April 27, 1971 D. B. PARLIN 3,576,687

LUBRICATED NON-WOVEN FABRIC AND METHOD OF PRODUCING THE SAME

Filed March 14, 1968 2 Sheets-Sheet 1

Fig. 1.

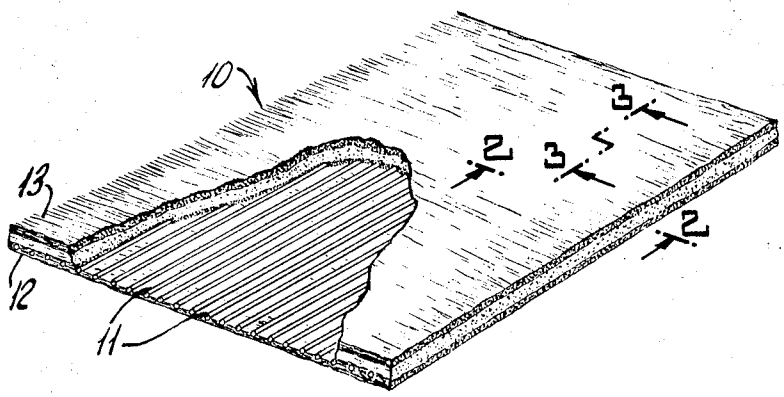



Fig. 2.

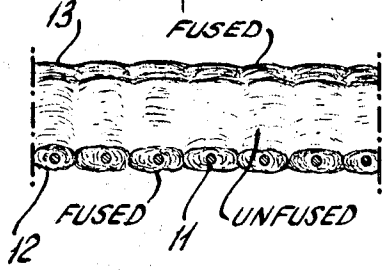



Fig. 3.

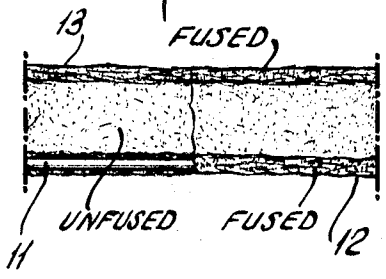



Fig. 4.

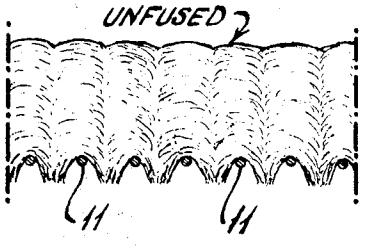
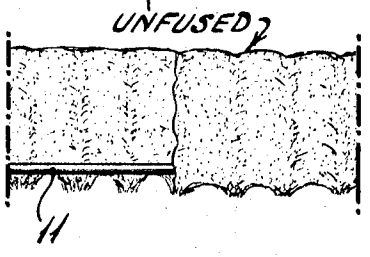



Fig. 5.

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LUBRICATED NON-WOVEN FABRIC AND METHOD OF PRODUCING THE SAME

Filed March 14, 1968 2 Sheets-Sheet 2

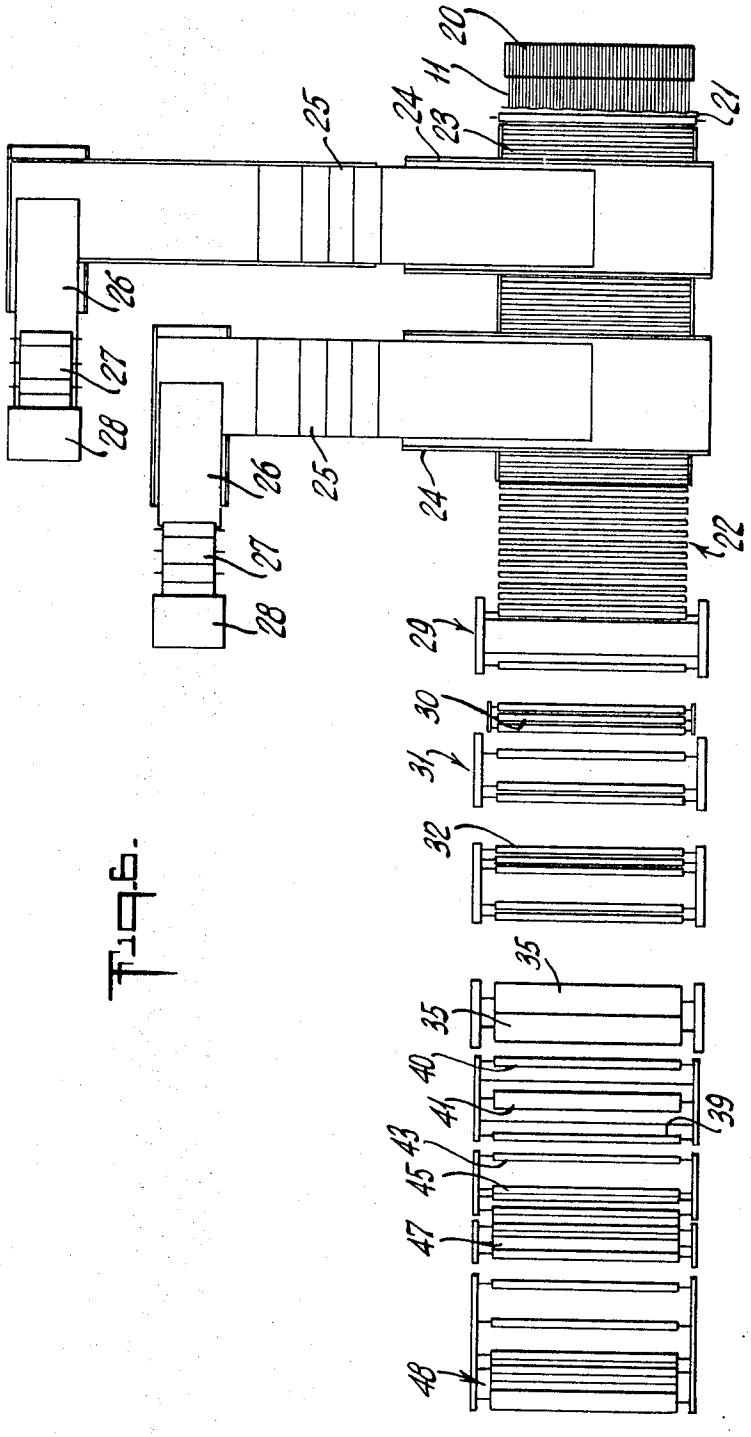

Fig. 6.

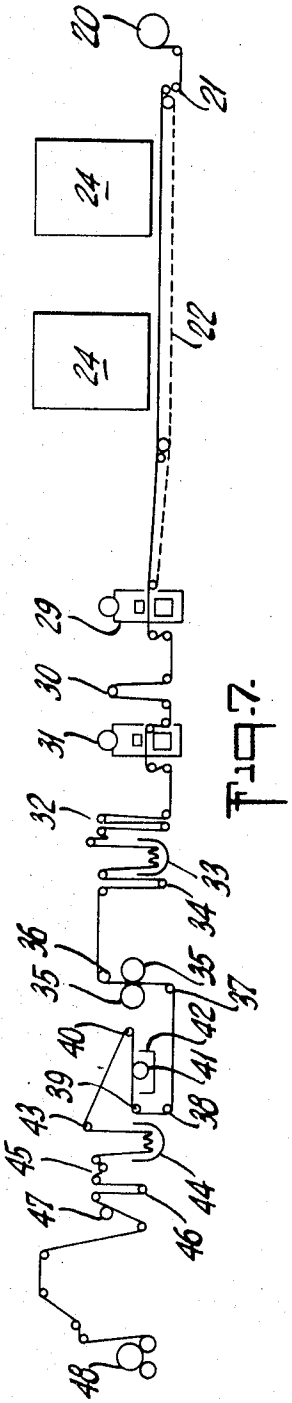

Fig. 7.

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# LUBRICATED NON-WOVEN FABRIC AND METHOD OF PRODUCING THE SAME

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Int. Cl. D04h 18/00
U.S. Cl. 156—148 7 Claims

## ABSTRACT OF THE DISCLOSURE

A needled non-woven fabric which comprises a needled web of crimped fibers of a synthetic thermoplastic material such as a polyolefin or a polypropylene. Said web and the fibers thereof being lubricated and including a series of lengthwise extending, spaced warp threads of a material such as cotton which are relatively inextensible in comparison with the needled web of fibers.

The thermoplastic fibers comprising the needled web being bonded or fused into engagement with each other on one or both exterior surfaces of the fabric. The fibers on one such surface also being bonded or fused into engagement with the warp threads. The remaining or interior fibers of the fabric being unfused and mobile or movable relative to each other.

The fibers of the needled fabric being lubricated with a lubricant such as coconut oil to increase the mobility of the unfused fibers and to reduce the noise resulting from tufting of the fabric. The lubricant also prevents overheating of the tufting needles.

Said needled and lubricated fabric is produced in a continuous manner by depositing fibers on a continuously moving band of spaced warp threads and then needling the layer of deposited fibers and the warp threads in a vertical direction relative to the thickness of the fabric. Then fusing the thermoplastic fibers on at least one exterior surface of the web of fibers into engagement with each other and with the warp threads without fusing the remaining or interior fibers of the web and then applying an aqueous solution containing a lubricant to at least one exterior surface of the web.

The present invention relates to a needled non-woven fabric and the method of producing such a fabric. It relates more particularly, to a lubricated non-woven fabric of the needled type which is suitable for use as the backing fabric for tufted carpet or the like and to the method of producing such a fabric.

An object of the present invention is to provide a needled-type of non-woven fabric comprised of thermoplastic fibers in which part of the fibers are mobile and carry a lubricant. This permits the mobile fibers to be deflected more readily by tufting needles and as a result, there is little loss or change in the strength of the fabric when it is tufted. This permits the tufting needles to be spaced more closely than is usually the case.

The lubricant also reduces pounding and noise due to tufting operations and it prevents the tufting needles from reaching a temperature where damage to the tufting yarns may result.

Another object of the present invention is to provide a non-woven fabric of the needled type in which warp threads are incorporated in and extend lengthwise of the fabric adjacent one surface thereof. Such a fabric can be produced at less expense than when woven threads are employed.

An important feature of the present invention resides in the method by which the subject non-woven fabric is produced on a continuous basis and with a high degree of uniformity.



Generally speaking, a non-woven fabric of the type to which the present invention relates is described and claimed in United States patent application Ser. No. 595,304 filed Nov. 7, 1966, now U.S. Pat. No. 3,394,043, issued July 13, 1968 in the names of David B. Parlin and Philip B. Mitchell and which is copending herewith.

Briefly, a non-woven fabric embodying the present invention comprises a needled sheet-like web of lubricated fibers of a high strength synthetic thermoplastic material including polyolefins, polypropylenes, polyesters and the like. The fibers are intermixed and entangled by the needling with portions thereof being displaced vertically relative to the thickness of the web. In addition to the fibers, warp threads of cotton or a similar material extend in spaced parallel relation to each other in a lengthwise or warpwise direction of the web adjacent one surface thereof.

The thermoplastic fibers on one or both exterior surfaces of the web are bonded or fused into engagement with each other with the fibers on the surface adjacent the warp threads being fused or bonded to said threads. The remaining fibers of the fabric are not fused or bonded together and remain mobile relative to each other.

A lubricant applied to the web and the fibers thereof permits a large percentage of the unfused or unbonded fibers to be deflected or pushed aside without being severed or broken in the passage of tufting needles through the fabric. As a result, there is little change in the strength of the fabric due to tufting.

More specifically, the needled web is formed from crimped fibers of a high strength synthetic thermoplastic material including polyolefins, particularly polypropylene in staple or fibrillated (split film) form. Fibers of other synthetic thermoplastic materials such as polyesters and mixtures may be employed. Where fibers of polypropylene are mixed with other fibers, the percentage of polypropylene fibers in the mixture is preferably not less than 80%, but this will depend on the strength requirements. The fibers may be in the form of a 4½ in. staple and may vary in size up to about 15 denier with different sizes being mixed. For example, a mixture containing 75% six denier and 25% three denier fibers of polypropylene may be employed.

The warp threads may be of cotton, polyester, high-modulus rayon, nylon, polypropylene or the like. The material from which the warp threads are made and the number of warp threads per inch will depend upon the cost and strength requirements. In a non-woven fabric for use as the backing fabric for tufted carpet, 9/1 cotton or 18/1 polyester threads at a spacing of eight threads per inch have been found to provide satisfactory strength at low cost. In a four ounce fabric, this provides an elastic limit (tensile strength before permanent elongation) of about 25 pounds per inch in the length or warpwise direction of the fabric.

In lubricating the fibers, an aqueous solution containing the lubricant may be applied to one surface of the fabric after fusing. The lubricant solution may be applied to the surface of the fabric by a padding or lick-roll. The amount of lubricant is about 4% by weight of the fabric and examples of solutions which have been found to be satisfactory, are solutions containing 4% (by weight) of coconut oil; 3% (by weight) of peanut oil; 2% (by weight) of silicone; 2½% (by weight) of coconut oil with ½ to ¼% of a silicone and 2½% peanut oil with ¼% of a silicone. Lubricants such as cottonseed, corn, linseed and tung oil may create a fire hazard and hence, are not recommended.

As mentioned, the lubricant reduces the pounding and noise resulting from a tufting operation and prevents the tufting needles from reaching a temperature where damage to the tufting yarns, particularly during stoppage of

the tufting machine, may result. In addition, the lubricant results in there being little loss in the textile strength of the non-woven fabric after tufting. As explained, the lubricant permits the mobile fibers to be more readily deflected or pushed aside by the tufting needles without being broken or severed. The fibers are deposited by a cross-lapping operation by which a large number of the fibers extend in a widthwise direction relative to the fabric and when the fibers are not damaged or broken by the tufting needles, the tensile strength in the width of the fabric can be maintained with acceptable limits.

Under these conditions, it has been found that up to 12 stitches per inch and down to 5/64" gauge may be employed in tufting without difficulty and with little loss in the widthwise tensile strength of the backing fabric even though the tufting needles may be in the neighborhood of .156" in diameter and hence, overlap at 12 stitches per inch. In the case of non-robbing or "honesty" type tubular needles, the subject non-woven fabric will withstand up to 9 stitches per inch, whereas woven backing of jute and similar materials are generally restricted to around 7 stitches per inch with such needles.

These and other features of the present invention will be better and more clearly understood from the following description and the accompanying drawings in which:

FIG. 1 is a perspective view diagrammatically illustrating a piece of non-woven fabric embodying the invention with certain portions thereof being broken away to illustrate details of its construction and being drawn to a somewhat enlarged scale;

FIG. 2 is a section view taken along the line **2—2** of FIG. 1 and is drawn to a larger scale than FIG. 1;

FIG. 3 is a section view taken along line **3—3** of FIG. 1 and is also drawn to a larger scale than FIG. 1;

FIGS. 4 and 5 are section views corresponding respectively to FIGS. 2 and 3, but showing the fibers and warp threads after needling and prior to fusing of the exterior surfaces thereof.

FIG. 6 is a diagrammatc plan view of machinery positioned to carry out the invention; and

FIG. 7 is a side elevation of the machinery of FIG. 6.

It will be understood that the drawings are of a diagrammatic nature and reference should be made to the following description for a more detail explanation of the construction of the subject fabric.

Referring now to the drawings, FIG. 1 shows a needled non-woven fabric **10** formed from synthetic thermoplastic fibers of relatively high strength such as polypropylene fibers or the equivalent thereof. Warp threads **11** which are relatively inextensible as compared with the needled web of fibers extend lengthwise of the fabric in spaced relation to each other and are incorporated in the fabric adjacent its lower surface. The warp threads may be of cotton, polyester, or other material having an elastic limit equal to cotton.

As will be described, the fibers are deposited by cross-lappers which operate in a filling direction and the fibers are deposited in a fluffed-up condition on the warp threads as the warp threads advance. When the desired thickness of the fibers has been deposited on the advancing warp threads, the fibers together with the warp threads are subjected to the action of one or more needle looms in which barbed needles are forced through the deposited fibers and to a point slightly beyond the warp threads at closely spaced intervals. The barbed needles which are closely spaced, engage with the fibers and displace portions of the fibers vertically with portions of some of the fibers being displaced beyond the warp threads. This results in the warp threads being located immediately above and adjacent the lower surface of the web of fibers after needling.

The needling intermixes and entangles the fibers vertically relative to the thickness of the fabric and compacts the fibers into a sheet-like web having substantial tensile strength. However, due to the nature of a needled fabric and the properties of the fibers employed, the needled sheet-like web may be subject to undesirable elongation or stretching, particularly in its length. The warp threads which are made of cotton or a similar material, are less subject to such elongation or stretching and thus, increase the elastic limit of the fabric in a lengthwise direction.



The warp threads **11** extend lengthwise of the fabric in spaced parallel relation to each other and in a non-woven backing fabric for tufted carpet, eight warp threads to the inch may be employed. It has been found that 9/1 cotton or 18/1 polyester threads spaced at eight threads to the inch will provide adequate strength for such a backing fabric and this spacing avoids interference with or deflection of the tufting needles. The use of warp threads in this manner permits the non-woven fabric to be produced in wide widths, such as nine and twelve feet, without the overlapping required for woven materials such as cheesecloth due to limitations as to the widths in which woven materials are produced commercially. Thus, the use of warp threads permits the non-woven fabric to be produced with greater uniformity and at less expense as weaving of the warp threads is not required.

As shown in the drawings, the thermoplastic fibers forming the lower surface of the needled sheet-like web are fused, as indicated at **12**, into engagement with each other and with the warp threads **11** which are adjacent such surface. The warp threads are not sized or finished as in the case of a woven material and hence, engagement of the fused fibers with the warp threads can be more readily achieved. Such engagement prevents slippage of the warp threads relative to the fibers of the fabric and more effectively increases the tensile strength and elastic limit of the fabric in its lengthwise direction.

The thermoplastic fibers forming the upper exterior surface of the fabric may also be bonded or fused into engagement with each other as indicated at **13**, but the interior or remaining fibers of the needled sheet-like web remain in an unfused or unbonded condition and are mobile or free to move relative to each other.

A lubricant such as coconut oil carried on the fibers of the web permits the unbonded or unfused fibers to be more readily deflected or pushed aside without being damaged in penetration of the fabric by the tufting needle. A large percentage of the fibers lie in a filling or widthwise direction of the warp threads due to cross-lapping and thus, there is little change in the widthwise tensile strength of the fabric as the result of tufting.

The lubricant also decreases the pounding or noise produced by the tufting operation and it prevent the tufting needles from becoming heated to a temperature where tufting yarns, such as an acrylic yarn, may be damaged during stoppage of the tufting machine.

The procedure by which the subject non-woven fabric is produced will now be described. As will be seen from FIGS. 6 and 7, this is a continuous process and for the most part conventional equipment is employed. At the outset, a band or series of spaced warp threads **11** are drawn from a beam or creel **20** by powered rolls **21** and are guided by suitable means such as a threaded roll in spaced relation to each other onto a slatted type of continuous conveyor **22** having friction strips **23** on the surface of the slats to aid in maintaining the warp threads in spaced relation and in advancing the warp threads with the conveyor. The drive for the conveyor **22** is connected to and synchronized with the power rolls **21**.

As the warp threads **11** advance on the conveyor **22**, fibers are deposited on the moving band or warp threads by a pair of cross-lappers **24** which reciprocate back and forth across the width of the band of moving threads. Each of the cross-lappers reciprocates at a speed which deposits four layers of the fibers on a given area of the moving warp threads, with the fibers being laid generally in a filling direction relative to the warp threads.

Each of the cross-lappers **24** is supplied with fibers from a garnet or carding machine **25** and each of the garnets is in turn supplied with fibers from a secondary pair of cross-lappers **26** to which fibers are supplied from another set of garnets **27**. Feed boxes **28** supply fibers to the second set of garnets. Fibers are delivered to the feed boxes from the usual blenders and pickers (not shown).

After the desired quantity of fibers has been deposited on the moving warp threads, the fibers and the warp threads which continue to move enter a first needling loom **29** where the fibers and the warp threads are subjected to the needling action of small barbed needles which are reciprocated vertically and are forced through the fibers to a point beyond the warp threads. In this operation, the barbed needles engage with and displace portions of the fibers vertically, causing the layer of fibers to be compacted with fibers from different levels of the layer being intermixed and entangled. It also forces portions of some fibers beyond the warp threads so that the warp threads are positioned in the needled mass of fibers immediately above the lower surfaces thereof.

From the first needling loom, the needled fibers and the warp threads pass over a dancer roll into a second needle loom **31** where the needling operation is repeated. The dancer roll is counterbalanced so as to act as a take-up on the needled material as it passes from the first to the second needle loom and it compensates for differences in the speed at which the material being needled passes through the needle looms.

After the second needling, the needled web passes around a second dancer roll **32** and into a J-box **33**. As the needled web is drawn from the J-box **33**, it passes around a third dancer or take-up roll **34** and is then guided in a vertical path between a pair of heated rolls **35** by guide rolls **36** and **37**. The heated rolls **35** exert some pressure on the needled web and are maintained at a temperature which is sufficient to cause thermoplastic fibers on exterior surfaces of the needled web to fuse together during the time the web is in contact with the walls without fusing fibers on the interior of the web. The thermoplastic fibers on the lower surface of the web are also fused into engagement with the warp threads at this time.

The needled and fused web then passes around guide rolls **38**, **39** and **40** and is guided in a path which brings the lower surface of the web into contact with the surface of a padding or lick roll **41** which is rotatably mounted in a receptacle **42** containing an aqueous solution of a lubricant.

After the solution containing the lubricant is applied to the lower surface of the moving web, the web is fed over a guide roll **43** into another J-box **44**. As the lubricated web is withdrawn from the J-box **44**, it passes over a series of guide rolls **45** and around a dancer roll **46** from which it is guided by rolls **47** and **48** beneath slitting wheels **47** which cut the web along its outer edges to the desired width.



The cut web then passes through an inspection area to a take-mechanism **48** where the web is wound into rolls of the desired length.

It will be understood that various modifications and changes may be made in the embodiment of the invention which has been shown and described herein without departing from the scope of the invention as defined by the following claims.

What is claimed is:

**1.** A method of producing a needled non-woven fabric which comprises the steps of

depositing fibers at least some of which are of a thermoplastic material, in a loose condition on a band of parallel, unconnected spaced warp threads;

needling the deposited fibers and the warp threads in a vertical direction at closely spaced points with barbed needles and thereby compacting the deposited fibers and incorporating the warp threads in said compacted fibers adjacent one surface thereof; and

bonding the fibers on said one surface into engagement with each other and with the warp threads by fusing said thermoplastic fibers with heat without bonding the fibers in the interior of the web.

**2.** The method of claim **1** comprising the step of applying an aqueous solution containing a lubricant to at least one surface of the needled web of fibers and warp threads.

**3.** The method of claim **2** wherein the aqueous solution contains from 2% to 4% by weight of a lubricant.

**4.** The method of claim **1** wherein the fibers are deposited generally in a filling direction relative to the warp threads.

**5.** The method of claim **1** wherein the fibers are deposited generally in a filling direction relative to the warp threads.

**6.** The method of claim **2** wherein the fibers are deposited generally in a filling direction relative to the warp threads.

**7.** The method of claim **5** wherein the warp threads are continuously advanced by powered rolls.


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