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[54] **METHOD AND NEEDLE MACHINE FOR THE PRODUCTION OF PILE FABRICS**

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

[58] **Field of Search** ..... 28/4 R, 72.2 R, 32

[56] **References Cited**

UNITED STATES PATENTS

502,376	8/1893	Ochs	28/4 R
2,377,564	6/1945	Lundgren	28/4 R
3,110,951	11/1963	Seelig	28/32 X
3,497,927	3/1970	Norton	28/32
3,602,967	9/1971	Zocher	28/4 R
3,774,273	11/1973	Okamoto	28/4 R

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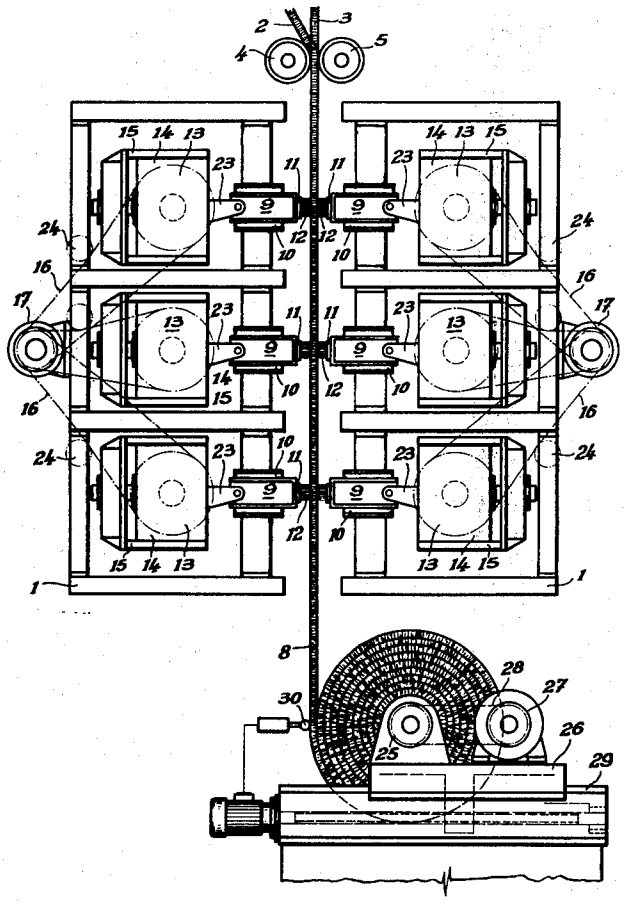
[57] **ABSTRACT**

Apparatus for needling fibre web to produce a pile thereon is arranged with the web to be needled passing vertically downwardly from a pair of guide rollers to a take-up roll with a plurality of pairs of needle boards located therebetween. As the web passes between the pairs of needle boards which perform the needling operation, the take-up roll positioned therebelow is moved horizontally to accommodate web material accumulating thereon in order to maintain the location of the incoming web constant and accommodate build-up in the diameter of the accumulated web roll.

10 Claims, 2 Drawing Figures



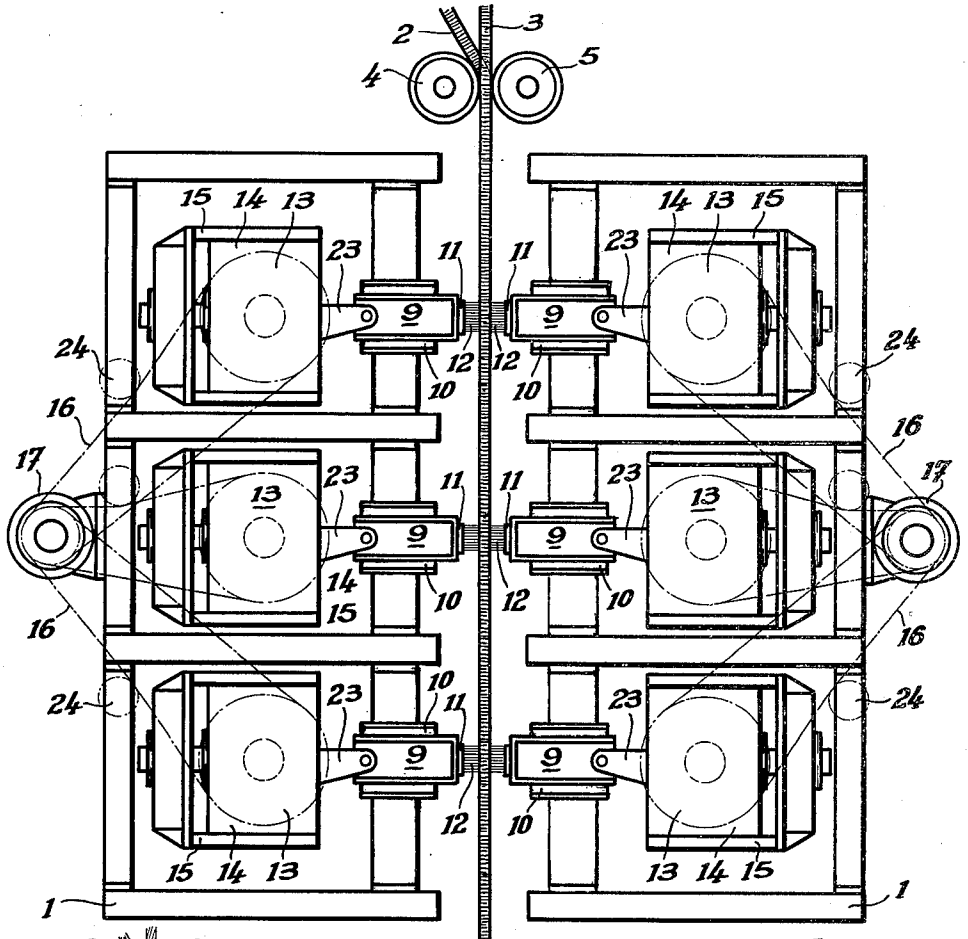


FIG. 1

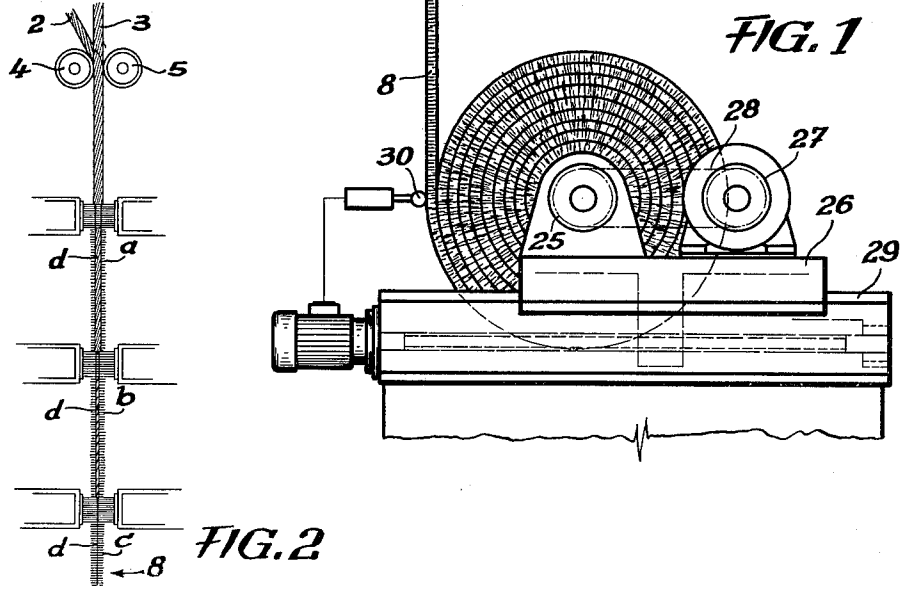


FIG. 2

METHOD AND NEEDLE MACHINE FOR THE PRODUCTION OF PILE FABRICS

The invention relates to a method and to a needling machine for the production of non-woven pile webs (3-dimensional non-woven needled web material with a pile formed thereon) from a non-woven web comprising one or more adjacently disposed individual non-woven fibre webs which are preconsolidated by needling.

Methods for producing so-called needled felt — also known as non-woven needled web — are known. Such methods are used to a large extent, more particularly in the manufacture of so-called needled felt or non-woven needled web carpet backs. The material is manufactured by the mechanical consolidation through needling machines of one or more non-woven fibre webs which are produced on carding engines from synthetic staple fibres, for example polyamide, polyacrylic, polyester or polypropylene fibres, resulting in the production of surface structures which are known as needled non-woven webs or needled non-woven web materials, which are mechanically consolidated to a greater or lesser extent depending on the construction of the needles and in accordance with the intensity of needling. Accordingly they comprise a large number of parallelized fibre webs (pile) which are compressed by mechanical consolidation through needling from an initially relatively large volume into a relatively shallow structure, depending on the degree of needling. Structures which have been substantially needled in the manner described herein above are referred to as 2-dimensional — to the extent to which they are to be used as carpet backs — because the fibres are disposed substantially horizontally in accordance with the original arrangement of the individual fibre piles. Mechanical consolidation by needling is followed by chemical impregnation, preferably with latex, more particularly when carpet backs are produced in accordance with this method. Needled felts have a very useful value. They have a textile character but generally comprise rather shallow structures which occupy a lower quality grade in the range of carpet backs.

The manufacturing stage which is decisive for such needled felts employs needling machines in order to obtain mechanical bonding of the individual layers by interbinding of the individual fibres. The needling machine is therefore provided with a horizontally disposed needle board which is moved vertically up and down by mechanical means against a needle bed. The fibre web which is to be needled is disposed between the needle board and the needle bed. The needle board is usually provided with several thousand needles which are mounted in the needle board in a regular pattern. Apertures or slits of limited length in the needle bed enable the needles to penetrate through the fibre web into the needle bed. A stripper in the form of a perforated plate is disposed between the needle board and the needle bed in order to prevent the non-woven fibre web, hereinafter referred to as fibre web, being drawn up after needling during the return motion of the needle board. The needles themselves are provided with differently orientated barbs for the needling operation in order to obtain the most extensive possible binding of the fibre web.

In the needling operation a change was made from the originally employed slits of limited length in the needle bed to apertures in order to obtain a needling configuration which was as uniformly diffused as possible. The purpose of known needling technology in the first place was to compress the needled web by binding the fibres in the vertical and alternating directions.

Despite all advantages of this form of consolidation of needled felts the known methods suffered from a genuine disadvantage by comparison with other methods for the production of carpet backs from other material by virtue of the fact that it was not possible for a pile to be formed of the kind which can be achieved in weaving technology as well as in tufting technology. In the last mentioned technologies the actual pile is erected into the third dimension, preferably by using a carrier fabric. By contrast to shallow, 2-dimensional articles such carpet backs are also referred to as 3-dimensional carpet backs.

Needling machines which deviate from the above described construction both with regard to the needles employed to this end as well as with regard to the needle bed used for the purpose, have been developed in order to achieve this object with needling processes. So-called bifurcated needles, the free ends of which are constructed in a bifurcated manner and whose function it is to form a pile loop or pile filament when penetrating the fibre web, are used in place of the normal employed needles with laterally disposed barbs which point in different directions. Depending upon the amount of lift it is possible to produce piles with a height of between a few mm up to, for example, 15 mm while at the same time consolidating the web in the base stratum. In view of the formation of pile filaments which are erected into the third dimension it is necessary to ensure that the pile loops are retained in the needle bed when the web member is transported, thus making it impossible to employ the arrangement used hitherto of slits of limited length or apertures. A needle bed with reeds or ribs disposed in the cloth feed direction are therefore used in the production of such pile webs, the said reeds or ribs having no interruption over the entire length of the needle bed width. In practice the width of the needle board and of the needle bed are limited because the mechanical needling of the pile rows into the narrow slits between the reeds or ribs involves severe frictional resistance when the needled web is advanced over or through the needle bed, particularly when pile of substantial height is being produced.

It is also already known to dispense entirely with the provision of a needle bed so that the last mentioned disadvantages are eliminated. In this case however it is necessary to support the horizontally forward moving fibre web both upstream of the needle board as well as downstream thereof, generally by means of roller pairs between which the fibre web passes while being retained in the horizontally tensioned state between the two pairs of rollers. This procedure however leads to undesirable axial elongations and results in irregularities in the thickness of the finished product.

The methods and machines employed to this end as mentioned previously are suitable to produce a pile on only one side during the needling operation but this pile is compressed when passing through the roller pair and is also compressed as the consequence of stretch of the needled web. More particularly, it is impossible with these known methods to produce a pile or pile zones on both sides of the web and to retain them without compression of the material.

It is the object of the invention to disclose a method and a needling machine for performing the said method for the production of a needled web comprising one or more adjacently disposed preconsolidated fibre webs and which is provided on both sides with a pile or pile zones so that a web needled in this manner can be utilized not only as carpet without defining its visible side but can also be used as a blanket or the like.

The method according to the invention is characterised in that the fibre web is moved forward when suspended in the direction of its longitudinal axis while being subjected simultaneously from both sides to needling, the needles of oppositely moved needle boards being staggered in an offset configuration.

The use of this method dispenses with separate guide rollers upstream and downstream of the needle boards because these act against each other from both sides and therefore themselves ensure that the vertically suspended fibre web remains in this position even during the needling operation.

To perform the method according to the invention it is possible to utilize a needling machine which is characterised in that the fibre web feed direction is vertical, adjoining a roller pair adapted to move the fibre web in the forward direction and the said fibre web moves between the horizontal and oppositely movable needle boards of at least one needle board pair, a take-up drum for the needled web being slidably supported directly below the lowest needle board pair and in relation to the needled web which is fed in vertically and is to be coiled up so that the vertical direction of motion of the needled web is retained as far as the coiling up line independently of the number of needled web layers that have already been coiled.

Support rollers for the guiding of the fibre web between the needle boards which move opposite to each other can be omitted in a machine of this kind according to the invention because supporting is provided directly by the needle boards and the vertical suspended position of the fibre web is retained during the needling operation. The web material mentioned in the description above and below is described as "fibre web"prior to the needling operation and as "needled web" after the needling operation.

Reversing backing rolls can be entirely omitted since a take-up drum for the needled web is disposed according to the invention below the lowest needle board pair and is slidably supported with respect to the vertically arriving needled web that is to be coiled so that the vertical direction of motion of the needled web is retained as far as the coiling line, independent of the number of needled web layers that has already been coiled.

The sliding velocity of the take-up drum during the take-up operation can be adapted by conventional tracing means to the increasing diameter of the take-up drum so that the fibre web is always moved perpendicularly between the needle boards of the needle board pairs.

In a further embodiment of the invention the needle rows of at least some of the serially disposed needle boards may be laterally offset with respect to each other to produce a general consolidation of the pile rows.

According to a further feature of the invention the needle boards may be movably guided perpendicularly to the vertical direction in guide ways and can be adapted to move against the fibre web and away therefrom by means of rotating eccentrics. This kind of drive for the needle boards is particularly simple and provides individual adjusting facilities for the needle boards in the sense that the length of stroke of the needle boards can be varied in accordance with a further feature of the invention or that the needle boards can be advanced towards the fibre web or away therefrom independently of the stroke so that the needling penetration depth can be varied independently of the stroke of the needle board.

According to the invention it is also possible to vary the stroking rate of the individual needle boards so that the needling operation can be adapted to the previously attained consolidation or pile forming if a substantial number of needle boards are provided.

According to a further feature of the invention one or more further fibre webs can be fed in between the two needle board pairs in addition to webs which have already been partially needled and can be advanced together with the fibre webs that have already been needled so that the thickness of the web can be increased in the course of the web passing through the machine and a varying intensity of needling can be obtained within the individual strata, for example so that one or both outer strata can be made softer.

According to a further feature of the invention different needle boards can be provided with different needles, preferably the needle boards of the first needle board pairs with needles for preneedling and subsequent needle board pairs with needles for pile needling.

In the drawing FIG. 1 shows a needling machine as an exemplified embodiment according to the invention which is explained hereinbelow by reference to the process according to the invention.

FIG. 2 shows diagrammatically how the needled web is produced with pile formation on both sides by needling with three needle board pairs from two fibre webs which are preconsolidated by needling.

According to FIG. 1 the diagrammatically illustrated needling machine comprises a frame, referenced in its entirety with the numeral **1** and adapted to accommodate the elements which are required for the needling operation. As may be seen by reference to the illustration two preneedled fibre webs **2** and **3**, which adjoin each, other travel through the needling machine on a vertical path to which end the fibre webs **2** and **3** are moved downwardly by the roller pairs **4, 5.** Accordingly, the needle boards **11** which are provided in pairs and are adapted to move opposite to each other are actuated by their corresponding drives in the horizontal direction for the needling operation. Sets of two needle boards **11** with their needles **12** operate against each other the paired arrangement of the needle boards **11** ensuring that the vertical position of the fibre webs **2** and **3** or of the complete needled web **8** is retained thus dispensing with the need for lateral support by means of separate support cylinders.

The needle boards **11** are detachably mounted on slides **9** of box-shaped cross-section. The slides **9** are horizontally slidably guided in guide frames **10** and are hinged to an eccentric crank **23** which is driven by the drive pulley **13** and thus performs stroking motions. The drive pulley **13** is supported by a slide **14** which is adjustable in the frame **15** by adjusting means which are not shown. This enables the initial position of the slide **14** to be varied either continuously or in steps in relation to the fibre web **8** so that the penetration depth of the needles **12** into the web **8** can be varied indepen-

dently of the stroke which in turn can also be varied by altering the eccentricity of the radius rod system of the eccentric crank **23.**

The drive pulley **13** is driven by a motor **17** via the drive belt **16** on which a resiliently supported jockey pulley **24** bears the resiliency of which enables the slide **14** to be displaced in the frame **15** while retaining the tension of the belt **16.**

If it is assumed that the needles **12** of the needle boards **11** are so called bifurcated which form a pile on both sides of the needled web **8** and therefore lift pile loops on both sides of the needled web **8** in accordance with the arrangement of the needles, it follows that the pile thus produced remains unchanged because all guide rollers between which the needled web **8** is moved are omitted in the illustrated machine.

If needles **12** are used with barbs a pile will also be formed on both sides but the pile loops will not be-pushed out but instead will be pulled out.

The needles of oppositely disposed needle boards **11** are offset with respect to each other. The needle rows of the individual needle boards **11** which come into operation successively are laterally offset with respect to each other so that every needling operation by one of the needle board pairs causes the density of the pile rows to be increased to enable a very dense needling effect to be achieved so that the pile rows are positioned in closely adjacent configuration in the finished web material.

The fibre webs **2** and **3** or the needled web **8** is fed through the machine freely suspended by the drive of the feed rollers **4** and **5.** A take-up drum **25** is supported on the slide **26** and can be driven via the belt **28** by means of the motor **27** that is mounted on the slide, the take-up speed being adapted by a steplessly variable transmission to the feed rate of the web **8** through the needling machine. The slide **26** is moved to the right on the bed **29** and is thus continuously adapted to the take-up operation so that the vertical position of the needled web is retained at all times. The sliding motion is automatically applied by a motor through transmission elements such as a gear rack, pinion or the like, a sensor **30** which is in contact with the vertically descending needled web **8** being utilized for control purposes. The sensor may be a mechanically acting or a photoelectrically acting sensor.

FIG. **2** is a diagrammatic view of the needling operation. The two preconsolidated, fibre webs **2** and **3** bear upon each other and move vertically between the three needle board pairs **11** which are disposed one below the other and are provided with needles **12.** The pile is formed on both sides at a specific height designated with *a* during the needling operation by the first needle board pair. The pile height is increased during the second needling operation to the height *b* and this is followed by an increase to the height *c* during the third needling operation. This is accompanied by consolidation of the core of the needled web thus produced so that the core *d* can be regarded as a carrier web which becomes progressively thinner in the course of needling, that is to say with an increasing pile height and therefore with an increasing pile formation and increasing height of the pile.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

I claim:

1. Needling apparatus for producing needled pile web from fibre web passed therethrough comprising, in combination, roller guide means for guiding said fibre web through said apparatus in a direction extending vertically downwardly therefrom, a take-up drum disposed substantially directly below said roller guide means adapted to have said needled pile web wound thereabout in an accumulated web roll, at least one pair of directly opposed horizontally movable needle boards located between said roller guide means and said take-up drum and arranged to perform needling operations from opposite sides thereof upon fibre web passing therebetween in order to form pile layers thereupon, means for sensing the amount of web material accumulated upon said take-up roll, and means for moving said take-up roll in response to said sensing means in accordance with the amount of material accumulated thereupon to retain substantially constant the location through which portions of said web material incoming to said take-up roll are passed.

2. Apparatus according to claim **1** wherein said needle boards comprise a plurality of needles arranged in rows and wherein said rows of needles are offset laterally with respect to each other.

3. Apparatus according to claim **1** wherein fibre web in addition to fibre web which has already been partially needled is fed between said at least one pair of needle boards, said additional fibre web being movable in a forward direction together with web having already been needled.

4. Apparatus according to claim **1** including guide ways having said needle boards guided therein for movement in directions perpendicular to the direction of movement of said fibre web through said apparatus, and rotating eccentric means for driving each of said needle boards of said at least one pair with a reciprocating stroke against said fibre web in opposed directions.

5. Apparatus according to claim **4** including means for varying the reciprocating stroke of each of said needle boards.

6. Apparatus according to claim **4** wherein said needle boards are movable towards and away from said fibre web independently of the length of the stroke of said needle boards.

7. Apparatus according to claim **4** wherein said needle boards have different individual stroking rates.

8. Apparatus according to claim **4** including a plurality of serially arranged pairs of needle boards between which said fibre web may be sequentially passed, said needle board pairs being provided with needles having differing configurations.

9. Apparatus according to claim **8** wherein said serially arranged pairs of needle boards include a first pair through which said fibre web is first passed, and wherein said first pair of needle boards are provided with needles for preneedling with the other of said needle board pairs being provided with needles for pile needling.

10. A method for producing needled pile web from fibre web comprising the steps of moving said fibre web vertically downwardly between vertically aligned roller guide means and a take-up drum therebelow while passing said web between at least one pair of opposed horizontally moving needling boards which perform needling operations upon said web from opposite sides thereof in order to form pile layers thereupon, winding

said needled pile web upon said take-up roll to form an accumulated web roll, sensing the amount of web accumulated upon said take-up roll and moving said take-up roll in accordance with the amount of accumulated web thereupon to maintain substantially constant the location through which incoming web material accumulated upon said take-up roll is passed.

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