

[54] **PROCESS AND APPARATUS FOR THE MANUFACTURE OF PILE FABRICS**

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[30] **Foreign Application Priority Data**

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[51] Int. Cl. D04h 15/00

[58] Field of Search 28/72.2 R, 4 R

[56] **References Cited**

UNITED STATES PATENTS

3,451,109 6/1969 Klein 28/72.2 R

3,579,763 5/1971 Sommer.....28/72.2 R

Primary Examiner—Louis K. Rimrodt

Attorney—Ralph D. Dinklage et al.

[57] **ABSTRACT**

Improvements in the art of making pile fabrics by needle looming a non-woven fabric. The conventional needle loom is modified to use needles in which the conventional barbed end is replaced with a knife edge end so that a filament or fiber pushed out of the non-woven fabric by the needle is cut as the needle reaches its maximum throw between the needle knife edge and an anvil means placed below the tufting plate. The anvil means provides a surface against which to cut the filaments or fibers which are needled into the "pile" position at substantially uniform pile length. A disposable material such as paper or the like may be disposed on the anvil for the needle and knife edge to bear against.

9 Claims, 5 Drawing Figures

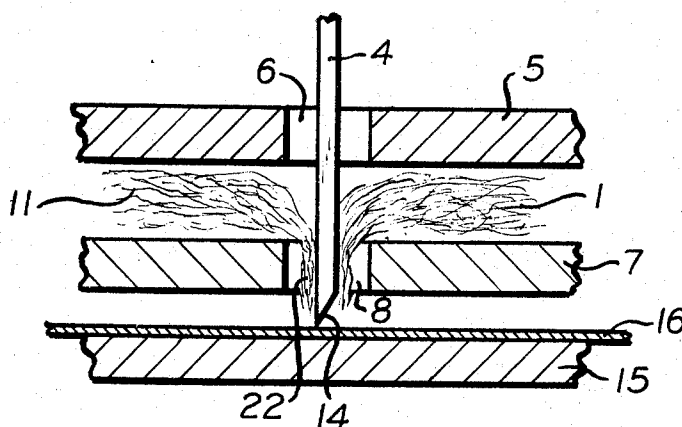


FIG. 1.

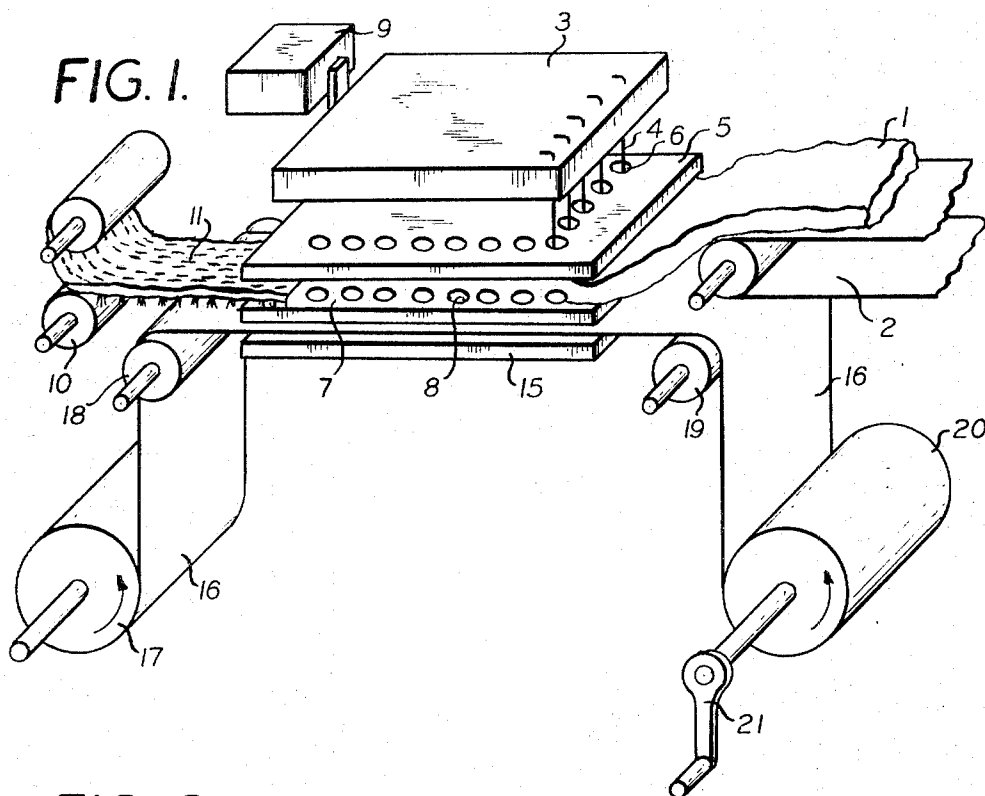


FIG. 2.

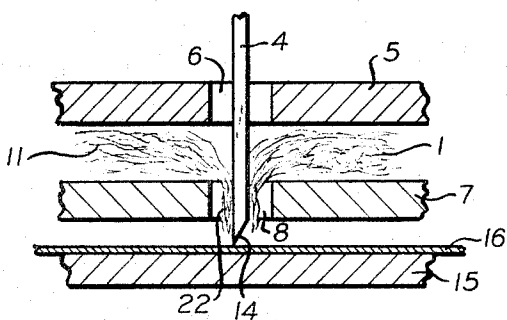


FIG. 3.

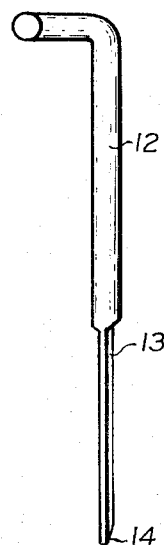
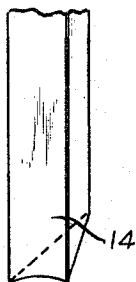
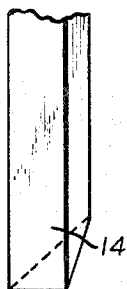


FIG. 4.

FIG. 5.



PROCESS AND APPARATUS FOR THE MANUFACTURE OF PILE FABRICS

This invention relates to pile fabrics. It more particularly refers to pile fabrics made by needling a continuous filament or staple fiber non-woven fabric.

The needling of non-woven fabric is a generally known operation which is carried out on a commercially available piece of equipment called a needle loom. In the operation of needle looms, a bed of barbed needles is worked in reciprocating fashion transverse to the major surface of a pre-formed non-woven fabric so as to displace some of the staple length fibers of the fabric, or some portions of continuous filaments of such fabric, into a position which is transverse to the major fabric surfaces. The barb on the needle end causes fibers to be displaced when the needle is being moved both toward and away from the fabric. The purpose of needling is generally to increase the delamination resistance of non-woven fabrics.

A needle loom is usually composed of a needle bed with a multiplicity of needles, generally having barbed ends, extending normal thereto; means to move the needles and needle bed in a reciprocating motion generally parallel to the needle axis; a hold-down plate with apertures therein generally corresponding to the needles through which the needles pass; a tufting plate spaced from and generally parallel to the hold-down plate with apertures therein corresponding to the needles through which the needles pass; and means to dispose a fabric to be needled between the hold-down plate and the tufting plate.

A needle loom conventionally operates by positioning a pre-formed fabric, preferably a non-woven fabric, between the hold down plate and the tufting plate of the loom and reciprocating the needle board and barbed needles thereon into and out of engagement with the fabric. Usually the fabric is a continuous fabric which is moved through the needle loom in an intermittent motion consistent with the reciprocation of the needles.

In passing through the non-woven fabric, the needles impale or otherwise force one or more fibers or portions of continuous filaments out of their conventional alignment generally parallel to the major surfaces of the fabric to a position generally transverse to the plane of these major fabric surfaces so as to prevent or retard delamination.

In making pile fabrics by the needling of non-woven fabrics, the needles are so sized, positioned and operated that they are not barbed. These needles are caused to pass completely through the non-woven fabric and push fibers or portions of continuous filaments out past one of the major surfaces of the non-woven fabric into a position generally normal thereto but not to pull any fibers back in the other direction. These normal fibers or filament portions are the pile portion of the fabric.

It is known in the prior art to produce rather hard floor coverings by carrying out the tufting of a non-woven fabric via a needle loom and then fully impregnating the pile fabric thus obtained with a suitable binding agent which is then dried and set up in the usual manner. Such floor coverings are commercially available on the open market.

It is also known that softer floor coverings, that is carpets or carpet tiles, can be made, according to German Gebrauchsmuster No. 1,989,434, by limiting the impregnation of such needled, tufted non-woven fabrics to about two-thirds of the thickness thereof from the non-pile side thereof, that is from the side which afterward will face the floor. The upper third of the fabric remains free of bonding agent so that a soft tread layer is thus achieved. Such carpeting is commercially available on the open market.

If it is desired to produce loop type carpeting, it is known to substitute forked needles for conventional straight needles whereby portions of filaments or fibers are pushed out of the fabric in a loop or folded configuration. Such loop carpeting is commercially available on the open market.

The carpeting materials which are obtained by the two last-described processes do present a pleasing appearance, but when used as floor coverings they prove to be extremely difficult to clean, it being especially difficult to remove wood chips, Christmas tree needles and other particles. For this reason, consumers of woven or tufted floor coverings are more likely to purchase a more open pile type of fabric, in which the tops of the loops are cut, even though this type of fabric is more costly. This cut pile type of structure can also be achieved in a needle tufted non-woven fabric type of pile material by performing an especially deep needling with the classical needles, possibly subjecting the needled fabric to napping the loop surface thus produced, and then subjecting the looped pile surface to a shearing process like that used in the manufacture of velours. Although this process produces a good product, it is not particularly desirable because it requires a plurality of expensive process steps and because there is a significant material loss in the shearing process.

It has been proposed to produce such sheared type of pile fabrics by a sort of combination of some of the techniques described above (see French Pat. No. 1,528,749). According to this reference, forked needles are used to needle continuous filament non-woven fabric. The needles are so dimensioned and operated that they stretch portions of continuous filaments past their elastic limit and therefore break the loops thus pushed out of the base non-woven fabric. Since not all continuous filaments in the same non-woven fabric have the same ultimate tensile strength, this procedure results in a product having a rather random length pile. While this may be acceptable for certain end use products, it is by no means satisfactory for all carpet applications.

It is therefore an important object of this invention to provide a novel process and apparatus for the production of pile fabrics from non-woven fabrics.

It is another object of this invention to provide a novel process and apparatus for producing a type of pile fabric having a sheared appearance in a more efficient manner than is available in the prior art.

Other and additional objects of this invention will become apparent from a consideration of this entire specification including the drawing and the claims hereof.

In accordance with and fulfilling these objects, one aspect of this invention resides in a modification of ex-

isting needle looming apparatus by providing a knife edge on the needle end so as to be able to cut the filament or fiber loops as they are pulled out of the non-woven fabric against an anvil means which is disposed on the side of the tufting board away from the hold-down board. In a preferred embodiment of this invention, means is provided for limiting the throw of the reciprocating needles so that the knife edge end thereof just barely touches, or just barely misses, the above-referred-to anvil means whereby cutting the filament loops between the knife and the anvil.

The improved process of this invention utilizes the above apparatus in the following manner: the needles engage individual staple fibers, preferably of about 4 to 10 mm in length continuous filaments or portions thereof and push them out of the base fabric into a loopy pile configuration; as the needles extend to the limit of their throw, carrying a filament or fiber portion on the end thereof, the knife edge end thereof approaches an anvil means until they juxtapose with the filament loop therebetween such that the loop is severed, usually at the maximum extension of the needle throw. Thus all of the pile filament portions have a uniform height without the inconvenience of either having a loop pile construction or a shearing operation with attendant inefficiencies.

Understanding of this invention will be facilitated by reference to the accompanying drawing in which:

FIG. 1 is an isometric, schematic view of a needle-loom operation and apparatus in accord with this invention;

FIG. 2 is a sectioned elevation of the operation of one needle of the loom of FIG. 1 at the maximum throw position;

FIG. 3 is an elevation of a needle for use in this invention;

FIG. 4 is an enlarged view of the needle knife edge; and

FIG. 5 is similar to FIG. 4 showing a different knife edge construction.

Referring now to this drawing, and more particularly to FIG. 1 thereof, a fabric 1, suitably composed of non-woven fibers or filaments, is fed from a source (not shown) by means of a conveyor belt 2, or other similar means, into a needle loom. The needle loom comprises a needle board 3 with a multiplicity of needles 4 extending parallel to each other normal to the needle board; a tufting board 7, with a multiplicity of apertures 8 therein aligned with the needles 4 and the hold-down board apertures 6, generally parallel to and spaced from the hold-down board 5 on the side thereof away from the needle board 3; a means 9 for reciprocating the needle board 3 and attendant needles 4 into and out of engagement with the fabric 1 through the apertures 6 and 8; and take-up means 10 for the needled pile-fabric 11 emerging from the needle loom.

The needles 4 used in the needle loom of this invention are shown in FIGS. 3, 4 and 5 and have an angled shank 12 terminating in a narrow blade 13 which blade 13 has a knife edge 14 on the end thereof. The knife edge 14 may be flat as shown in FIG. 4 or it may be hollow ground as shown in FIG. 5.

According to this invention, an anvil means 15 is provided in the needle loom. This anvil means is disposed on the side of the tufting board 7 away from the hold-

down board 5. It is composed of an anvil 15 and, preferably, an anvil band 16 positioned on the needle-directed side of the anvil. The anvil band 16 may be a disposable film or layer of relatively soft material such as paper, paper board, plastic or the like. The cutting of the fiber or filament loops is actually accomplished between the knife edge end 14 and the anvil band 16.

It is within the spirit and scope of this invention to utilize a constantly or intermittently moving anvil band 16. This can be accomplished by having a feed roll 17 of paper or the like; passing the fed paper 16 over a guide roller 18 into appropriate position, taking the used paper out of the anvil means over a roller 19 and winding it up on a take-up roll 20. The paper 16 may be moved by means of a hand crank 21 or by any other conventional motive means keyed to the movement of the fabric and/or the operation of the needle loom or not as the case may be.

According to this invention, a generally conventional needling machine may be used but it should preferably be of sturdy construction. The needle ends should have a cutting edge 0.5 to 2 mm wide. The needle board, tufting board and hold-down board are drilled in strict geometrical alignment to achieve a uniformly dense pattern, a uniformly offset arrangement with a spacing of, for example, 7 mm on the centers of the holes being technically feasible. A denser spacing, down to 4 mm for example, may be desirable, and requires extreme precision in the manufacture of the parts and the needles must be very straight. A wider needle spacing is, of course, conceivable, especially when heavy fibers are involved, but wider needle spacing results in relatively coarse pile structures. The offset arrangement of the needles means that the spacing between the needle wales in the finished product will be equal to half of the needle-to-needle distance in the needle board (3.5 mm in our example). The anvil band is preferably transported at a velocity that is independent of the production velocity, (e.g., from 0 to 5 m/min).

During the needling process the needles 4 first penetrate the hold-down board 5, then the fabric 1, from which they push fiber clusters 22 down through the tufting board 7. As soon as the cutting edge of the needle contacts the surface of the anvil band 16 and slightly penetrates into the latter, the fibers of the fiber clusters are severed. The sharpness of the cutting edges is preferably such that until they encounter the anvil band the needles will produce a perfect loop without appreciable fiber damage, and the loop will not be severed until the cutting edge cooperates with the anvil band.

The position of the anvil 15 is fixed in the machine in accordance with the needle length in such a manner that it is not quite contacted by the knife edge end of the needle at the bottom dead center of the movement (maximum needle throw). This prevents unnecessary dulling of the cutting edges. The length of the cut pile in the carpeting is determined by the needle length, the spacing between the tufting plate and the anvil means and the needle throw.

The cut pile-like structure of the needled carpeting produced in this matter is achieved without loss of material.

Partial impregnation, addition of bonded padding and back coating are all conventional carpet making

operations which can be performed by methods well known in the art.

It is within the scope of this invention to utilize as the non-woven fabric, a continuous filament or staple fiber non-woven fabric which has been subjected to a needling process whereby positioning portions of the fiber or filaments thereof transverse to the plane of the major surfaces thereof but retained within the overall fabric structure, that is needled but not tufted non-woven fabric.

What is claimed is:

1. In a needle loom comprising means for feeding non-woven fabric thereinto, means for removing needled, non-woven fabric therefrom, a needle board, a multiplicity of needles extending generally parallel to each other and normal to said needle board, a hold-down board with apertures therein corresponding to said needles positioned to receive said needles therethrough, a tufting board with apertures therein corresponding to said needles which tufting board is normally spaced from said hold-down board sufficient to pass said non-woven fabric therebetween, and means for moving said needles through said apertures relative to said non-woven fabric whereby forcing portions of fibers of said fabric to become aligned substantially normal to the major surface of said fabric; the improvement which comprises the fabric-directed ends of said needles being a knife edge and an anvil means juxtaposed the maximum throw position of said needles whereby cutting said fiber portion between said knife edge and said anvil means at substantially the same individual pile fiber portion height.

2. The improved apparatus as claimed in claim 1, including means for intermittently moving said non-woven fabric through said needle loom.

3. The improved apparatus as claimed in claim 1

wherein said anvil means comprises an anvil and an anvil band, and wherein said anvil means is spaced from said tufting board a distance such that said needle knife edge contact said anvil band and do not contact said anvil.

4. The improved apparatus claimed in claim 3 wherein said anvil band is a disposable, soft material selected from the group consisting of paper, paper board and plastic.

5. The improved apparatus claimed in claim 5, including means for feeding said anvil band to said needle loom and means for removing such therefrom.

6. The improved apparatus as claimed in claim 1 wherein said knife edge end is 0.5 to 2 mm wide.

7. Process of forming pile carpeting comprising a non-woven fabric composed of fibers to a needle loom; pushing loops of portions of said fibers out of said non-woven fabric into a direction normal to a major surface of said fabric by reciprocating needles through said fabric normal to said major surface; juxtaposing the fabric-directed end of said needles to an anvil means; and cutting said fiber portions between the knife edge and said anvil means at the substantially maximum throw of said needles.

8. Process as claimed in claim 7, including providing said anvil means as a combination of a relatively hard anvil and a relatively soft anvil band and including bearing said knife edge only against said anvil band.

9. Process as claimed in claim 8, including feeding said fabric to said loom intermittently in synchronization with the reciprocation of said needles, utilizing as said anvil band a disposable material, and feeding said anvil band between said needles and said anvil at a rate independent of the rate at which fabric is fed to said loom.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,725,984

Dated April 10, 1973

Inventor(s) Adolf Wilhelm Graber

It is certified that error appears in the above-identified patent
and that said Letters Patent are hereby corrected as shown below:

Front page: Name of Assignee is missing. This should read:

--Firma Carl Freudenberg
Weinheim, Germany--

Signed and sealed this 1st day of January 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents