NEEDED TEXTILE FIBER MATERIAL

Josef Zocher, Birkesdorf, Duren, Germany, assignor to The Singer Company, New York, N.Y., a corporation of New Jersey


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5 Claims

ABSTRACT OF THE DISCLOSURE

Felted textile fiber materials are disclosed as well as mechanisms employing barbed felting needles for producing the felted materials, in which linear fiber fascicles are formed and primarily parallel to the surfaces of the workpieces. Felted textile fiber materials are also disclosed in which the fiber fascicles include series of enclosed loops of the textile fiber.

CROSS REFERENCE TO RELATED APPLICATION

This application is a division of my prior United States patent application Ser. No. 483,697, filed Aug. 30, 1965 now Patent Number 3,340,586.

SUMMARY OF THE INVENTION

This invention relates to the art of the integration of felting of textile fabrics by the action of barbed felting needles, and particularly, to novel felted materials which are attainable thereby.

When a web of loosely or randomly arranged fibers or two or more layers of such fiber webs are penetrated by barbed felting needles, the resulting commingling and reorientation of the fibers can result in a compaction of the total web thickness, a union of the two or more layers, and an increase in the cohesive strength of the web. The degree to which these results are obtainable depends in part upon the nature of the fibers being worked and to a large degree upon the fiber reorientation which is effected by the instrumentalities and methods employed.

It is known in the art of felting to utilize straight barbed felting needles for concatenating the fibers of a textile workpiece by using plain reciprocation of the straight barbed needles through the workpiece either perpendicular to or at a slight angle to the workpiece surface. Using this known arrangement, the needles in penetrating the workpiece, form holes through the workpiece which not only make the workpiece porous but are noticeable on the faces of the workpiece. It is also true of the known arrangement that the fibers of the workpiece are interconcatenated by the action of the needle only in a direction substantially perpendicular to the workpiece surface i.e., directly through the workpiece, so that the intermingling of fibers will occur over a minimum distance. These factors of unidirectional fiber concatenation over a minimum distance together with the inherent formation of through holes seriously limit not only the degree of compaction which can be attained but also limit the degree of strength and cohesion which may be imparted to the web by the needling process.

Where the workpiece is maintained in planar disposition during the felting process, this invention comprehends the use of an arcuate felting needle which is oscillatory about an axis corresponding to the center of curvature of the felting needle so as to enter and emerge from the same face of the planar workpiece. With this needle arrangement, through holes are avoided in the workpiece, the holes which are produced lie at such an acute angle to the surface of the workpiece as not to be apparent, and each needle passage, since it occurs primarily within the thickness of the workpiece extends over a far greater distance within the workpiece than in the case of the known straight felting needles thereby increasing the effectiveness of fiber interconcatenation during each needle stroke.

It is an object of this invention to provide novel and superior felted materials attained by the novel techniques outlined above. The felted materials of this invention can be produced using curved felting needles arranged to oscillate in paths which intersect angularly, or can be produced using such angularly arranged curved felting needles in combination with a conventional felting operation using straight felting needles passing through the workpiece.

The advantage of these novel felted materials resides in the superior strength and cohesion attained by orientation of the fibers in diverse directions. Where the angularly arranged curved felting needles are utilized combined with the conventional straight felting needles advantage is attained where genuine three dimensional fiber orientation in the felted material can be attained in three substantially perpendicular planes.

In instances in which only one or two dimensional fiber orientation is employed the path of needle reciprocation may be arranged so as to pass close to but avoid completely one surface of the textile fiber web being needle. In this manner the integrity of the avoided surface can be maintained and, for instance, the color or type of fiber appearing at the avoided surface will not be mixed with or visibly influenced by the remaining fibers of the web.

Another object of this invention is to provide a novel felted material produced by the action of barbed felting needles in which the needles, rather than being moved in plain or conventional reciprocatory fashion, are imparted an endwise reciprocation impressed with a higher frequency endwise vibration such that each needle stroke comprises a series of overlapping oscillatory increments. It has been found that a novel felted material results from such mode of felting needle actuation in which fiber breakage is greatly reduced in the needling process while the degree of fiber interconcatenation is materially increased by the formation of series of encahined fiber loops with the resulting advantage of increased strength and cohesion in the felted product.

DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

With the above and additional object and advantages in view as will hereinafter appear, this invention is illustrated in the accompanying drawings in which:

FIG. 1 represents a diagrammatic elevational view of an apparatus for producing felted textile web in accordance with this invention and utilizing separate banks of straight and curved felting needles.

FIG. 2 is a cross-sectional view of a modified needle and web supporting arrangement in which straight needles and curved web supporting surfaces are employed with the needles illustrated at the completion of a work penetration stroke showing that the needles will enter and emerge from the same side of the fiber web.

FIG. 3 is a cross-sectional view of a modified needle and web supporting arrangement in which curved needles and curved web supporting surfaces are employed, advancing from the same face of the planar workpiece.

FIG. 4 is a perspective view of a curved felting needle of this invention.

FIG. 5 is a cross-sectional view of a modified needle and web supporting arrangement in which both curved and straight felting needles are employed to produce a three dimensional felting.

FIG. 6 represents a top plan view of the needle arrangement of FIG. 5,
FIG. 7 is a perspective view of a portion of fabric web which is being felted by a needle arrangement as illustrated in FIGS. 5 and 6 with two of the fabric edges illustrated. Each needle takedown the direction of motion one of the banks of curved needles.

FIG. 8 represents a cross-sectional view of a portion of fabric web comprising layers of fibers of two different colors which have been felted by an arrangement employing only curved felting needles, and FIG. 9 is an enlarged cross-sectional representation of a textile web felted in accordance with this invention and illustrating the novel fiber orientation attained on one stroke of a needle having only one barb using the overlapping reciprocatory needle actuation of this invention.

DETAILED DESCRIPTION

Referring to FIG. 1 this invention is illustrated as applied to an organized machine capable of producing textile fabric webs as the web is passed along a supporting surface 11. The supporting surface 11 may be supported by any conventional type of frame (not shown) relatively to a main drive shaft 12 from which the reciprocatory action of the felting needle and the feeding movements of the fabric web are derived.

A pulley 13 fast on the main drive shaft accommodates a belt 14 entrained on a pulley 15 carried on a counter-shaft 16. A crank pin 17 adjustably secured in a radial slot 18 in the pulley 15 is used for connecting the lift arm 19 pivotally connected at 20 to an oscillatory arm 21 operatively associated with a one way clutch 22 which may preferably be of the sprag type. The one way clutch 22 is carried on a feed shaft 23 and serves to impart increments of turning movement in one direction to a fabric web feeding roller 24 on the feed shaft over which the finished fabric web is directed.

Indicated at 25 are additional fabric web feeding rollers opposed to the supporting surface 11. The feeding rollers 25 are each turned by a one way clutch 26 having an oscillatory arm 27 drivingly associated therewith. The arms 27 may be linked to the arm 21 for operation, or the arms 27 may be driven each by separate crank mechanisms from the main drive shaft 12.

Arranged between the work feeding rollers 25 is a needle board or crosshead 30 from which depends a multiplicity of straight barbed felting needles 31. Associated with the needle board or crosshead 36, is a feed mechanism for a connecting shaft 34 which replaces the shaft 36 fast on the crank disk 36 fast on the main drive shaft 12. Rotation of the main drive shaft 12, therefore, will impart plain vertical reciprocatory movement to the straight felting needles 31 through apertures 37 aligned with the needles and formed in a pressure plate 38 positioned by conventional biasing mechanism (not shown) by way of pressure rods 39 at a selected distance from the supporting surface 11. The straight felting needles 31 may also reciprocate through apertures 40 aligned with the needles in the supporting surface 11.

Arranged between and parallel to the work feeding rollers 24 and 25 above the work supporting surface 11 is a needle rock shaft 50 to which may be secured one or more needle clamps 51. The needle clamps 51 fixedly accommodate the butt portions 52 of one or more curved felting needles 53 such as that illustrated in FIG. 4. The butt portion 52 is preferably bent at right angles to a shank portion 54 of which the free extremity 55 forms a barb which spaced barbs 56 are struck out along each of the triangular cross-section. The axis of said shank portion 54 including the free extremity 55 is disposed in a plane within which plane the barbed trihedron extremity of the needle is also preferably curved in a circular configuration having a center of curvature substantially coincident with the axis of the needle rock shaft 50.

For actuating the curved needles 53, a rock arm 60 secured to the needle rock shaft 50 is connected by a link to one end of a lever 62 fulcrumed at 63. A connecting rod 64 pivoted at 65 to the other end of the lever 62 embraces a crank pin 66 carried on crank pulley 67. The crank pulley 67 is journaled on an eccentric portion 68 of a shaft 69 which is driven by an electric motor 70 by way of a belt 71 which connects a pulley 72 on the motor and a pulley 72 on the shaft 69. The crank pulley 67 is separately driven by means of a belt 74 from a pulley 75 fast on the main drive shaft 12. The speed of rotation imparted to the shaft 69, and hence to the eccentric portion 68, is much greater than that imparted to the crank pulley 67 and may preferably be on the order of 17 revolutions for one revolution of the crank pulley 67. The eccentric, moreover, has sufficient throw as to cause a succession of momentary reversals in the direction of movement of the needle during each needle stroke. The resulting motion impression with a higher frequency endwise vibration such that each needle stroke comprises a series of overlapping oscillatory increments. It will be understood that the throw of the eccentric portion 68 and the speed of rotation thereof may be selected so as to provide for any desired spacing of the series of reversals in the needle reciprocation as well as to vary the extent to which the needle partakes of retrograde motion during reversal. These factors may thus be chosen to suit the characteristics of the particular fibers being needled.

The curved needles 53 oscillate through apertures 80 and 81 in a pressure plate 82 which may preferably be positioned along with the needle rock shaft 50 selectively toward and away from the supporting surface 11 by conventional biasing mechanism (not shown) by way of pressure rods 83. The curved needles therefore enter and emerge during each reciprocation from the same side or surface of the textile web and by adjustment of the distance of the pressure plate and needle rock shaft from the supporting surface 11 the degree of penetration into the textile web may be regulated.

In order to establish timed operational sequence between work feeding motion and feltling needle penetration of the web, the belts 14 and 74 may preferably comprise timing belts formed with clips or lugs and the pulleys 13, 15, 67, and 75 may similarly be formed with lugs or serrations cooperating with the timing belts to maintain a timed relationship such that the textile web will be advanced only while the needles are withdrawn from the web.

In the construction illustrated in FIG. 1, the textile web is maintained flat on the supporting surface 11 during the entire needling process. In FIG. 2 is illustrated a modification in which a textile web indicated at 90 is directed in seriatim over rollers 91, 92, 93, 94 and 95 which rollers are arranged so as to guide the textile web in a sinuous path having, when the web passes about each roller, an acute configuration. Disposed one at each side of the rollers are a pair of needle boards or crossheads 96 each carrying straight barbed felting needles 97. The needle boards or crossheads 96 may each be imparted either plain reciprocatory motion in a manner similar to that of the straight needles shown in FIG. 1, or they may be reciprocated in overlapping oscillatory increments as described above. The textile web may be advanced by imparting feed motion to one or more of the rollers while the needles are out of the web. The needles are preferably disposed each so as to enter and emerge given a side or surface of the textile web during the penetration stroke as the web is guided in the same path about the rollers. As shown in FIG. 2, the use of a pair of needle boards or crossheads one at each side of the web provides for needling of the web from both surfaces thereof.

A further modification is illustrated in FIG. 3 in which needle rock shafts 50, having needle clamps 51 sustaining curved needles 53 in a fashion which may be identical to that illustrated in FIG. 1 and described above, cooperate with a curved surface 100 for supporting a textile web
In accordance with the arrangement illustrated in FIG. 3 the combined curvature of the needle path of motion and of the textile web position opposite to the needles to result in the entry and emergence of the needles from the same side or surface of the textile web.

In FIGS. 2 and 3 the pressure plates have been omitted in the interest of clarity. With certain types of work and particularly where a degree of coherence exists prior to needleing sufficient to preserve the stability of the web as it is directed to the needles, a pressure plate may not be required. It will be understood, however, that the inclusion of pressure plates apertured to accommodate passage of the needles as illustrated in FIG. 1 is contemplated in FIGS. 2 and 3.

FIGS. 5 and 6 illustrate diagrammatically that the curved needles may be operated in separate banks with each bank of needles arranged angularly with respect to the other, and with the straight felting needles also arranged in separate banks associated one with each of the banks of curved felting needles.

In FIGS. 5 and 6, two banks of curved felting needles 53A and 53B are illustrated each being sustained in needle clamps 51 carried on needle rock shafts 50 and actuated as illustrated in FIG. 1. As shown in FIG. 5, the direction of motion of needles 53A is indicated by the line A—A, and the direction of motion of the needles 53B by the line B—B. The straight felting needles are arranged in separate banks 31A and 31B but may be sustained in a needle board or crosshead 30 as illustrated in FIG. 1. The pressure plate 110 is apertured at 111 to accommodate the straight needles and is apertured at 112 to accommodate the curved needles. A work supporting surface 113 upon which the textile web 114 is disposed may also be apertured as at 115 to accommodate the straight barbed needles 31A and 31B.

In accordance with one method provided by this invention for needleing textile webs, the textile web is subjected in seriatim to the action of one or more banks of curved felting needles 53 as illustrated in FIGS. 1, 3, 5 and 6 with the straight felting needles being omitted. Using this method, the path of the needles can be regulated so as to avoid the undersurface of the fabric web. As illustrated in FIG. 8, the novel textile web produced using this method is characterized by the loose or random fiber arrangement of the web being drawn into a series of fiber bundles or fascicles extending in large measure parallel to the plane containing the textile web with the fiber interextension extending to the top surface but avoiding the undersurface. In FIG. 8 the textile layers are shaded for color, fibers the top layer 120 being concatenated with fibers of the bottom layer 121 in fascicles 125 along the needle paths. The needles may be disposed in angularly arranged banks moving in directions labeled A—A and B—B as illustrated in FIGS. 6 and 7 in which case the fiber fascicles 125 of FIG. 8 will similarly extend in angular and intersecting relation so as stabilize the resulting fabric web both lengthwise and widthwise.

In accordance with another method provided by this invention, the textile web is subject first to the action of a bank of straight felting needles 31 penetrating through the web and is subsequently subjected to the action of one or more banks of curved felting needles 52 or to the action of one or more banks of straight felting needles which as illustrated in FIG. 2, cooperate with curved work supporting surfaces so that the needles each enter and emerge from only one side of the textile web. With this method the textile web is first stabilized thicknesswise by the action of the through-and-through passage of the straight felting needles which results in a partial compaction facilitating transport of the web relatively to the subsequent action of the curved or straight felting needles which enter and emerge from the same side of the web.

Still another method provided by this invention is illustrated in FIGS. 5 and 6 in which the straight through-and-through felting needles and the curved felting needles operate simultaneously upon each individual area on the fabric web.

FIG. 7 illustrates the three dimensional interconnection of fibers which is attained when a textile web comprising two fiber layers 130 and 131 is subjected to the action of straight through-and-through felting needles such as 31A or 31B and additionally two curved felting needles 53A and 53B. The number of needle penetrations per unit area of textile web in each of the three possible directions may be regulated by selection of the rate of feed and the numbers of needles which act in each direction. It will be appreciated that while only one needle acting in each of the three directions is illustrated in FIG. 7, the textile product which will result from the repeated action of such needles or banks of such needles as the web is advanced in regular step-by-step fashion, will comprise a highly coherent web with the fiber fascicles frequently intersecting and located in three substantially perpendicular planes.

Using any of the above methods, the needles whether passing through the textile web or entering and emerging from the same side may be advantageously actuated with overlapping series of oscillatory increments as described in detail hereinbefore. The textile web resulting from such needle actuation is characterized by a greater degree of compaction for a given amount of needleling, fewer broken or torn fiberstrands and consequently denser and more compact web surfaces, and enhanced fiber concatenation resulting in an increase in strength and durability of the textile web. When the barbed felting needle is imparted a movement in a series of overlapping reciprocatory increments, the bars once having seized and drawn out fibers in the web, release at least a part of those fibers during the retrograde movements and then seize fresh fibers on the next succeeding increment of the stroke. The result, as illustrated in FIG. 9, is a fascicle of fibers of which at least a portion includes a series of enmeshed loops 140 of the fiber. Such an enmeshed fascicle has been found to be inherently stronger and with greater ability to compact the web than a fiber fascicle formed by a continuous reciprocatory motion which merely orients the fibers in the direction of the needle path. Moreover, where curved felting needles are used and partake of a greater length path through the web than comparable straight needles, the overlapping increments of needle reciprocation becomes the particular advantage in reducing fiber breakage. The fibers seized by the needle bars are not held continuously as they are with conventional plain reciprocation until either the fiber breaks or the penetrating stroke of the needle is completed; but instead the degree of fiber loop formation may be controlled. As a result not only can greater degree of compaction and strength be attained than heretofore, but fibers which had heretofore been considered too brittle or too inextensible for needleling may now be felled successfully using this mode of needle actuation.

Having thus set forth the nature of this invention, what I claim herein is:

1. A felted textile fiber material having substantially parallel top and bottom surfaces and comprising a web of textile fibers drawn from a random arrangement into a multiplicity of linear fiber fascicles extending in arcuate paths within said web, each fiber fascicle being disposed for a portion of its length substantially parallel to said top and bottom surfaces and extending between spaced points on one of said substantially parallel top and bottom surfaces.

2. A felted textile fiber material as set forth in claim 1 in which said linear fiber fascicles extend in mutually perpendicular directions primarily within the thickness of the web.
3. A felted textile fiber material as set forth in claim 2 in which additional fiber fascicles extend substantially normal to said top and bottom surfaces.

4. A felted textile fiber material comprising a web of textile fibers drawn from a random arrangement into a multiplicity of linear fiber fascicles, each fascicle extending within said web and including a series of enchained loops of the textile fiber embedded beneath the surface of the web.

5. A felted textile fiber material as set forth in claim 1 in which each of said linear fiber fascicles includes a series of enchained loops of the textile fiber.