



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 435 542 A2

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **90313777.6**

(51) Int. Cl.⁵: **A47G 27/02, D06N 7/00**

(22) Date of filing: **17.12.90**

(30) Priority: **27.12.89 US 457612**

Spartanburg South Carolina 29304(US)

(43) Date of publication of application:
03.07.91 Bulletin 91/27

(72) Inventor: **Higgins, Kenneth Benjamin**
204 East Yorktown Drive
LaGrange, Georgia 30240(US)

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

(74) Representative: **Pacitti, Pierpaolo A.M.E. et al**
Murgitroyd and Company Mitchell House 333
Bath Street
Glasgow G2 4ER Scotland(GB)

(71) Applicant: **MILLIKEN RESEARCH**
CORPORATION
Post Office Box 1927 920 Milliken Road

(54) **Latex adhesive bonded pile fabrics.**

(57) A latex adhesive bonded pile fabric is provided which comprises a base layer; a pile forming yarn adjacent to the base layer in pile forming fashion but not tufted through the base layer; the pile forming yarn having been bonded to the base layer by means of a latex adhesive. A method and apparatus for making latex adhesive bonded pile fabrics are also provided.

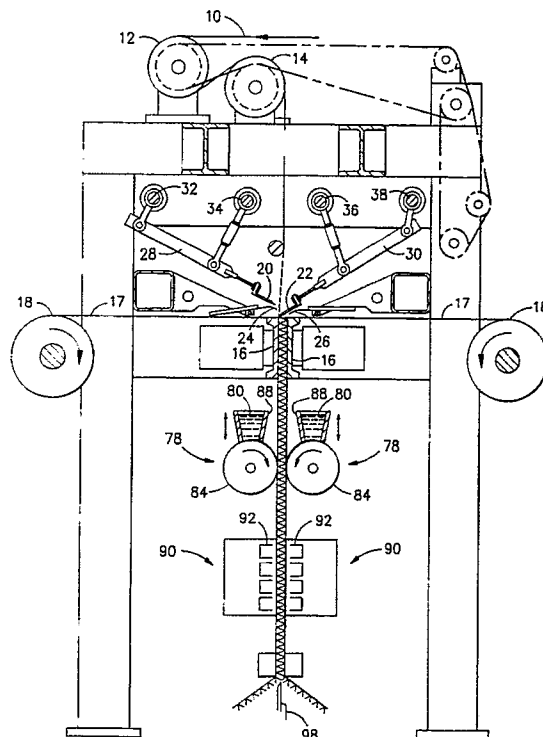


FIG. -1-

EP 0 435 542 A2

LATEX ADHESIVE BONDED PILE FABRICS

The present invention relates to pile fabrics. More particularly, the present invention relates to latex adhesive bonded pile fabrics and latex adhesive bonded carpet tiles.

Pile fabrics such as carpeting may be manufactured in several ways such as by weaving, tufting, needling or bonding. In each method the pile must be secured to a base or support layer in one way or another. The present invention is particularly concerned in one aspect with a method of manufacture wherein the pile is bonded by means of a latex adhesive to a base layer. Such fabrics will herein be referred to variously as latex adhesive bonded pile fabrics, or latex adhesive bonded carpets.

A number of techniques are known for the manufacture of bonded pile fabrics which involve the coating of a preformed base layer with a layer of an adhesive and thereafter pressing pile-forming lengths of a yarn into the adhesive to adhere pile-forming lengths to the base layer.

Prior commercial techniques for making bonded fabrics have typically relied on the use of polyvinyl chloride (PVC) plastisol formulations because of the processing disadvantages thought to be associated with the use of other adhesive formulations such as hot melt and latex adhesive systems. According to such techniques a polyvinyl chloride plastisol is applied to the base layer prior to positioning the pile-forming yarn relative to the base layer. Then the pile yarn may be positioned into contact with the base layer and the plastisol may then be fused or cured, typically by heating. When attempts were made to substitute other adhesives, such as hot melt adhesives for the PVC plastisol in this process difficulties were encountered. Thus, for instance, with regard to hot melt adhesives, it has generally been thought that the apparatus employed for positioning the yarn may become coated with the adhesive requiring frequent shut downs of the apparatus for cleaning which is, of course, commercially unattractive.

Thus, while PVC plastisol has been the bonding agent of choice in the preparation of bonded pile fabrics, there are disadvantages associated with the use of PVC plastisol in the manufacture of such fabrics. Thus, PVC plastisols generally may not penetrate to the desired extent into the yarn bundles to effect complete adhesion of all pile yarn fibers of the pile yarn bundle to the pile fabric structure. Other disadvantages typically associated with the use of PVC plastisol as the bonding agent in the manufacture of bonded pile fabrics are detailed in U. S. Patent Number RE31,826 to Machell (assigned to Milliken Research Corporation) incorporated by reference herein.

Another disadvantage typically associated with the prior art techniques for making bonded or non-tufted pile fabrics, that is fabrics where the pile yarn is not tufted through the backing but simply adhered to the backing, is that the adhesive is normally applied to the base layer on the side of the base layer facing the pile yarns, and the base layer is normally of a construction such that the adhesive will not flow through it but will substantially remain on that surface with perhaps some penetration into the base layer. Then, if it is desired to apply a backing layer, e.g., a hard back, to the back side of the pile fabric as may be desired in the making of carpet tiles the base layer must be either adhered directly to the backing layer or an additional process step of applying adhesive to the back side of the base layer may be necessary. In either event, there are created numerous distinct layers in the finished product, namely pile layer, adhesive layer, base layer, another adhesive layer and a hard back layer. Such constructions may inherently have processing disadvantages and be costly to construct.

According to Machell U. S. Patent Number RE31,826, bonded pile fabrics are provided wherein the bonding of the pile-forming yarn to the base layer may be accomplished by means of a hot melt adhesive. A process and apparatus are also disclosed therein where the hot melt adhesive is applied to a liquid-permeable layer from the back of the base layer and it may be forced through the base layer so that a one step adhesive layer application may both provide a means for bonding the pile yarn to the base layer and also provide a means by which a backing layer may be integrally affixed to the base layer. The resulting product may be less complicated and costly to manufacture and may have fewer separate and distinct layers in the final product where undesired separation may occur.

As contrasted to conventional bonded carpet tiles water-based adhesive backed tiles are generally easier to cut both in the production process and during installation. Latex adhesive based products typically also have a relatively soft hand and are, therefore, easy to handle as compared to conventional products.

From a production standpoint, hot melt adhesives are typically applied at temperatures in the range of about 300° F to 400° F. They are difficult to handle in the hot state and the equipment used to apply the adhesives must be heated which may be dangerous and energy consumptive. Latex adhesives by contrast may be applied at room temperature greatly facilitating production operations especially safety and cost considerations.

Furthermore, because latex adhesives typically contain a significant aqueous component by contrast to

conventional adhesives used to manufacture bonded carpet tiles, they may be applied at significantly lower viscosities, greatly facilitating yarn bundle penetration which is desired to achieve desired tuft bind and minimize fuzzing and other undesirable properties in the final product. Latex adhesives may, furthermore, be stored for lengthy periods of time without degrading and without the necessity of being heated prior to being put into use in production.

The pile fabrics of the present invention are latex adhesive bonded fabrics which may be comprised of a liquid-permeable base layer, a pile forming yarn adjacent to but not tufted through the base layer, in pile forming, preferably folded, fashion; the pile forming yarn having been bonded to the base layer by means of a latex adhesive. Preferably, the latex adhesive is applied to the back of said base layer and forced through said base layer into contact with said pile forming yarn. It should be understood, however, that the latex adhesive may also be applied to the front surface of the backing prior to bringing it into contact with the yarn, or it may even be applied to the folded yarn prior to contacting it with the backing layer.

Pile forming configurations may include the so-called I-tuft configuration, e.g., a non-folded configuration, U-tuft configurations, and loop pile configurations, among others. With regard to the phrase "folded, pile forming fashion," which refers to a preferred embodiment, it should be understood that what is intended is a configuration of the pile yarns where the yarns are provided with at least one fold at the portion of the yarn generally most nearly adjacent to the base layer, e.g., a cut pile configuration. Another "folded" configuration which is contemplated is a loop pile configuration where the pile yarns remain uncut in the form of substantially continuous folded yarns in the final product. A variety of pile configurations, both non-folded and folded, are illustrated in the attached drawing. According to the most preferred embodiment the pile yarns are cut to form a folded, cut pile product.

According to the method and apparatus of the present invention a pile forming yarn is positioned in pile forming fashion adjacent to one side of a liquid-permeable base layer. Thereafter a latex adhesive, is applied to the base layer on the opposite side of the base layer from the side adjacent to the pile forming yarn. According to the next step of the method the latex adhesive may be forced, either simultaneously with its application or in a separate step, through the base layer into bond forming contact with the pile forming yarn, and the adhesive is then cured by heating it to a temperature of from about 200° F to about 400° F for about 60 seconds to about 500 seconds thereby bonding the pile forming yarn to the base layer. The apparatus includes a means for applying the adhesive and forcing it through the base layer.

According to a preferred embodiment of the present invention a method and apparatus are provided wherein two continuous, liquid-permeable base layers are positioned in a passage where they lie in substantial parallel relationship to one another at a predetermined distance from one another; at least one continuous pile forming yarn is driven by folder blades alternatively against the opposing surfaces of said base layers when they are at or near the entrance to the above mentioned passage in such a way as to position the pile forming yarn relative to the base layers and to fold it zig-zag; thereafter applying to the back of said base layers a latex adhesive; forcing said latex adhesive through said base layers so that said latex adhesive contacts said pile forming yarn; and curing said latex adhesive to thereby bond said pile forming yarn to said base layers. This step in the method may accomplish an additional function, namely that of bonding the individual pile forming yarns to themselves typically at or near the portion of the yarns nearest the base layer, thereby imparting improved performance characteristics to the pile fabric product. Thereafter, the base layers may be separated from one another to form two continuous, latex adhesive bonded products. Typically such separation may be accomplished by means of a stationary or moving knife blade positioned between the base layers which cuts the pile yarns along the entire width of the joined base layers to provide the latex adhesive bonded products.

The yarn used in forming the pile may be made of any type of fiber known to be useful for fusion bonded fabrics such as carpets, for example nylon, acrylics, polyester, wool, cotton and rayon.

Any of a wide variety of latex adhesives used as carpet backing adhesives for many years may be employed in connection with the present invention. Examples include styrenebutadiene (SBR), acrylics, vinyl acetate, vinyl acrylate, water-based urethanes and the like. SBR latex emulsions may be preferred.

The SBR latex emulsion may be prepared in accordance with known procedures such as, for example, the polymerization of the respective monomers in appropriate proportions in an aqueous medium containing an emulsifying agent and a peroxide catalyst. An emulsion stabilizer, such as an anionic surface-active agent, is usually added during the polymerization process. The SBR latex is usually a binary copolymer of styrene and butadiene but copolymers incorporating a third or fourth monomer may also be utilized in this invention. A preferred latex in the carpet adhesive industry is a carboxylated styrene-butadiene polymer having a fairly high styrene content.

The emulsion usually contains about 50% water, by weight, but may contain more or less, e.g. from about 40% to about 60%. Extra water may be added in order to attain the desired working properties of the

adhesive composition.

Other additives commonly used in carpet backing adhesives such as fillers, thickeners, anti-oxidants, anti-freeze compositions, fungicides, corrosion inhibitors and colorants may be present in the carpet backing adhesives of this invention. Sodium polyacrylate is representative of one type of thickener that may be used. Each additive must be selected carefully so that it is compatible with the prime ingredients of the composition and does not adversely affect the function of the other additives.

The carpet backing adhesive of this invention may be applied to the carpet by the techniques usually employed in the industry. A lick-roll technique, a spreading technique and a spraying technique are described in "High Polymer Latices" (Applied Science Publishers, Ltd., 1966). Briefly, the lick-roll application comprises pulling the carpet under tension through an assembly of rollers, brushing and steaming the carpet back, pressing the back with a lick-roller carrying the adhesive from a bath of adhesive in which the lick-roller revolves, passing the adhesive-coated carpet back under a doctor blade to control the thickness of the adhesive and drying the adhesive with heat to cure the adhesive.

Suitable liquid-permeable base layers which may be employed in the product and process of the invention include woven fabrics, knitted fabrics, non-woven mats or scrims, felted materials, or even flexible, foraminous materials.

After the latex adhesive is applied the composite then travels into a curing oven where the latex adhesive is cured and water is removed. In the past it was considered to be impossible to remove large amounts of water from the adhesive during the manufacture of a bonded type floorcovering product. It has been found, however, quite to the contrary, that the majority of the moisture actually travels into the yarn thereby causing the yarn to bulk as the liquid phase water is converted into steam in the curing oven just prior to removal of the steam through the exhaust fans. Thus, the moisture present in the latex adhesive is a benefit in terms of the properties of the final floorcovering product rather than a detriment.

Where it is desired to provide the latex adhesive bonded pile fabrics of the present invention as floor covering products, especially carpet tiles, it may be desirable to apply any of a wide variety of suitable, resilient backing layers to the fabric. Such carpet tiles are also considered to be within the scope of the present invention. The backing layer may be formed, for example, from a suitable thermoplastic or thermoset material such as blends containing ethylene/vinyl acetate copolymers, atactic polypropylene, bitumen, hydrocarbon resins, waxes, polyvinyl chloride compounds, synthetic and natural rubbers.

In the past, use of latex adhesives in the manufacture of bonded carpet tiles in particular was discarded because it was believed that the resilient backing layer, whether it be polyvinyl chloride, ethylene vinyl acetate, or even hot melt backing materials, would be incompatible with the latex adhesive. It has been found, however, quite to the contrary, that latex adhesives may be quite compatible with a wide variety of resilient backing layers by selecting the proper combination of latex adhesive composition, resilient backing layer composition and, furthermore, by imparting as much mechanical bond as possible by adding only the exact amount adhesive to the yarns as may be necessary to achieve desired yarn bundle penetration. By so doing voids are left between and around the yarn bundles for mechanical adhesion of the secondary backing material to the preformed composite.

The backing layer, which may be bonded to the pile layer by means of a separate hot melt adhesive, may be provided with at least one stiffening and stabilizing membrane, such as woven or nonwoven glass fibers. After the backing has been applied the consolidated material may then be severed by suitable cutting means into a carpet tile by any of a variety of techniques which are well-known to those skilled in the art.

The resulting carpet tile product may be printed and even subjected to further textile processing operations at relatively high temperatures without adversely affecting its physical properties. It is suitable for use as a floor covering in home and/or commercial use in an office environment where substantial high stress conditions (e.g., wheeled traffic) are applied across the tiles. The tiles typically have a dense pile and may not require adhesives for installation. The individual modules may be replaced or rotated as necessary or desired. The carpet tiles may also have excellent dimensional stability with substantially no curling, slipping, buckling, stretching or shrinking. In addition, the carpet tiles may have low smoke emission and low "fuzzing" characteristics.

The invention may be further understood by reference to the drawings and accompanying description thereof. It is to be understood, however, that various changes may be made without departing from the scope or spirit of the invention which is to be limited only by the scope of the appended claims.

Referring now to the drawings:

Figure 1 is an elevation view of the apparatus; and

Figures 2 through 6 illustrate various embodiments for forcing the latex adhesive through the base layer.

Figures 7 through 10 illustrate various pile forming configurations which may be employed in the hot

melt adhesive bonded pile fabrics of the present invention. Figure 11 is a photomicrograph of the base of a pile yarn that was bonded to a base layer by means of the latex adhesive compositions of the present invention. Figure 12 is a representation of a pile yarn bonded to a base layer by conventional techniques.

Referring now to Figure 1, carpet yarn 10 is supplied from a yarn source (not shown) over and around guide rolls 12 and 14 and down to the vertical guides 16. Base layer 17 is supplied from rolls 18 into position between the guides 16. As the yarn 10 enters between the vertical guides 16 the folding blades 20 and 22 alternately displace the yarn in a zig-zag fashion into one or the other of the base layer sheets 17 as the carpet backing is being drawn downwardly. Pivotaly mounted bladelets 24 and 26 may assist in the folding of the yarn. Folding blades 20 and 22 are mounted, respectively, to connecting rods 28 and 30. Connecting rod 28 is pivotaly connected to pivot shafts 36 and 38 through suitable links (not shown). The shafts 32 and 38 are oscillated by an oscillating crank arm mechanism (not shown).

It should be noted that the blade 20 is out of phase with the blade 22 so that when the blade 22 is being pivoted inwardly as shown in Figure 1 the blade 20 is being pivoted outwardly and vice versa to provide a zig-zag configuration of the yarn between the carpet base layers 17 which are liquid-permeable, that is permeable to the adhesive to be applied.

After the yarn has been positioned in zig-zag configuration between the carpet base layers 17, latex adhesive 80 contained in trough 88 is forced through the liquid carpet base layers 17 by rotation of applicator rolls 84 into contact with the carpet yarns 10.

After the latex adhesive has been applied to the carpet base layer and forced through it into contact with the carpet yarn, it may be converted into the solid phase by heating means 90 to form a bond between the carpet yarn 10 and the carpet base layer 17. Heating means 90 may be supplied with infrared heater 92 to heat the latex adhesive causing it to cure. The yarn 10 may then be severed, generally in the middle of the base layers 17 by cutting blade 98 to provide, simultaneously, two sheets of carpet.

Figure 2 is an alternate latex adhesive applicator means of the embodiment 78 shown in Figure 1. The trough 100 is positioned underneath the applicator rolls 84 which are rotated in the direction of the movement of the fabric. Rate of application of the latex is controlled by doctor knife 102. Figure 3 is yet another embodiment showing a trough 103 located at the side of applicator rolls 84. Rate of application of latex adhesive is controlled by doctor rolls 105.

Figure 4 illustrates an alternative embodiment wherein the latex adhesive is maintained in a reservoir sided on one side by base layers 17 and on the other side by doctor blades 104. The adhesive 80 is allowed to contact the carpet backings and is forced therethrough by the tips 106 of doctor blades 104.

Figure 5 illustrates yet another embodiment of the invention where the latex adhesive is maintained in tanks 108. Application of the adhesive to the base layers 17 is accomplished by drawing the adhesive out of the tank 80 through pumps 110 into manifolds 112. The adhesive is then forced from the opening 114 in manifolds 112 under sufficient pressure to force the adhesive through the carpet base layers 17 into contact with carpet yarn 10.

Figure 6 shows a spray application of latex adhesive by means of spray applicator 107. After spraying the latex it is forced through the base layer 17 into contact with pile yarns 10 by means of penetration rolls 109.

Figure 7 illustrates an embodiment of the present invention showing an I-tuft configuration of the pile yarns. Latex adhesive 80 is shown as a continuous layer into which the base layer 17 of a relatively open-weave, adhesive permeable fabric has become embedded at the base thereof. Backing layer 150 is made of a thermoplastic material having a stabilizing layer of glass fibers 151 and is shown as having been bonded to the pile fabric by means of thermoplastic material. Figures 8, 9 and 10 illustrate some folded configurations of the pile forming yarns which may be preferred. Identifying numbers refer to the same structural components as in Figure 7. Figure 8 shows a folded, cut pile configuration. Figure 9 shows a loop pile configuration. Figure 10 shows another folded pile configuration where the folded portion of the yarn is on the surface giving the appearance of a loop pile, although the loops are not joined to one another at their base. This configuration provides in essence a loop pile product while simultaneously offering the advantages of, for instance, yarn savings of the so-called I-tuft configuration.

Figure 11 is a photomicrograph (20X) of a tuft bonded by means of the process described in Example I. The tuft was pulled out of the latex adhesive and a cross-section was cut at its base to show adhesive penetration. As can be seen, the latex adhesive showed excellent penetration contacting all of the fibers of the yarn bundle.

Figure 12 is a yarn from a conventional, bonded product taken and cut in the same way as the yarn from Figure 11. Adhesive has penetrated only through the surface layer leaving many loose fibers which may result in undesired fuzzing and pilling.

The invention may be further understood by reference to the following examples which are not to be

construed as unduly limiting the invention.

EXAMPLE I

Employing the apparatus substantially as illustrated in Figure 1 with the exception that the adhesive applicator means was the embodiment shown in Figure 6, liquid-permeable base layers were provided of non-woven glass scrim of 10 ends by 8 ends per inch. Into these base layers were positioned pile forming yarns of stock-dyed Nylon 6,6, 2.00/2 spun yarn. The yarn was folded at about 8 folds per inch by 9 ends per inch construction. Fabric traveled at about 1 ft./minute linear speed. A latex adhesive composition (a 50% aqueous composition of styrene butadiene supplied by Reichhold Chemical) was applied at the rate of about 50 ozs./sq. yd. The latex adhesive composition also contained filler at the level of about 150 parts filler per 100 parts polymer. Viscosity of the latex adhesive composition was about 3,000 centipoise which provided optimum yarn penetration and maximum surface area form a mechanical bond to the tie coat. The adhesive was then cured using infrared heaters (three - 18" strips at 100% output were used followed by one bank at 50% output). Excess moisture was drawn off by exhaust fans not shown. The carpet was then cooled and slit.

A pre-formed backing layer of filled atactic polypropylene (weighing about 50 ozs./sq. yd.) was cast on a non-woven glass mat which was then laminated to the slit, latex adhesive bonded carpet by casting about 20 ozs./sq. yd. of filled atactic polypropylene onto the backing layer and then immediately pressing the carpeting into this molten material by conventional means. The resulting product was allowed to cool and was then cut into carpet tiles and was suitable at that time for further processing, e.g. printing, steaming, washing and drying.

EXAMPLE II

In this example carpet tile properties of tuft lock, pilling and fuzzing were determined for the carpet tile made as described in Example I and, furthermore, a comparison was made to those same properties in a polyvinyl chloride bonded tile manufactured by means of the equipment essentially as described in U. S. Patent No. 3,411,966. The PVC was applied at the rate of 55 ozs./sq. yd. (100% solids). The tuft bond was measured by ASTM Standard Test Measure D1335, filling and fuzzing were measured by DuPont random filling and fuzzing tests which is the conventional test in the industry. The results for this latter test are measured on a scale of one to five with one being poor and five being excellent. The results are summarized in the table below.

TABLE

	<u>TUFT LOCK</u>	<u>PILLING & FUZZING</u>
EXAMPLE I	8 lbs.	4.0
EXAMPLE II	4.5 lbs.	3.0

The results summarized in the table above show that the product of the present invention results in improved properties of tuft bond, pilling and fuzzing with less than 50% of the added weight for the adhesive component. The product also had better hand and better yarn coverage due to the bulking of the yarn which occurred during the latex cure step while water was being driven off.

Claims

1. A latex adhesive bonded pile fabric comprising a liquid-permeable base layer, a pile forming yarn adjacent to, but not tufted through said base layer, said yarn having been bonded to said base layer by means of a latex adhesive applied to a back of said base layer and forced through said base layer into contact with said yarn.

2. A pile fabric according to Claim 1 further comprising a backing layer of thermoplastic material bonded to said back of said base layer.
3. A method of bonding yarn to a base layer comprising the steps of:
 - 5 feeding first and second continuous, liquid-permeable base layers between guides where said base layers lie spaced from one another in parallel relationship;
folding a continuous pile forming yarn against opposing surfaces of said base layers with folder blades while said base layers are fed through said guide, to position said yarn in zig-zag, folded fashion without tufting said yarn through said base layers;
 - 10 forcing a latex adhesive through a back of each of said base layers and into contact with said yarn after said yarn has been folded between said base layers;
drying said latex adhesive while in contact with said yarn by passing said base layers, with said folded yarn in between, through a heater; and
 - 15 cutting said yarn between said first and second base layers after drying said latex adhesive, to form two continuous bonded pile fabrics.
4. A method according to Claim 3 wherein said guides position said base layers vertically and said latex adhesive is applied to said base layers at a point below said guides.
- 20 5. A method according to Claim 4 wherein said heater is positioned vertically below said point of latex adhesive application.
6. A method according to Claim 3 wherein said latex adhesive is simultaneously forced through said first and second base layers.
- 25 7. A method according to Claim 5 wherein said base layers are free of lateral support applied to said backs as said base layers are fed between said point of latex adhesive application and said heater.

30

35

40

45

50

55

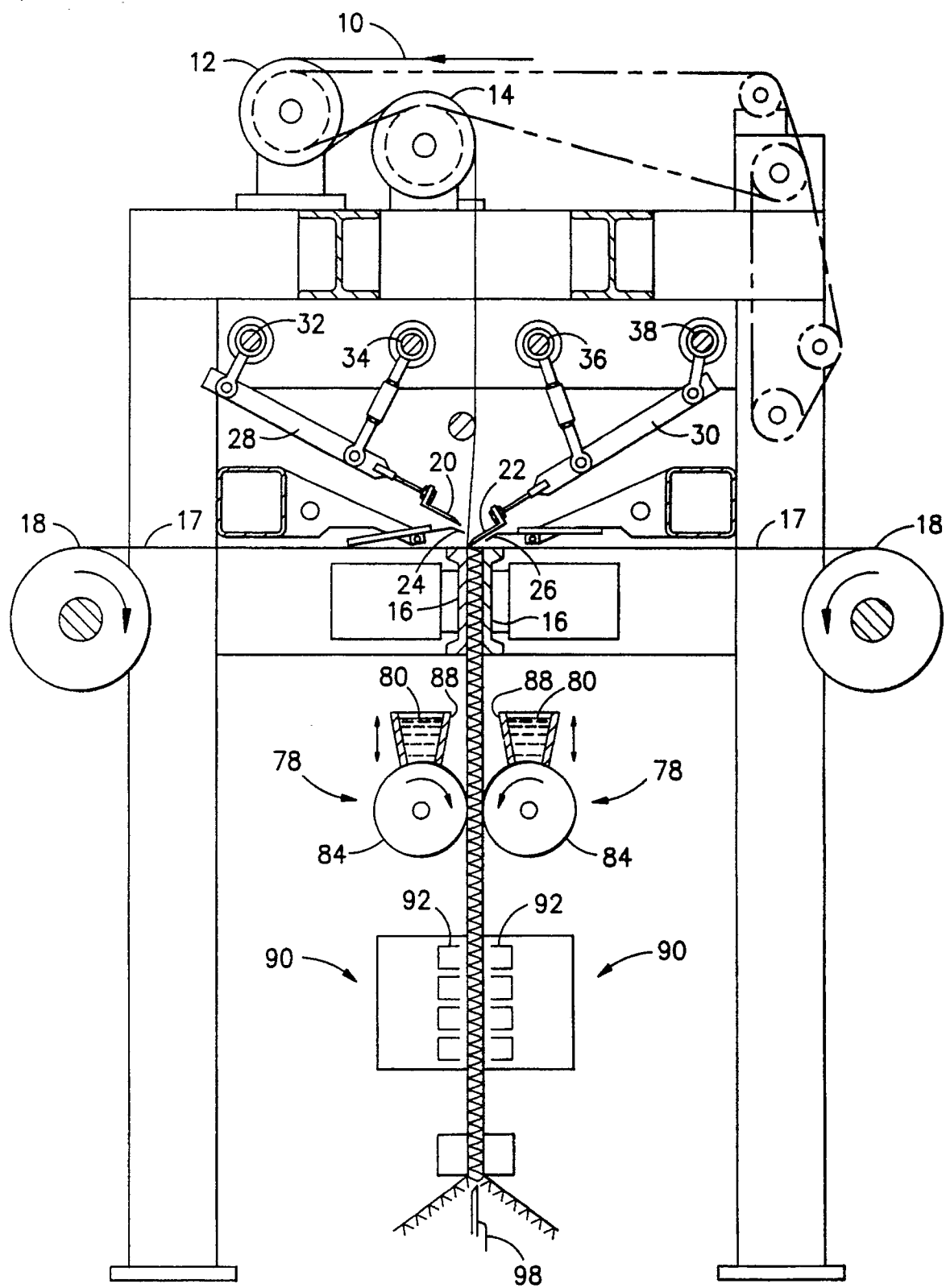


FIG. -1-

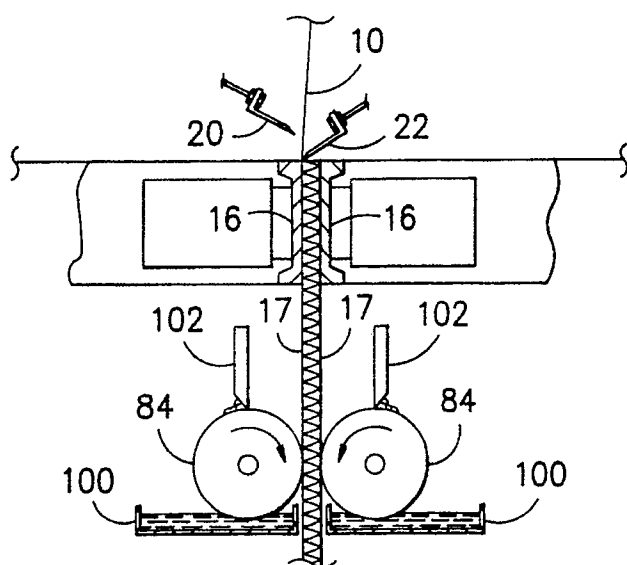


FIG. -2-

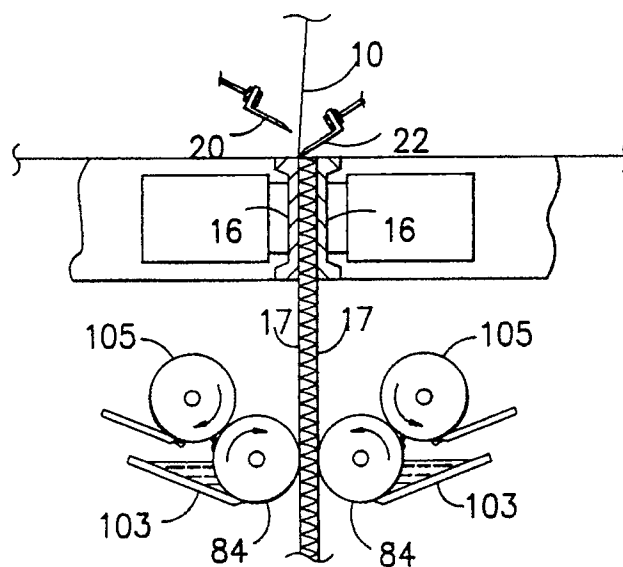


FIG. -3-

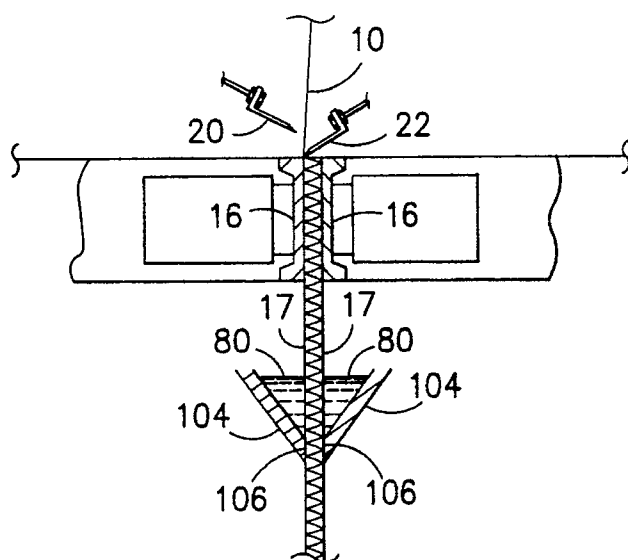


FIG. -4-

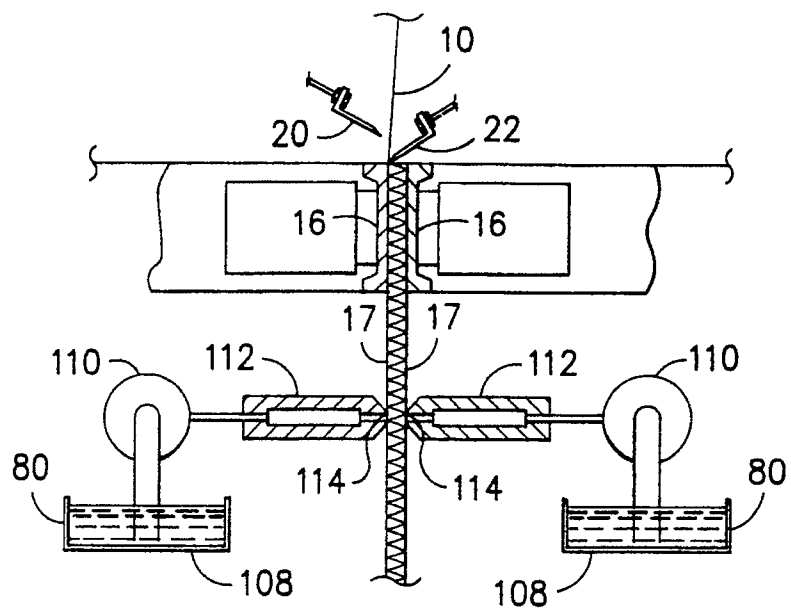


FIG. -5-

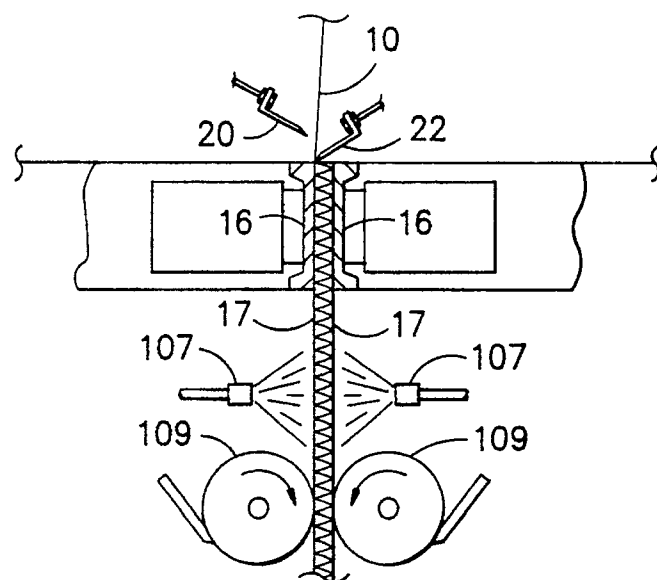


FIG. -6-

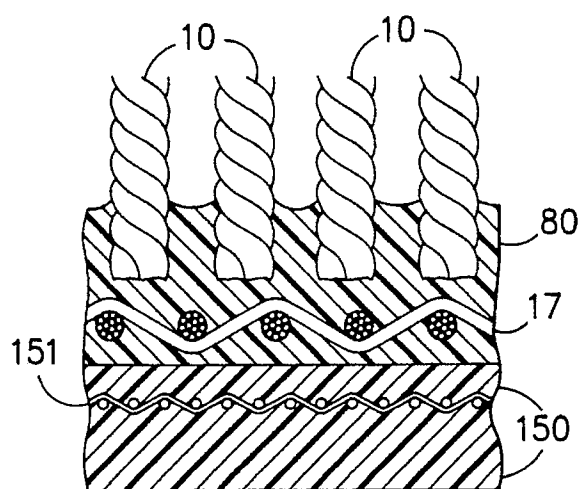


FIG. -7-

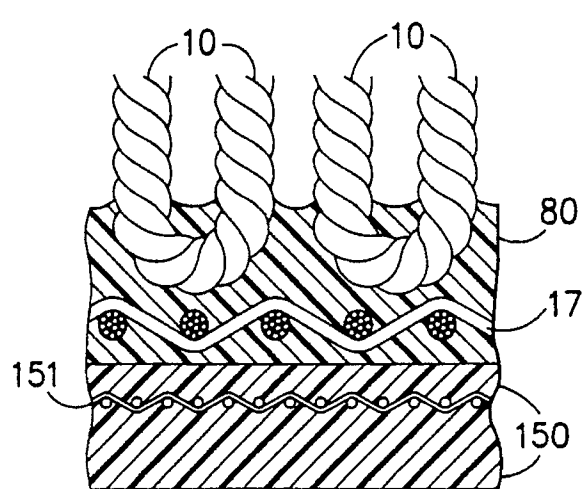


FIG. -8-

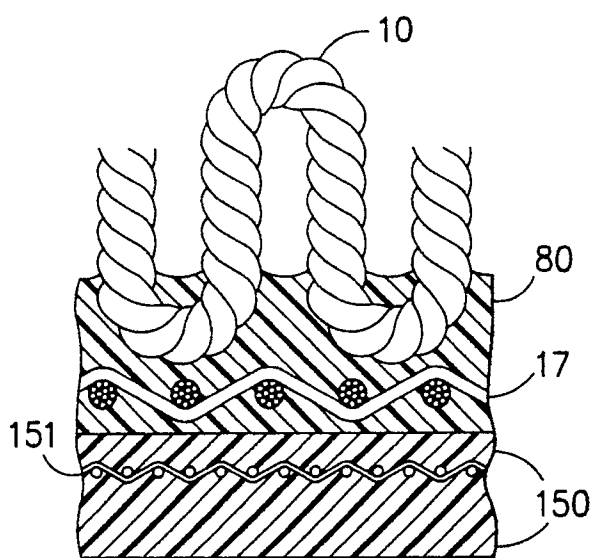


FIG. -9-

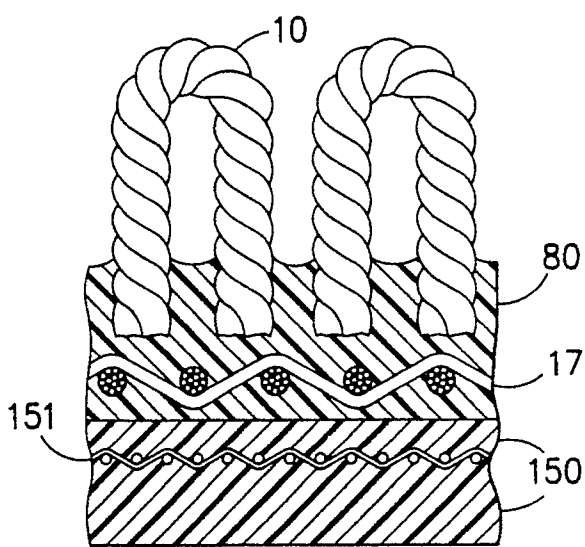


FIG. -10-



FIG. -11-



FIG. -12-