APPARATUS TO MAKE PILE FABRICS IN WHICH PILE THREADS ARE BONDED TO A BASE LAYER

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ABSTRACT
A group of plate-like elements, which are hollow between a top and bottom plate are arranged in stacked location, the threads to form the pile fabric being placed adjacent each other between the plate-like elements. A needle-holding web, having needles projecting therefrom is passed intermittently in front of the stacked threads and pressed against the end faces of the threads so that the needles will spear the threads; a knife cuts off the threads, clearing the spearing needles, to transfer the pile threads to the web. The threads between the plates are fed forwardly again by grippers arranged in the hollow between the plate-like elements, the plate-like elements reciprocating back and forth to feed the threads. The web may then be moved to a bonding position at which the cut ends of the pile threads are contacted with a bonding material and, if desired, with a base layer, which is guided over a different path, the then bonded threads being stripped off the needles.

9 Claims, 7 Drawing Figures
APPARATUS TO MAKE PILE FABRICS IN WHICH PILE THREADS ARE BONDED TO A BASE LAYER

The present invention relates to the manufacture of pile fabric, in which individual pile threads or fibers are joined to a base layer, and bonded to the base layer; and more particularly to apparatus to make such a pile fabric, and to the pile fabric being formed in an elongated web.

Various apparatus to make textile pile fabrics, chenille fabric and the like are known, in which cut pile fibers or threads are bonded in a binder, or bonding base substance. These methods are time-consuming, do not produce material at a rapid rate and provide little opportunity to insert pile material in accordance with a predetermined pattern.

It has previously been proposed to electrostatically apply carrier material with covering layers. When utilized with threads or fibers, the fibers have to be aligned longitudinally, must stand singly, and must have a certain relationship between their length and their thickness. This method permits only little possibility to provide patterns in pile fabrics.

It is an object of the present invention to provide an apparatus which is simple and in which selected threads or fibers are applied to a base layer or to a base material, with low loss of covering pile fiber material and permitting application of the pile material in various patterns.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, superimposed layers of the threads or the like are fed between stacks of feed plate elements against an intermittently moving, endless web which has needles placed thereon, extending from the web. The web and the fibers are moved against each other, so that the projecting needles will pierce the fibers. The fibers are then cut to the desired height of the pile. The pile threads, held on the needles, or between other pile threads which are held on the needles may then transported towards a binder material, with which the cut ends of the fibers will bond, so that, upon transporting the binder material over a path different from that of the web, the pile will be stripped off the needles and the pile material, on the base, will have been produced.

In accordance with an embodiment of the invention, the layers of pile threads are compressed before introduction of the needles into the end fibers, and cutting of the pile, to obtain the desired pile density.

In accordance with a further feature of the invention, the bonding step to a base layer can be combined with applying the pile to a base carrier, such as a carrier web, or backing.

The apparatus is formed of a group of plate-like elements which consist of feed leaves, or the like, between which the threads are located in layers, each feed leaf having movable grippers located therein, so that the threads can be gripped and fed forwardly after each cutting operation.

The present invention permits the use of yarn, roving, slivers, carded ribbons, strands, non-woven fabrics, fibrous or filamentary parallel webs, or the like. Additionally, fibers and threads which heretofore could not be used in pile fabrics can be processed by the method and apparatus of the present invention, such as spirally interwined fibers or the like.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a general side view of the apparatus and illustrating the method;

FIG. 2 is an isometric projection of the feed arrangement for the fibers;

FIG. 3 is an isometric projection, partly broken away, of a feed plate;

FIG. 4 is a partial top view of a feed plate;

FIG. 5 is a longitudinal cross section along line V-V of FIG. 4;

FIG. 6 is a longitudinal cross section along line VI-VI of FIG. 3; and

FIG. 7 is a greatly enlarged fragmentary side view illustrating the cutting arrangement.

The apparatus has a group of stations. FIG. 1 illustrates, at A, the feed arrangement in which fibers or threads 1, located in vertically stacked layers, are fed forwardly. The feed arrangement A essentially, includes feed plates 2, 3, which are located in a pair of groups B, C, and which are located between the threads 1. The groups B, C are adjacent each other. Each one of the feed plates 2, 3 is formed of a top plate 2a, 3a and a bottom plate 2b, 3b (FIG. 3), between which claws or grippers 2c, 3c are located. The top and bottom plates are formed with slots 2d, 3d, through which the grippers 2c, 3c may extend. The grippers are in the form of claws, or with reversely bent hooks, such as fishhooks. The grippers 2c, 3c are located on a tongue 2e, 3e which is slidable in order to feed the threads 1. The tongues 2e, 3e are moved, for example, by means of a compressed fluid cylinder 4, 5, having piston rods located in holders 6, 7. The holders 6, 7 are located in carriers 8, 9 which, in turn, can be moved by means of compressed fluid cylinders 10, 11 to move the entire groups B, C of the plate-like elements in feed direction, or in direction opposite thereto, the grippers being pushed outwardly to grip the threads when the carriers 8, 9 are moved in feed direction, and to hold the threads, and the grippers being retracted upon reverse movement of the carriers 8, 9.

The slots 3d formed in the upper and lower plates 3a, 3b (FIG. 6) are so arranged that the grippers 3c can extend therethrough and thus pass beyond the upper and lower plates 3a, 3b. Upon movement of the tongue 3e in opposite direction, the grippers 3c retract within the two plates from the slits 3d and are completely retained between the top and bottom plates 3a, 3b of the plate-like elements 3. The movement is similar to the extension and retraction of claws of a cat.

An endless web 12 which has needles placed thereon extending from the web is moved transverse to the end face direction of the threads 1. The feed assembly A is associated with a frame 13, movable in feed direction, which retains the threads 1 which extend beyond the ends of the plate-like elements 3. The lower part of the frame 13 has a counter element 14 (FIG. 7) connected thereto. A horizontally movable plate 15, in the nature of a back-up plate is movable by means of a compressed fluid cylinder 15' in horizontal direction, to press the needles against the end faces of the threads, and to feed the threads thereon. A cutter C (FIG. 7) cuts the threads into pile elements. In a preferred form, it is a band, or thin blade knife which is movable in vertical direction. When the cutter C is moved against the stack of fibers, the fibers are cut, as best seen in FIG. 7.
The cut fibers, speared on the needles of the needle-holding web, or retained between other fibers which are so speared, are carried by the web 12 over a roller 28, to be transferred to a shearing station D, where the lengths of the fibers are equalized. A roller 16, which may be formed with projections equalizes, or forms a pattern in the threads speared on the needles of web 12. The roller 16, likewise, can be moved back and forth, that is, away from the web by means of a pressure fluid actuated cylinder-piston arrangement 16.'

The web 12, with the fibers thereon, equalized or patterned at station D is then introduced between rollers 17, 18. Additional to the web, a base or back-up carrier 19 is introduced between the rollers 17, 18 on which, prior to such introduction, a bonding, or adhesive layer has been applied by a spreading knife 19'. The web 12, with the fibers retained thereon, is carried in contact with the Karrier web 19, and its adhesive and bonding layer over a heating drum 20, then through a cooling path 21 and thereafter over a removal drum 22. The finished pile fabric is rolled on a drum 23; the needle carrying web 12, now free from pile fibers, is returned to the region of the feed assembly.

Rather than utilizing a carrier 19, a re-usable backing can be used, if the final pile product is to be made without a backing fabric.

**OPERATION**

The starting position of the various elements is shown in FIG. 1. The faces of the stack of fibers are spaced from the needle carrying web 12 by a predetermined distance. By means of the feed arrangement A, the faces of the stack of fibers are moved towards the needle carrying web 12. The grippers 2c, 3c are extended by placing pressure fluid, such as compressed air, or oil, into cylinders 4, 5. The grippers will now pass through the slots 2d, 3d and extend beyond the upper and lower plates of the plate-like elements 2, 3. The grippers 2c, 3c will penetrate into the fibers from both sides of the plate-like elements 2, 3, so that the fibers are gripped both from the top and the bottom. The pressure cylinders 10, 11 will then have pressure applied thereto and the groups B, C of plate-like elements are moved towards the right, that is, towards web 12 with the needles thereon.

The grippers 2c, by suitable operation of the tongues 2e, are then retracted, so that the grippers 2c are removed from engagement with the threads 1, the threads 1, however, being held in position by the grippers 3c. The group B of plates is then moved towards the left, the plate-like elements 2 passing over the corresponding layers of the fibers. When in final position, the grippers 2c are again projected and penetrate the fibers 1, to hold the fibers securely, in order to permit the next cycle during which the grippers 3c are retracted, to separate from fibers 1 and permit movement of the group C of the plates 3 towards the left (FIG. 1). In the final position, the grippers 3c are again projected such that, in this position, both grippers 2c, 3c of both groups again grip the fibers and are ready for the next cycle.

A stationary web 12 is then pressed by means of plate 15 into the end faces of the stack of fibers. A top roll 27 connected to frame 13 holds the edge of the fibers in straight line position and permits spearing by, or insertion of the needles of the web 12.

The cutter C then cuts the threads 1, by movement of the cutter blade downwardly. The web 12 can, at this time already, be started to move. The cut is carried out, as shown in FIG. 7, the distance of cut from the base of the web 12, of course, being sufficient so that the knife edge will clear the tips of the needles on the needle carrying web 12. A section of the needle carrying web 12 now has the threads, or fibers speared or located thereon. The portion of web 12 changes direction adjacent the cutting by being guided around a sheave 28. The entire cutting arrangement C, including the back-up plate 15 and sheave 28 move, in a vertical direction, relatively to the feed apparatus A; of course, the feed apparatus A could also be moved vertically and the cutter be held stationary. The band-knife of the cutter C is schematically indicated in FIG. 1, and in detail in FIG. 7.

The web is then guided over a compensating loop to the equalizing station D. The end faces of the threads can be held in pre-compressed condition, to permit control of the tightness of the pile, between the top roll 27 and the bottom rail 14. After the cutting operation, the cutter C and plate 15 are moved back to the initial position, shown in FIG. 1, and feed of a next section of fibers 1 can commence.

The back-up carrier 19 is introduced between rollers 17, 18 and is pressed against the web 12, filled with fibers. The portion of the web 12 which is filled with fibers, together with the carrier 19, is then conducted over the heating drum 20 and, after being guided thereto, to a further roller 24 and to the cooling path 21. The group of rollers between rollers 12, 18 and heating drum 20 is utilized as a compression station to securely compress or embed the pile threads into the adhesive of the carrier web 19. Heating and subsequent cooling bonds the fibers in a heat-setting adhesive applied to the carrier 19. The bonding strength between the carrier 19 and the fibers is greater than the holding strength of the needles on the needle web 12, so that, when the needle web 12 and the carrier 19 are moved over different paths, by looping the carrier about a roller 22, the fibers are removed from the needle web 12 and can be rolled on a take-up roller 23. The now freed needle carrying web 12 is again returned to the feed apparatus A where it is stopped, and moved at that section only upon start of the cutting operation. The needle band 12 moves conjointly with the cutter C and the plate 15, after the cutting operation has been terminated, and plate 15 has been retracted to the right (FIG. 1).

A brush 25 may be provided to clean the needle band 12 which, additionally, can be cleaned by compressed air blast from a pipe 26.

The needles of the needle bed 12 suitably are somewhat shorter than the length of the pile, at least by the depth of the backing. It is also possible, however, to make the needles of the needle bed 12 as long, or longer than the cut pile threads, if the extent of movement of the back-up plate 15 is suitably controlled so that interferences between the knife of cutting assembly C and the needles is prevented.

The needles on the needle bed need not all have the same length; longer needles can be very pointed, and shorter needles can be provided which are somewhat blunt. The degree of conical taper, the thickness, and the strength of the needles of the needle carrying web 12 are preferably so selected that the pile threads
which are speared, and cut, are securely held in projecting direction. The longer needles, then, only have to penetrate the adhesive layer and the carrier. It is possible to insert into the needle web 12, with long needles, a filler or liner, which is elastic, and which is of such thickness that the remaining free length is shorter by the distance of the adhesive bed with respect to the length of piles to be cut.

That portion of the band knife which faces the roller 28 is hollow ground, the radius of hollowness of the grinding being approximately equal to the thickness of the web 12 and the needles, plus the radius of roller 28.

The cut pile fibers or threads secured to the web 12 are preferably profiled, and equalized before they are bonded to the adhesive substrate. It is also of advantage to loop the needle band or web 12 with the pile material thereon about a roller in which the needles face the direction of the roller in order to obtain suitable pressure on the pile by the tension of the web 12.

In accordance with a feature of the invention, the pile material can be fed to the needle holding web 12 with more fibers than there are needles, the fiber being held between the needles. It is also possible to cut the pile much longer than necessary and, after cutting and moving the web 12 with the needles and the elongated piles thereon away from the feed apparatus A, to guide the needle against a second needle holding web, similar to web 12 in such a manner that the needles of the second web will engage the pile held on the first web, and then to cut the pile between the needles.

The bonding and equalizing device may operate continuously, whereas the feed and cutter operate intermittently. To provide for continuous operation of the web where it is continuously operating, suitable slack loops, and the like, if necessary guided by rollers such as roller 50 and movable in a longitudinal direction can be used. The upper position of roller 50 is indicated in FIG. 1 at 50', and the path of the web 12 is indicated in dashed lines when tight, the movement of roller 50 between the full line position and the flashed line position at 50' providing for a slack loop.

Various changes and modifications may be made within the inventive concept.

I claim:

1. Apparatus to make pile fabric in which individual pile threads or fibers are joined to a base layer comprising:
   a) a needle holding web (12) having projecting needles transverse to the web;
   b) means (15) guiding the web to the end faces of the threads with the needles projecting towards the end faces of the threads to shear at least some of the threads on the projecting needles;
   c) cutting means (C) severing the threads at a position beyond the insertion depth of the needles;
   d) and thread feed means (A) comprising a plurality of spaced, stacked, plate-like elements (2, 3) adapted to hold the thread therebetween essentially in parallel alignment and to have the end faces of the threads exposed at the ends of the plates;
   e) gripping means (2c, 3c) located on said plate-like elements and movable between a projecting position in which the threads between the plates are engaged, and a retracted position in which the gripping means are out of contact with the threads; and means cyclically moving the plate-like elements transverse to the web (12) and moving the gripping means to grip the thread when the plate-like elements are moved towards the web to feed a pile of threads, and to retract the gripping means when the plate-like elements are retracted in advance of the next feeding movement.

2. Apparatus according to claim 1, wherein the plate-like elements are arranged in two similar groups alternately stacked above each other; and carrier elements are provided supporting each group of plate-like elements, said carrier elements moving the plates, alternately, and the gripper means cyclically, to be alternately projecting so that the gripper means of one group will hold the threads while the gripper means of the other group is moving, and vice versa.

3. Apparatus according to claim 1, wherein each plate-like element comprises:
   a) a top plate (2a, 3a);
   b) a bottom plate (2b, 3b);
   c) slots (2d, 3d) formed in said plates, the gripper means (2c, 3c) being extendable through said slot; and
   d) a control tongue (2e, 3e) extending between the plates and connected to the respective gripper means to control movement thereof.

4. Apparatus according to claim 3, further comprising fluid operable means located externally of the plates and connected to said tongues to move the tongues and hence the gripper means.

5. Apparatus according to claim 1, comprising a frame (13) which is movable in a direction of movement of said moving means and located to support the ends of the threads extending beyond the plate-like elements.

6. Apparatus according to claim 5, wherein said frame comprises:
   a) a rail (27) effecting a compressive force against the top layer of the fibers to compress the fibers during insertion of the needles.

7. Apparatus according to claim 6, wherein the frame further comprises a counter rail (14) to counter the compressive force of said first rail (27).

8. Apparatus according to claim 1, wherein the guide means comprises:
   a) a plate (15) movably transverse to the threads and located behind the needle holding web, the guide plate being moved against the web to press the needles of the web into the end faces of the threads.

9. Apparatus according to claim 1, wherein the cutting means comprises a band knife, and said band knife and stack of threads are relatively movable transverse to the longitudinal extent of the threads.