United States Patent [19]

Dilo

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[54] **NEEDLING APPARATUS**

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[62] Division of Ser. No. 323,257, Jan. 12, 1973, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **28/4 R**; 28/4 R

[51] **Int. Cl.**[2] **D04H 18/00**

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

[56] **References Cited**

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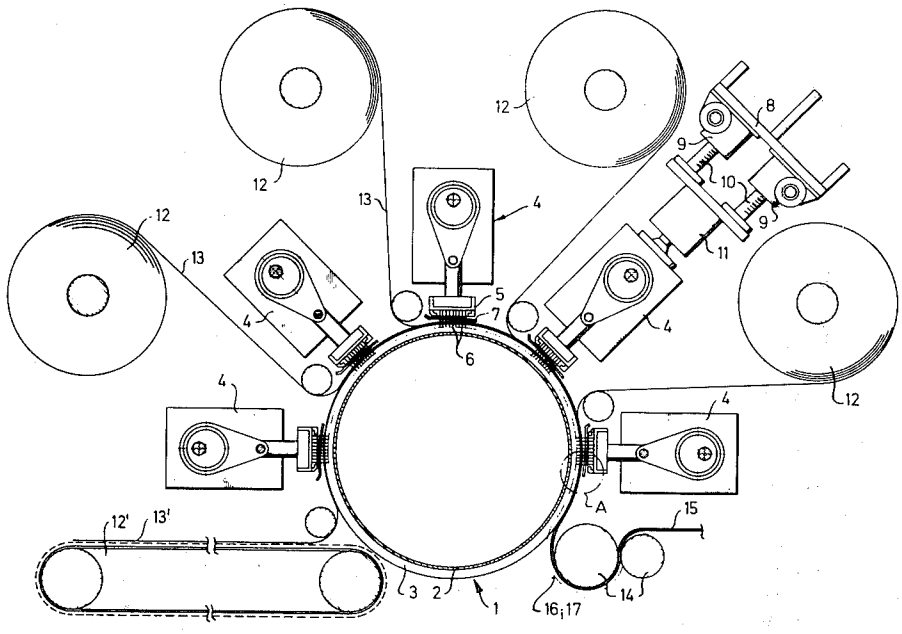
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[57] **ABSTRACT**

A non-woven multi-layered textile web having felt-like surface patterns is made by delivering a sequence of non-woven textile layers to a continuously rotating elongated drum. A plurality of needling units are angularly spaced about the circumference of the drum, each needling unit carrying a plurality of barbed needles arranged to impart a surface pattern upon reciprocation at predetermined intervals in a radial direction in a plane perpendicular to the drum axis for moving the needles into and out of peripheral grooves in the drum. In this manner, the needling units sequentially needle the layers and form the web with the patterns of superposed layers during the continuous rotation of the drum. The reciprocation of the needling units is preferably programmed.

5 Claims, 3 Drawing Figures



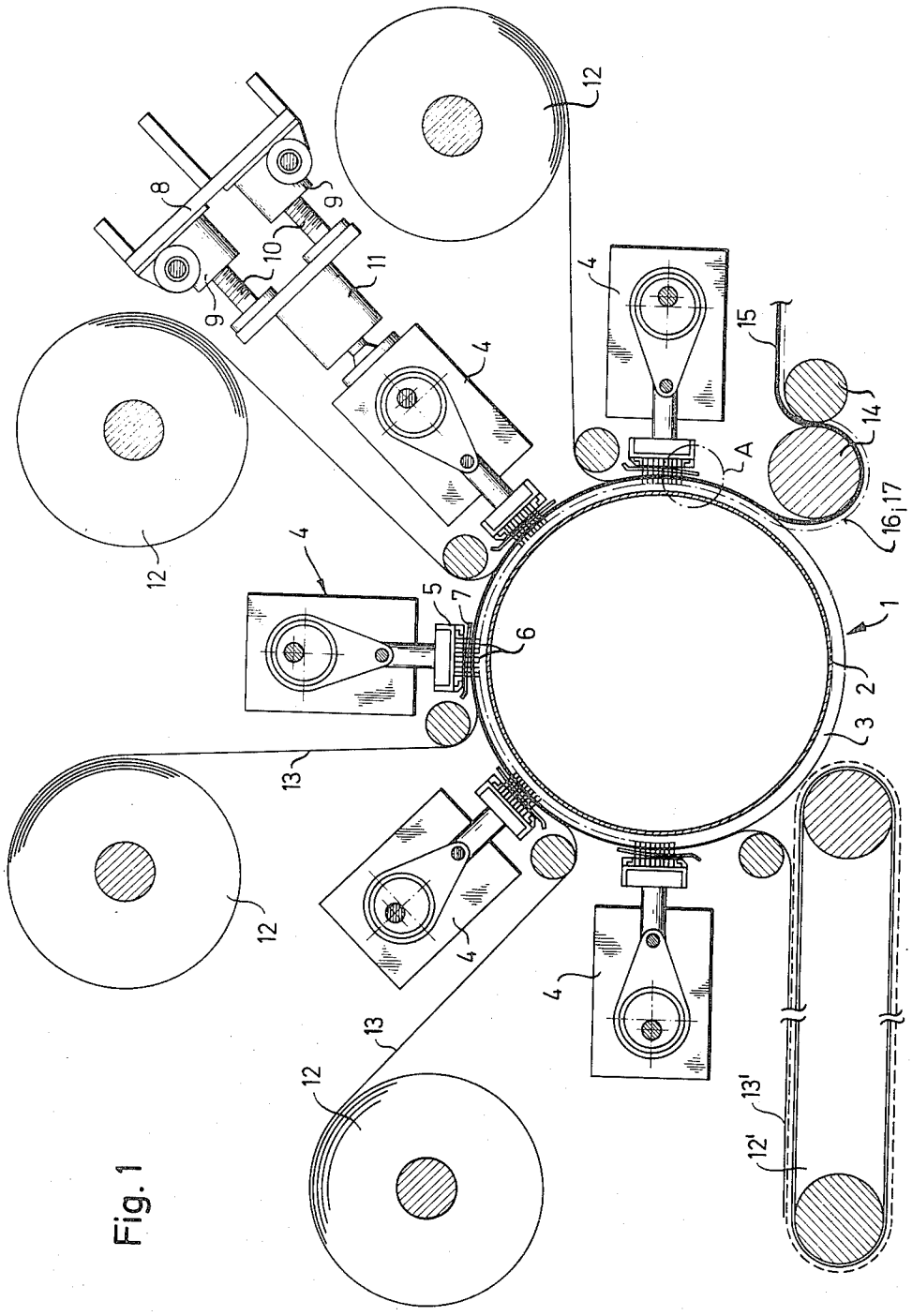


Fig. 1

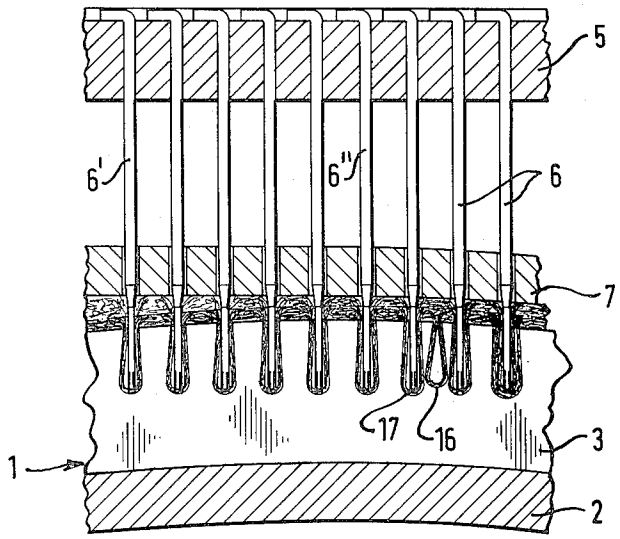


Fig.2

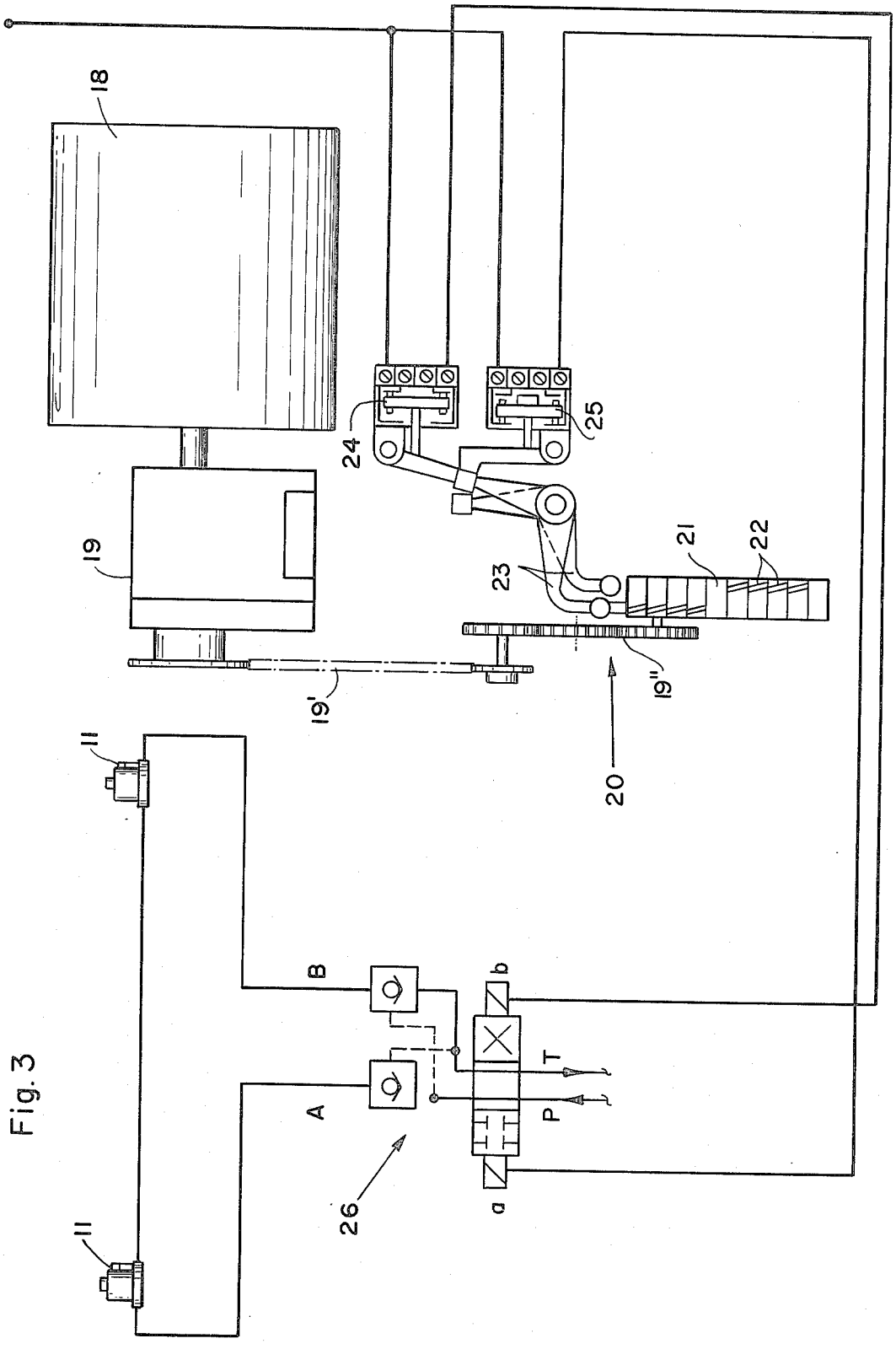


Fig. 3

NEEDLING APPARATUS

This is a division of application Ser. No. 323,257, filed Jan. 12, 1973 now abandoned.

The present invention relates to an apparatus for making a non-woven textile web having felt-like surface patterns.

Different surface patterns may be imparted to nonwoven fibrous textile webs by needle punching or needling with needling units carrying a plurality of needles arranged to impart a desired surface pattern, either by the arrangement of the needles in a desired array and/or the gauge of the needles and/or the array of perforations or grooves in the support for the web during the needle punching or needling operation. The needling is effected by reciprocating the needling unit in respect of the web on the support so that the barbed needles pass through the web into the perforations or grooves of the support.

In conventional needle punching arrangements of this general type, there is little change in the surface patterning of the needled web.

It is a primary object of this invention to improve the needling of non-woven textile webs so as to obtain a great variety of surface patterns while simultaneously improving the efficiency of the operation and producing a denser needled web.

The above and other objects are accomplished in accordance with the invention by continuously moving the nonwoven textile web over a support defining a multiplicity of adjacent grooves and needling the continuously moving textile web at predetermined intervals, which are preferably automatically programmed, to provide corresponding surface patterns thereon.

According to a preferred embodiment, a plurality of different non-woven textile layers, for instance layers of different color and/or different weight or density, are sequentially delivered to the support and the sequentially delivered layers are superposed on the support to form the web, the needling intervals occurring after each layer has been delivered to the support whereby the superposed layers are needled together.

The apparatus of the present invention comprises a continuously rotating elongated drum having an axis and defining a multiplicity of circumferential grooves, and a plurality of needle punching or needling units angularly spaced about the circumference of the drum. Each needling unit carries a plurality of needles arranged to impart a surface pattern, and means is provided for reciprocating each needling unit at predetermined intervals in a radial direction in a plane perpendicular to the drum axis for moving the needles into and out of the circumferential or annular grooves of the drum. A like plurality of delivery means feeds a sequence of non-woven textile layers substantially tangentially to the continuously rotating drum for continuous movement therewith, each delivery means being arranged ahead of a corresponding needling unit associated therewith, in the direction of drum rotation. In this manner, the needling units sequentially needle the layers and form the web with felt-like surface patterns of superposed layers during the rotation of the drum as the needles are moved through the layers into and out of the circumferential grooves of the drum supporting the layers.

The needles punch through the non-woven textile web only intermittently and at spaced-apart intervals, the patterning being variable further by changing the reciprocating stroke of the needling units, i.e., the depth to which the barbed needles descend into the web, the duration of the reciprocating stroke, and the speed of movement of the web, i.e., the rotational speed of the drum.

Using a rotating drum for support of the web during needling prevents a distortion of the web and, furthermore, enables the delivery to the apparatus of tissue-like nonwoven layers. It also considerably increases the output of the machine.

By the use of a plurality of needling units angularly spaced about the circumference of the drum and associating a delivery means for a non-woven textile layer with each needling unit, it is possible to combine a number of different layers into a single multi-layer web, thus providing a higher quality and denser non-woven fibrous web. Each needling unit may be differently controlled so as to provide a great variety of patterns.

Since the path of the web on the drum support is arcuate, i.e., the web support facing each needling unit is arcuate, a so-called filling effect is obtained in the production of looped or pile fabrics, i.e., upon reciprocation of the needling unit, the outermost barbed needles punch shorter loops out of the web than the center needles so that the shorter loops support the longer loops, thus stabilizing the entire loop structure.

The above and other objects, advantages and features of the present invention will become more apparent from the following detailed description of a presently preferred embodiment thereof, taken in conjunction with the accompanying drawing wherein

FIG. 1 is a side elevational view, partly in section, of an apparatus for making a non-woven textile web having felt-like surface patterns;

FIG. 2 is an enlarged cross sectional view showing the needle punching operation of one of the needling units, indicated at A in FIG. 1; and

FIG. 3 is a circuit diagram schematically illustrating the programmed control of the needle unit reciprocation.

Referring now to the drawing and first to FIG. 1, there is shown a conventional continuously rotating elongated drum 1 having an axis extending perpendicularly to the plane of the drawing and defining a multiplicity of adjacent circumferential grooves between axially spaced annular blades 3 mounted along the entire length of the tube 2. Such a support drum in an apparatus for needling non-woven textile webs is described in my U.S. Pat. No. 3,530,557, dated Sept. 29, 1970, and illustrated in a side view in FIG. 1 of the patent.

A plurality of needling units 4 are angularly spaced at predetermined intervals about the circumference of the drum. In the illustrated embodiment, five needling units are spaced about 45° apart over half the circumference of the drum. As is well known, each needling unit comprises a needle beam 5 carrying a plurality of barbed needles 6 and a stripper 7. As is known, needling is effected by reciprocating the needle beam, a crank drive being shown on each unit 4 to effectuate reciprocation. In accordance with the invention, the needling units are reciprocated in a radial direction in a plane perpendicular to the drum axis.

The radial distance of each needling unit 4 from the surface of drum 1 may be adjusted by affixing the unit to an adjusting means mounted on frame 8 of the apparatus, the illustrated adjusting means comprising worm drives 9 radially moving threaded rods 10 connected to

each needling unit. In this manner, the punching depth of the needles **6** of each needle punching unit **4** may be adjusted.

As shown, desired patterns may be produced by mounting a reciprocating means **11** between the adjusting means and the needling unit. Thus, while the crank drives of the needling units will continuously reciprocate the needles, reciprocation of the entire units at predetermined intervals will prevent the continuously reciprocating needles as such intervals from pass through the web and to needle the same, thus providing the desired patterns.

In the illustrated embodiment, the reciprocating means **11** for each needling unit comprises a pressure fluid operated motor, for instance a pneumatically or hydraulically actuated cylinder-and-piston device, the cylinder being mounted on a platform to which threaded rods **10** are attached while the piston rod is attached to the carrier of the crank drive of unit **4.**

In accordance with a preferred embodiment of the invention, a programmed control operates the reciprocating means **11** and thus controls the surface patterns effectuated by the needling operation. Suitable programming units are commercially available and useful matrix programming units which interchangeable programming casettes are available, for instance, from K. A. Schmersal & Co., Wuppertal-Barmen, Germany, and are described in the company's pamphlet "Mattenschaltwerke," Liste P 6 Ausgabe G. Such programming units include endless chains carrying pins in a predetermined array or matrix for actuating circuit elements in a programmed sequence. Changing the array or matrix changes the program.

FIG. **3** illustrates diagrammatically how the motors **11** of the needling units may be operated by a programmed control of this type, as will be explained hereinafter.

As shown in FIG. **1,** the apparatus of the present invention comprises the same number of delivery means **12'** and **12** as there are needling units **4** for delivering a sequence of non-woven textile layers **13'** and **13** to the continuously rotating drum **1,** the textile layer being delivered tangentially to the drum in the same direction as the direction of the drum rotation so that these layers are continuously moved over the drum, each delivery means being arranged, in the direction of drum rotation, ahead of a corresponding and associated needling unit **4.** In this manner, the needling units sequentially needle the layers and form the multi-layer web **15** with felt-like surface patterns of superposed layers during the drum rotation as the needles are moved through the layers into and out of the circumferential grooves of the drum supporting the layers.

If desired, the different layers may vary in color, fiber denier, weight per area unit, etc, to provide any desired variation in the finished web of superposed layers.

As shown in FIG. **1,** the first delivery means is a simple endless conveyor band **12'** feeding a base layer **13'** to the rotating drum over a guide roller properly guiding the layer **13'** onto the drum surface, this base layer being of tissue weight, if desired. After this base layer has passed the first needling unit **4,** the next non-woven textile layer **13** is fed from a supply roll **12** over a similar guide roller to the rotating drum to be superposed on base layer **13',** sequential layers **13** being similarly delivered to the drum, passing sequential needling units and being formed into a multi-layer web **15** which is removed from the drum by nip rollers **14, 14.**

As shown in FIG. **2,** since all needles are of the same length, the arcuate shape of the drum support **1** causes the outermost needles **6'** to penetrate less deeply into the drum grooves between annular blades **3** to form shorter loops **16** while the central needles **6''** penetrate more deeply to form longer loops **17.** Thus, the needling operation punches loops of different lengths, the shorter loops **16** supporting the longer loops **17** and thereby providing a filling effect. The resultant web is much more stable than needled webs produced on a flat support.

The above described and illustrated apparatus operates as follows:

As drum **1** is rotated clockwise, the layers **13'** and **13** are delivered thereto, superposed thereon and needled during the continuous movement of the superposed layers to combine them into a multi-layer web, the needled web **15** being continuously removed from the drum by rotating the first one of nip rollers **14** counterclockwise while the second nip roller **14** is rotated clockwise. A drive **18** is used to rotate the nip rollers and is synchronized with the programming unit **20** by means of gearing **19** operating chain-and-pulley drive **19'** which operates meshing gears **19''.** The gears **19''** drive the shaft of one of the pulleys supporting endless band **21** of programming unit **20** so that the band moves synchronously with drive **18.** The moving band **21** carries a suitable array of pins or cams **22** for programming actuation of switches **24** and **25.** The array or matrix of the pins or cams may be changed on the band to change the program. A pair of bell cranks levers **23** are arranged in the path of the pins or cams **22** to be selectively moved thereby and thus to actuate a respective one of switches **24** and **25.** The switches are connected respectively to a source of power and to a respective coil *a* and *b* of four-way solenoid valve **26.** The solenoid valve is mounted in the hydraulic circuit A, B supplying operating fluid to reciprocating motors **11.**

Thus, as illustrated, if the programming cams **22** contact and move the lever **23** which actuates switch **24,** the latter closes the control circuit leading to coil *b* of solenoid valve **26,** which is connected to switch **24,** thus opening the passages P-A and T-B in the valve and causing motors **11** to move the needle punching units **11** so far away from the circumference of the drum **1** that the needles **6** will not punch through the web on the drum while being reciprocated by their crank drives. On the other hand, when another set of cams **22** moves the other lever **23** which actuates switch **25,** the latter will close the control circuit leading to coil a of valve **26** so that the passages are switched to P-B and T-A, causing the needling units **4** to be lowered sufficiently to cause the reciprocating needles to punch through the web.

As indicated by the arrows beyond valve **26,** lines A and B of the hydraulic circuit lead to a suitable supply of hydraulic fluid (not shown).

Since the speed of withdrawal or take-up of the web is synchronously coupled with the speed of movement of band **21** of the programming unit, increased speed of rotation of nip rollers **14, 14** will automatically increase the speed of movement of programming band **21.** The program may be changed not only be a change

in the matrix of cams **22** but also by adjusting the variable gearing **19.**

I claim:

1. An apparatus for making a non-woven textile web having felt-like surface patterns, comprising

1. a continuously rotating elongated drum having an axis and defining a multiplicity of adjacent circumferential grooves.
2. a plurality of needling units angularly spaced about correspondingly spaced arcuate circumferential sectors of the drum, each needling unit carrying a plurality of needles arranged to impart a surface pattern,
3. means for reciprocating each of the needling units at predetermined intervals in a radial direction in a plane perpendicular to the drum axis for moving the needles into and out of the circumferential grooves of the drum in the corresponding arcuate sector thereof, and
4. a like plurality of means arranged to deliver a sequence of non-woven textile layers tangentially to the continuously rotating drum and to respective ones of the arcuate sectors thereof, each delivery means being arranged ahead of a corresponding one of the drum, whereby the needling units sequentially needle the layers and form the web with felt-like surface patterns of superposed ones of said layers during the continuous rotation of the drum as the needles are moved through the layers into and out of the circumferential grooves of the drum supporting the layers.

2. The apparatus of claim **1,** furhter comprising means for adjusting the radial distance of each of said needling units from the surface of the drum.

3. The apparatus of claim **2,** wherein the reciprocating means comprises a pressure fluid operated motor mounted between the adjusting means and the needling unit.

4. The apparatus of claim **1,** further comprising a programmed control for operating the reciprocating means.

5. The apparatus of claim **4,** further comprising nip roller means arranged to remove the web continuously from the rotating drum, and a drive for rotating the nip roller means; the programmed control comprising an endless band, means for driving the endless band synchronously with the drive, and an array of programming cam means on the endless band; the reciprocating means comprising a pressure fluid operated motor and a hydraulic circuit for supplying hydraulic operating fluid to the motor; and the programmed control further comprising solenoid valve means in the hydraulic circuit and means for actuating the valve means in response to the programming cam means on the driven endless band.

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