Inasmuch as a length of the pile yarn **30** is consumed in forming the bonded line **35**, a bonded line of minimum width represents a minimum loss of pile yarn and thus maximum coverage with a given quantity of yarn. There is also a reduced tendency for "grinning," that is, for the bonded line **35** to show on the face of the fabric, which is a condition that is particularly acute in forming a pile fabric over curved surfaces such as in the floor of an automobile.

The horn **14** is preferably elongated to provide a working face **20** that is as long as possible consistent with uniform results, which under the present state of the ultrasonic art, would appear to be about 12 inches. It is contemplated that fabrics wider than the width of a single horn can be produced by the use of a plurality of horns which may be arranged end to end or in another manner such as a staggered or stepped relation to minimize the effect of a gap between adjacent horns.

As mentioned above, it is preferred that the yarn and backing be so chosen as to exhibit a minimum differential in their melting points, for example, less than about 20° C., to insure a mutual interfusion of both the backing member and the yarn in order to form an optimum bond at a high production rate. Where the differential in melting points is relatively large, there may be incomplete fusion of the higher melting component or excessive fusion of the lower melting component.

Attention is now directed to FIG. **3** wherein there is illustrated a modification of the present invention that is particularly adapted for processing self-sustaining backings such as films, as opposed to non-self-sustaining backings such as unbonded nonwovens. In lieu of the continuous belt arrangement of FIG. **1**, backing member **26*a***, illustrated in the form of a self-sustaining film, is fed to the bonding line directly from a supply roll **40**. In this embodiment of the invention, there is provided a separate anvil member **23** that is mounted for vertical reciprocation between its bonding position A and its retracted position B while the sonic device **10** is stationary. The looping bar **27** is mounted for horizontal reciprocation between a retracted position B and a bonding position A and having the desired number of the yarn bores or tubes **28**. Except for the fact that it is the anvil and not the horn that is moved to and from the work, the operation of the embodiment of FIG. **3** is similar to that of FIG. **1**.

With reference to FIG. **4**, there is illustrated a further embodiment of the invention in which there is provided a plurality of yarn feed rolls **41** and **42**. In the previously disclosed embodiments of the invention, the frictional engagement of the pile yarns **30** in the yarn tubes **28** is relied upon to pull the individual yarns from their supply packages and the height of the tufts is determined essentially by the stroke of the bar **27**. This arrangement is satisfactory for relatively simple setups wherein there is a limited number of pile yarns and there is no significant tension required to pull the yarns from their supply packages and the height of the tufts is determined essentially by the stroke of the bar **27**. However, when there is a large number of pile yarns so that the supply packages of some are located remote from the bonding line and are directed over various guides and/or through guide tubes which impose different tension on the different yarns, the bar **27** may slip relative to some yarns and thus produce variation in the pile height in the fabric.

Yarn feed means such as the rolls **41** and **42** is used to pull the yarn from the respective supply packages and present a predetermined length thereof in a substantially tension-free condition to the bar **27** upon each tuft-forming cycle. For a pile fabric having a uniform pile height, all of the yarns **30** may be fed by a single yarn feed means. For a patterned surface wherein the pattern is defined by variations in the pile height of the different yarns, the yarns may be fed by different yarn feed means which themselves are operable at different speeds. Thus the yarn fed to any particular yarn tube **28** on any particular tuft-forming cycle may be less than the length required to form a loop of maximum height so that as the bar **27** advances to its bonding position, the yarn is restrained and thus retracted through the tube **28**.

Various yarn feed means such as those commonly employed with tufting machines may be used to provide the desired control of the individual pile yarns.

Pattern or surface effects in the pile fabric may be achieved by cutting the tufts **37** such as by shearing to provide a cut pile effect or a mixed cut pile and loop pile effect. As herein used, it is contemplated that the term tuft will refer generically to pile such as the loops **37** as well as to pile which may be originally formed as loops but are either simultaneously or subsequently cut or sheared to provide cut pile or mixed cut pile and loop pile.

In addition to providing pile height control by a controlled yarn feed for each yarn or a selected group or groups of yarns, variation in the height of the tufts may be provided by forming the yarn tubes **28** independently and actuating them by a pattern mechanism to vary the stroke of the different tubes.

In the above-described embodiments of the invention, the sonic device **10** was energized only with the horn **14** in its operative or bonding position, that is, it was energized after the horn was moved into its operative position and was deenergized before it was moved out of its operative position so that the actual bonding cycle was determined by the energization interval of the device. However, it will be apparent that the device **10** can be continuously energized and the bonding time can be determined by the interval that the horn **14** is maintained in its operative or bonding position relative to the work.

In the above-described embodiments of the invention, the horn **14** is disposed on the pile surface of the backing member and the anvil means, such as the anvil **23**, is disposed at the opposite surface. This arrangement is not critical to the invention. The horn **14** may be arranged at the backing surface while the anvil means may be arranged at the pile surface, in which case, the anvil may be and preferably is formed with a relatively sharp working face comparable to the face **20** of the horn **14**.

The embodiments of the invention illustrated in FIGS. **1**, **3** and **4** are exemplary only and many other modifications can be made. For example, the desired pile configurations could be formed by the use of an endless belt, wherein the belt has a corrugated surface formed for example by spaced blades upstanding from the belt and corresponding to the desired tuft geometry. Thus, a band of yarns is conformed to the corrugated surface of the belt and the backing material laid thereover. The crests of the blades of the belt function as the anvil surface and the horn is brought to bear directly upon the backing.

The use of the term "thermoplastic" in characterizing the pile fabric components of the present invention is to be understood as including, for example, blended components which may be only partially thermoplastic. For example, the pile yarn may be in the form of a blended yarn containing both thermoplastic and nonthermoplastic constituents. The only criterion is that both the yarn and backing components contain thermoplastic constituents, preferably in a major proportion and having substantially the same melting points, and that the nonthermoplastic constituents are not damaged by the bonding operation. Polypropylene is a particularly suitable thermoplastic material.

The backing may take numerous forms depending upon the particular installation for which it is designed. Some typical forms of backing may be films, including fiber-reinforced films and nettings, nonwovens and backings woven from fibrillated or slit films, and laminations of any one or more of these forms. Further, in the case of a nonwoven backing, the backing may be bonded or otherwise formed into a stable or coherent fabric prior to application of the pile yarn, or it may be loose or noncoherent filaments or fibers that are bonded into a coherent fabric simultaneously with the bonding of the pile yarn. The geometry of the filamentary web may vary extensively, although for best results the filaments in the web should be arranged in a random manner such as achieved by depositing staple fibers from a Rando Weber. Other suitable webs may be formed by cross-lapping or laminating unidirectional filamentary webs.

With a nonwoven backing, it is preferred that the filaments or fibers thereof be oriented to increase the strength and dimensional stability. With a backing consisting of a thermoplastic film, the film may be unoriented so that it has greater tear resistance and less tendency to become distorted by heat, and can be more readily formed.

The following examples will serve to illustrate further the present invention and its practice, but are not to be taken as a measure of its limitations. The sonic transducer assembly employed was one commercially available from Branson Sonic Power Company of Danbury, Conn., and was designed for an input frequency of 20 kilocycles per second, the transducer of which was a lead-zirconate-titanate piezoelectric element. As supplied, this assembly includes a timing circuit by which the duration of the energizing cycle of the transducer can be controlled. The horns utilized are characterized by a half-wave resonance section made of a titanium alloy, selected for its strength-to-weight ratio to withstand the intense internal stresses generated within the horn element, as well as its excellent sonic conductivity. A conventional time delay mechanism was employed to control the dwell time of the horn against the workpiece for a preset length of time after the energizing cycle of the transducer to allow at least a partial solidification of the bond points. The force with which the horn was brought to bear upon the workpiece was provided by a pair of double-acting air cylinders having a ¾-inch inside diameter that were connected to source of compressed air through a variable reducing valve. The air cylinder pressures that are reported indicate the relative values of the horn pressure upon the workpiece. The tip or working face **20** of the horn **14** is designed to accommodate the loop configuration being worked, which is to say that is generally characterized by a long, narrow, straight working face **20**. The horns employed in the following examples had edge lengths of 3 and 7½ inches, the tip being machined to a width of from 0.20 inch to 0.25 inch with the sides tapered at an angle of 60° to the working edge.

EXAMPLE 1

Utilizing an apparatus similar to that depicted in FIG. **1**, an unbonded nonwoven web having a weight of 4.05 ounces per square yard and composed of continuous, uncrimped, 6 d.p.f., draw-oriented isotactic polypropylene filaments was collected upon and conveyed along an endless screen belt **24**. Though the method of forming the web does not constitute a critical feature of the present invention, the present web was formed by air-laying a 210/35 yarn by air jet spreaders positioned on 1-inch centers and operated at 10 p.s.i.g. to deposit a uniformly random array upon a 16-mesh screen travelling at 11.05 feet/minute, thereby to collect a 4.05 ounce per square yard web. Of course, any desired web weight is readily obtained by varying, for example, the belt speed and/or spreader jet pressure.

A stuffer-box-bulked, continuous filament, draw-oriented polypropylene yarn having a denier and filament count of 3,750/210 and 0.75 twist per inch was fed to the bonding station to be formed in a loop configuration upon the previously formed web. Both the pile yarn and the web yarn were further characterized by a melting point of 333° F. and an initial shrinkage temperature of 265° F.

A horn, as above specified, having an edge length of 3 inches, was utilized to bond simultaneously the filaments of the nonwoven web to one another and to bond the pile yarn to the web. Runs were conducted utilizing various horn pressures and bonding periods, the web being advanced intermittently to provide the desired tufts per inch. In each case, seven rows of tufts per inch were formed. A plurality of pile yarns was supplied by a looping bar such as depicted in FIG. **1** having yarn tubes **28** spaced to provide the desired tuft gauge (the measure of tuft spacing within a given transverse row of tufts). The dwell time signifies the period of time between deenergization of the transducer and disengagement of the horn. Tuft pull strength, as a measure of bond strength, was determined by a hand-held tension gauge provided with a hook that was engaged with a single tuft. Failure in each case was observed to occur at the junction of the filament with the backing.

A tuft pull strength of 8 pounds, or greater, is considered commercially acceptable for carpet applications, and it is apparent that the sonically bonded constructions according to the present practice are more than adequate. Of paramount importance is the fact that bonding was accomplished rapidly and without significant heating of adjacent regions, thus preserving the original levels of orientation in the pile yarns and in the backing.

EXAMPLE 2

Utilizing an apparatus similar to that depicted in FIG. **3**, a pile fabric was constructed utilizing cast, isotactic polypropylene film having a thickness of 10 mils. The pile yarn was a 2,600/120 count bulked, continuous filament polypropylene yarn having one twist per inch. The horn had a working face that was (7½ inches) long. The anvil **23** provided a smooth surface in lieu of the screened belt **24**. Following the procedures of Example **1**, the data set out in the table following Example **3** was obtained.

The resultant fabric construction had a uniform and relatively dense appearance, and it is significant to note that such appearance was attained utilizing approximately 29 percent less pile yarn than required in conventional construction of comparable tuft density and height.

EXAMPLE 3

A Rando Weber was employed to form an air-laid, nonwoven web composed of a blend of 6 d.p.f. polypropylene staple having a melting point of 333° F., 65 percent being an uncrimped 1¼-inch staple and 35 percent being a crimped 1½-inch staple having 10 crimps per inch. This web was then bonded by heat and pressure as by passing the same through a pair of heated pressure rolls to a case polypropylene film having a thickness of 1 mil and a melting point of 333° F. to form a fiber-reinforced film backing member weight 4.30 ounces per square yard. Following the procedure of Example **1**, pile yarn of Example **2** was bonded to this backing material. The bonding conditions and results are set out in the following table.

TABLE

	Bonding time (sec.)	Dwell time (sec.)	Air cylinder pressure (p.s.i.g.)	Pull strength (lbs.)	Tuft gauge (in.)	Pile height (in.)
Example 1	0.4	0.1	40	11.1	5/32	1/4
	0.3	0.1	40	9.7	5/32	1/4
	0.2	0.1	50	9.3	5/32	1/4
Example 2	0.4	0.1	80	15.0	1/8	1/4
	0.4	0.1	88	12.4	1/8	1/4
	0.3	0.1	90	11.6	1/8	1/4
Example 3	0.4	0.1	70	10.0	1/8	1/4
	0.3	0.1	90	10.6	1/8	1/4
	0.3	0.1	70	9.8	1/8	1/4

I claim:

1. A method of making pile fabrics comprising:

providing an elongated thermoplastic sheetlike backing member and a plurality of oriented thermoplastic pile yarns having a bonding temperature comparable to that of the backing member,

arranging the backing member endwise relative to an anvil member disposed transversely thereof,

guiding the pile yarns in a sheetlike manner onto the backing member along a bonding line transversely of the backing member and opposed to the anvil member and forming loops therein upstanding from the backing member between the bonding line and preceding fusion-bond of each pile yarn and the backing member,

engaging the pile yarns and backing member under pressure along the bonding line between the anvil member and the working face of a sonic device and sonically fusion-bonding the pile yarns and the backing member by precisely focusing the sonic device along the bonding line thereby avoiding the adverse affect of heat causing loss in the orientation level or oriented material between the fusion bonds,

releasing the backing member and pile yarns from between the anvil member and the working face of the sonic device,

advancing the backing member endwise a distance corresponding to the desired loop spacing, and

repeating the steps of guiding the pile yarns onto the backing member and forming loops therein, sonically fusion-bonding the pile yarns and backing member, and advancing the backing member to make a pile fabric.

2. A method of making pile fabrics in accordance with claim 1 wherein the sonic device is deenergized with the pile yarns and backing member in engagement under pressure between the anvil member and the working face of the sonic device, and the engagement is maintained for a predetermined time interval to provide for cooling and setting the bond between the pile yarns and backing member before release of the pressure thereon.

3. A method of making pile fabrics in accordance with claim 1 wherein a predetermined length of each pile yarn is fed upon each loop-forming cycle for controlling the height of the loops in the pile yarn.

4. A method of making pile fabrics in accordance with claim 3 wherein guiding the pile yarns and forming the loops therein is provided by a bar having individual yarn tubes for each of the pile yarns through which the yarns are adapted to slide with a predetermined frictional drag.

5. A method of making pile fabrics in accordance with claim 1 wherein the backing member is arranged over belt means comprising a screen which serves to advance the backing member to the bonding line and as the anvil member at the bonding line.

6. A method of making pile fabrics in accordance with claim 1 wherein the sonic device is continuously energized with the pile yarns and backing member in engagement under pressure between the anvil member and the working face of the sonic device, and maintaining the engagement for a predetermined time interval to effect the fusion bonding of the pile yarns and backing member after which the engagement is discontinued and the steps for forming the pile fabric repeated.

7. A method of making pile fabrics in accordance with claim 1 wherein the oriented thermoplastic pile yarns are fusion-bonded to an elongated oriented thermoplastic sheetlike backing member.

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