

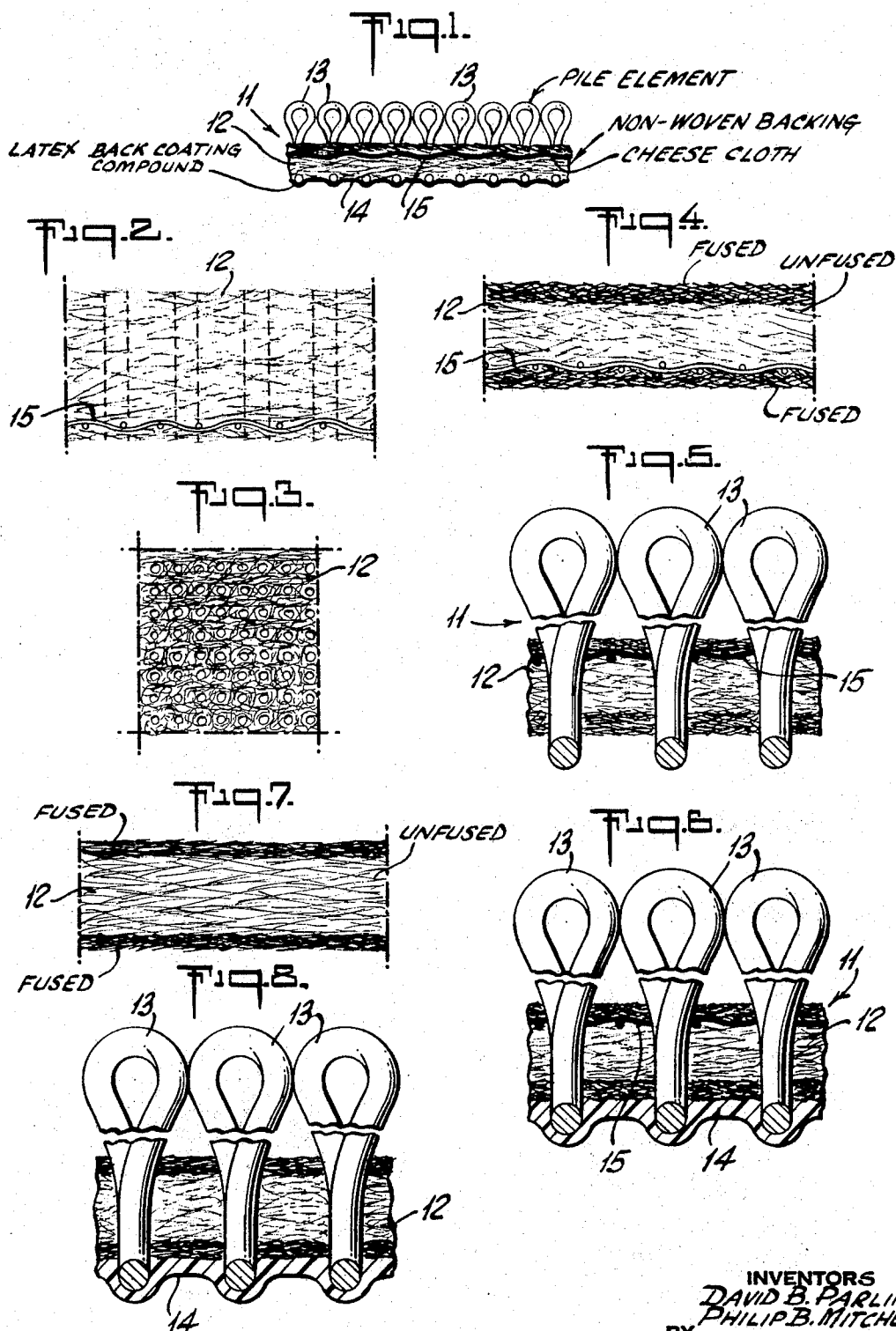
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METHOD OF PRODUCING TUFTED PILE FABRIC AND NONWOVEN BACKING
FABRIC FOR THE SAME

3,535,178

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2 Sheets-Sheet 1



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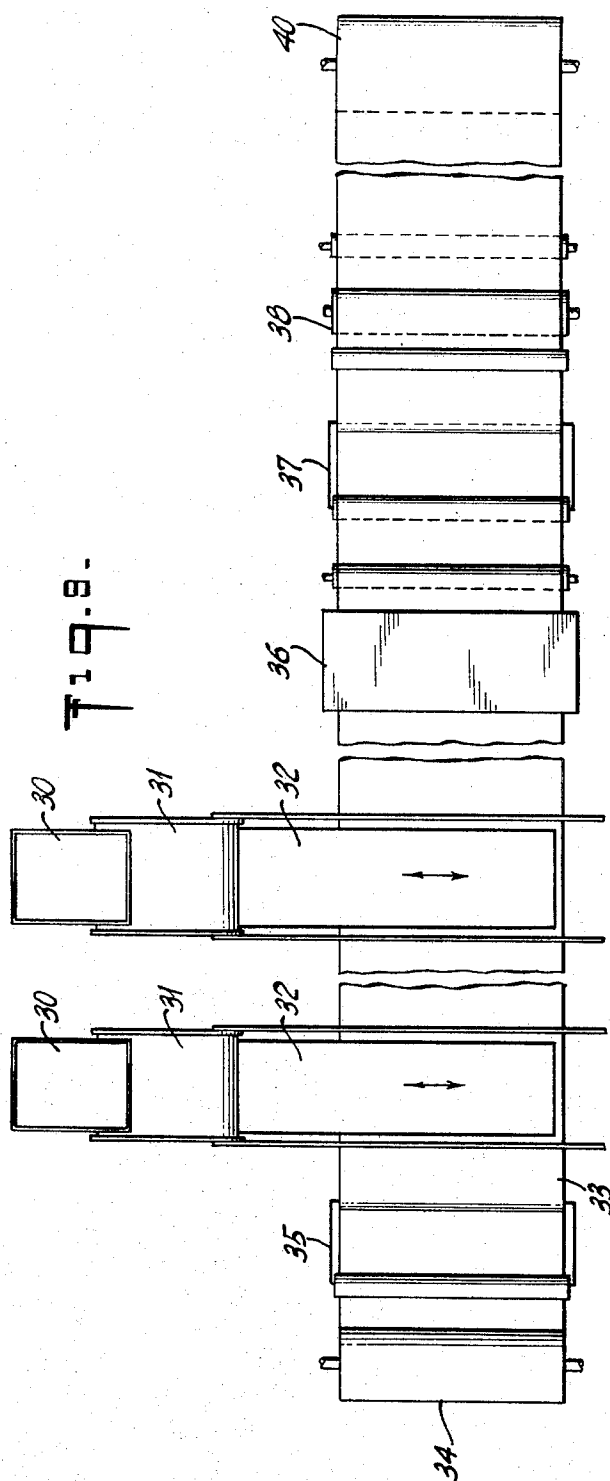
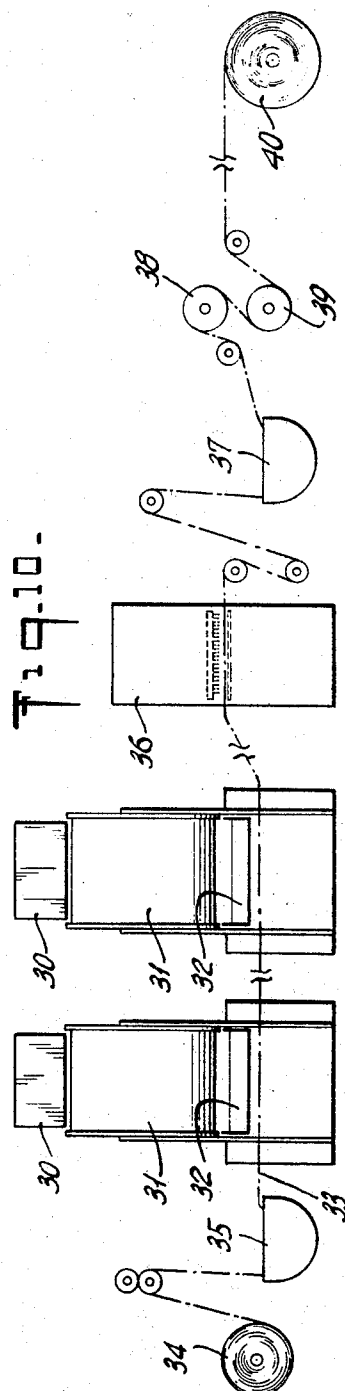
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METHOD OF PRODUCING TUFTED PILE FABRIC AND NONWOVEN BACKING FABRIC FOR THE SAME

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Application Nov. 7, 1966, Ser. No. 595,304, which is a continuation-in-part of abandoned application Ser. No. 320,276, Oct. 31, 1963. Divided and this application Jan. 24, 1968, Ser. No. 725,552

Int. Cl. D05c 15/00

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20 Claims

ABSTRACT OF THE DISCLOSURE

A layer of thermoplastic fibers is distributed on a thin, flexible, sheet-like carrier and needled thereto, portions of the fibers being forced through the layer and the carrier to form a web. The fibers at at least one surface of the web are bonded, as by fusion, to each other while the fiber portions in the interior of the web remain unbonded. The fibers may additionally be bonded to the carrier, or fibers on both surfaces of the web may be bonded. The web may then be tufted to form a carpet.

This application is a division of copending application Ser. No. 595,304 filed Nov. 7, 1966, now Pat. No. 3,394,043 and is a continuation-in-part of our copending application Ser. No. 320,276 filed Oct. 31, 1963, now abandoned.

The present invention relates to improvements in tufted pile fabrics such as carpet and to the method of producing the same. It relates, more particularly, to tufted carpet in which the pile elements are formed and supported on a novel backing fabric comprised principally of nonwoven fibers and the method of producing the same. The present application also relates to improvements in the backing fabric for tufted carpet or the like and the method of producing such fabric.

An object of the present invention is to provide a tufted carpet having a backing fabric comprised principally of non-woven fibers which imparts superior qualities to the carpet in a number of respects including the cost, weight, strength, dimensional stability, handle, availability of materials and the like, particularly in comparison to conventional tufted carpet which uses a loosely woven burlap or similar material as the backing fabric.

Another object of the present invention is to provide a backing fabric for tufted carpet which can be produced at a relatively high rate of productivity from inexpensive materials which are readily available in most countries, including the United States. This eliminates problems of long delays and uncertainties of delivery which are frequently encountered in obtaining the commonly used loosely woven burlaps which are usually manufactured from jute in countries such as India.

In addition a backing fabric in accordance with the present invention has a consistent uniformity in composition which practically eliminates irregularities or imperfections in the appearance of the pile face of the tufted carpet due to needle deflection which can occur when a tufting needle strikes a woven strand of jute or similar material. The nonwoven fibers of the subject backing fabric also provides for better closure on the pile forming yarns after tufting than do the strands of loosely woven materials such as burlap. The subject backing fabric also has a greater ability to pick up the adhesive back coating which holds the pile forming yarns in place without objectionable penetration of the back coating on the face of the fabric.

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In addition, tufted carpet embodying the present invention is lighter in weight than tufted carpet having comparable tufts or pile which use burlap as the backing fabric, with the result that shipping costs are reduced and larger rolls of carpet can be handled.

Various other objects and advantages of the present invention will become apparent and will be better understood from the following description and the accompanying drawings in which:

FIG. 1 is a side elevational view in vertical section in a warpwise direction diagrammatically illustrating a piece of tufted carpet embodying the present invention;

FIG. 2 is a side elevational view in vertical section in a warpwise direction diagrammatically illustrating the backing fabric of the tufted carpet shown in FIG. 1 but on an enlarged scale and in the form of a needled bat prior to surface treatment thereof;

FIG. 3 is a plan view diagrammatically illustrating the backing fabric shown in FIG. 2;

FIG. 4 is a side elevational view in vertical section in a warpwise direction diagrammatically illustrating the backing fabric shown in FIG. 2 after surface treatment;

FIG. 5 is a side elevational view in vertical section in a warpwise direction diagrammatically illustrating the backing fabric shown in FIG. 4 with yarns forming pile elements tufted thereon;

FIG. 6 is a fragmentary view of the tufted carpet shown in FIG. 1, but on an enlarged scale;

FIG. 7 is a side elevational view in vertical section in a warpwise direction diagrammatically illustrating a modification of the backing fabric shown in FIGS. 2-6;

FIG. 8 is a side elevational view in vertical section in a warpwise direction diagrammatically illustrating a piece of tufted pile carpet with the modified form of backing fabric shown in FIG. 7;

FIG. 9 is a plan view diagrammatically illustrating the apparatus and procedure employed for producing the backing fabric shown in FIG. 4;

FIG. 10 is a side elevation of the apparatus and procedure illustrated in FIG. 9.

It will be understood that the accompanying drawings are merely diagrammatic illustrations and that reference should be made to the following description for a more detailed explanation of the structures involved. Also, it will be understood that the backing fabric will be comprised principally of nonwoven fibers and hence, may be referred to as a nonwoven fabric. When used as the support element in tufted carpet, the thickness of the backing fabric will be of the same relative order as a woven burlap and may be readily substituted therefor.

Generally speaking, a tufted pile fabric such as carpet made in accordance with the present invention employs a novel backing fabric comprised principally of nonwoven fibers as the element on which yarns forming the pile elements are tufted and supported. Prior to tufting, the backing fabric is in the form of a bat of filaments or fibers of synthetic thermoplastic material of high strength, particularly polypropylene and the fibers employed by be those termed "waste" fibers in the trade. The backing fabric may be formed by distributing the fibers at random by means of garnets in one or more superimposed layers on a carrier such as a low-count cotton cheesecloth. The cheesecloth with the fibers deposited thereon is then moved to a needling machine where the web is subjected to a needling operation which causes the fibers to be intimately intertwined and interengaged with each other throughout the thickness of the web, particularly at the points of needling. After needling, fibers on one or both exterior surfaces of the bat are bonded together to a flattened and hardened condition with the interior fibers remaining unbonded. This may be done by heating the surface fibers to their

melting temperature so as to fuse the surface fibers without fusing the fibers on the interior of the web. The bonding or fusing of the fibers on exterior surfaces of the web tends to increase the tensile strength of the web and the bonded or fused surface can pass beneath the needles of tufting machines during the tufting operation without excessive interference or objectionable drag.

The usual tufting machines are employed in forming the pile elements and the tufting needles which carry the tufting yarns penetrate the backing fabric from the rear face thereof so as to form loops of the yarns having a desired length or height which extend from the opposite or front face of the backing fabric. The needles are then withdrawn from the backing fabric with the yarn loops being held in place while the backing fabric which has been tufted is advanced for the tufting of the next row of pile elements thereon.

It should be noted here that passage of the yarn-carrying needles through the backing fabric which takes place in the tufting has the effect of compacting the filaments or fibers of the nonwoven fabric in the area surrounding the pile yarns and this tends to increase the tensile strength of the backing fabric even though the tufting needles penetrate or puncture the fabric at closely spaced intervals.

After the formation of the tufted pile elements has been completed, a suitable adhesive back-coating compound, such as a high solids synthetic latex adhesive compound of the type usually used as a back-coating for tufted pile carpet, is applied to the rear face or back of the carpet. The back-coating penetrates the backing fabric to some extent and it secures the portions of the pile yarns extending along and through the backing fabric to the backing fabric.

Referring now to the drawings, FIG. 1 illustrates a tufted pile fabric 11 of a type suitable for use as a floor covering or carpet which may hereinafter be called tufted carpet or tufted pile carpet. However, it will be understood that the present invention is not necessarily limited to tufted pile fabrics for use as floor coverings, although it has particular advantages for such use.

As shown in FIGS. 1 and 6, the tufted pile carpet 11 comprises a backing fabric 12 comprised principally of nonwoven fibers which has several rows of tufted pile elements 13 in the form of loops of yarn supported thereon. The yarns forming the pile elements are stitched to the nonwoven backing by means of a tufting machine of a type customarily employed for such purpose and hence, the tufting operation need not be described in detail here. In addition, there is a coating 14 of an adhesive compound, such as a synthetic latex based compound, on the back or rear face of the nonwoven backing fabric which secures portions of the yarns forming the pile elements to the backing fabric in such a way that the yarns will not unravel readily or be pulled from the carpet under ordinary use.

The backing or supporting fabric 12 is comprised principally of fibers of thermoplastic material, preferably polypropylene or other polyolefins having similar characteristics including mixtures. The fibers are distributed at random and are needled into the form of a cohesive bat or web. The needling causes fibers from different levels of the bat to be intermixed in more intimate engagement with each other and imparts strength to the bat or web. A closed barb needle of small diameter, such as a #32 fine felt triple barb needle, may be employed for this purpose.

As shown in FIGS. 1-6, the needled web of nonwoven fibers includes a piece of low-count cheesecloth 15 of cotton or other suitable material extending therethrough. As shown in FIGS. 9 and 10, the fibers are deposited on a moving web of the cheesecloth and the fibers carried by the cheesecloth are then subjected to a needling operation. When the procedure illustrated is followed, the cheesecloth is incorporated in the needled web at a point adjacent its lower surface.

If desired, other means, such as a continuous moving

belt or slats or the like may be employed to support and transport layers of fibers to needling operation. In such case, the cheesecloth may then be eliminated. A modified form of the backing or support fabric without the cheesecloth is shown in FIG. 7 and the same reference numerals have been applied to corresponding elements. This form of backing fabric after tufting and back coating is also shown in FIG. 8.

It will be noted that in a tufted fabric, such as tufted carpet, double thicknesses of the pile-forming yarns extend through the backing fabric at closely spaced intervals both across and lengthwise of the fabric and the double portions of the pile forming yarns exert lateral forces on the fabric. Although such forces are of a low order, the cumulative effect of such forces, particularly in a twelve to fifteen foot width of the tufted carpet, will cause the tufted fabric to grow or expand in both its width and length when the backing fabric is formed from fibers having elastic properties, such as polypropylene.

Such growth takes place gradually and may not be uniform, particularly in instances of carpet where different pile yarns are used. Hence, the growth is likely to give rise to difficulties in subsequent manufacturing operations. However, this problem is overcome to a large extent by incorporation of the cheesecloth in the backing fabric as shown in FIGS. 9 and 10 as the threads of the cheesecloth will resist such forces.

When the fibers are deposited on the cheesecloth as shown in FIGS. 9 and 10 with the cheesecloth being adjacent the lower face of the web, the ends of some fibers are forced through the open mesh of the cheesecloth. This is called the beard side of the fabric. Thereafter, when the surface fibers on the beard side of the fabric are fused or bonded together, they also engage with and grip the threads of the cheesecloth and thus, prevent slippage or movement of the cheesecloth relative to the web of needled fibers. Under these conditions the fused fibers and the threads of the cheesecloth combine to resist and overcome the forces exerted on the backing fabric as a result of tufting and permit the desired dimensions to be maintained. When the fabric is tufted, it is preferable that the cheesecloth or the like be adjacent the upper or pile face of the carpet as shown in FIGS. 1 and 6.

The backing or support fabric may be made entirely from polypropylene fibers or from mixtures of polypropylene fibers with fibers of other materials such as nylon, rayon, acrylic, polyester or mixtures thereof. Polypropylene fibers have been found to have especially suitable characteristics particularly for use in conjunction with tufted carpet and are readily available in good supply and at low cost in most countries, including the United States. A satisfactory backing or support fabric for tufted carpet may be made from polypropylene fibers of 5 to 15 denier which are commonly produced commercially. If desired, fibers of different denier may be mixed.

In addition, fibers of other materials may be included in the mixture and the following is an example of a suitable mixture of fibers which may be employed in a backing fabric for tufted carpet: Polypropylene fibers (4½ in. staple)—90% (75%—6 denier; 25%—3 denier) and Rayon fibers (3 in. staple)—10%.

The rayon fibers in this mixture serve primarily as dye sites in the backing fabric so that its color will approximate the color of the pile yarns after dyeing. The content of rayon fibers may be increased to some extent, but it should not be increased to a point where substantial weakening of the backing fabric takes place.

In the above mixture of 3- and 6-denier polypropylene fibers, the 3-denier fibers will fill any voids or spaces between the larger 6-denier fibers and changes in these proportions can be made as desired.

As is customary, the polypropylene fibers are crimped and the crimp imparted by usual procedure employed in the United States; i.e., by overfeeding the filaments

as they are fed into a heated stuffing box, is satisfactory.

The bonding or fusing of the surface fibers also flattens upstanding fibers and provides a somewhat harder and smoother surface which will pass more readily beneath the needles of the tufting machine.

In the case of polypropylene fibers, the polypropylene fibers on the surface of the web may be bonded together by heating these fibers to a temperature slightly above their melting point for a short period of time so as to fuse the surface fibers without affecting the interior or remaining fibers of the web.

As noted above, the tufting needles penetrate the backing fabric repeatedly at closely spaced intervals in the tufting operation and in effect, form punctures or openings therein through which the double thickness of the pile yarns extend. With a conventional backing fabric, such as burlap, needle punctures which occur in the tufting tend to weaken the fabric. This is particularly true with woven fabrics such as burlap where strands of the backing fabric may be severed by the needles if proper care is not exercised. However, the tensile strength of a backing fabric embodying the subject invention is not appreciably reduced or diminished by the tufting and an increase in the overall tensile strength of the tufted pile fabric may result due to the compacting of the unbonded or unfused fibers in the interior center of the backing fabric in areas adjacent the points where the needles penetrate the fabric.

Tensile strength tests made of samples of nonwoven backing fabrics of several weights (8 oz., 6 oz., and 4 oz. fabrics) indicate that this is the case. In addition, the unbonded or unfused fibers which are compacted in areas surrounding the needle penetrations retain their resilient characteristics and thus, have a tendency to close on the portions of the pile forming yarns which extend through the backing fabric and to hold the pile yarns in place more effectively in the drawing of the loops than is the case with loosely woven backing fabrics such as burlap. Further, the backing fabric made in accordance with the subject invention will not fray.

A very distinct advantage of the backing fabric described herein over woven backings such as burlap is that no skewing of filling strands can take place and distortion in alignment of pile elements resulting therefrom is eliminated.

After the pile forming yarns have been tufted on the backing or support fabric, a suitable adhesive compound forming the back-coating 14 is applied to the rear face of the tufted backing fabric. The back-coating penetrates the backing fabric to some extent and it anchors the pile elements in place. A suitable back-coating compound for this purpose is a high solids synthetic latex base adhesive compound, such as is commonly used for tufted carpet.

In this connection, it should be noted that the backing or support fabric remains porous and the unbonded or unfused fibers on the interior thereof permit a considerable amount of the back-coating compound to be absorbed without having the compound penetrate to the pile face of the backing fabric. Thus, the hand of the tufted pile fabric can be varied by adjusting the amount of the adhesive compound applied thereto. Scrim or other suitable finish or covering materials may be applied, if desired, to the rear face of the tufted carpet in the usual manner.

One way in which the backing or support fabric embodying the subject invention may be produced is illustrated schematically in FIGS. 9 and 10. Briefly, polypropylene fibers (or mixtures containing polypropylene fibers) are fed from feed boxes 30 onto garnets 31 which combine the fibers into layers which pass onto run-out chutes 32. The run-out chutes traverse back and forth over a traveling conveyor or supporting element 33 which, as mentioned above, may be the low-count cheesecloth 15 and deposit the fiber layers thereon.

It is generally desirable to deposit more than one layer of the fibers on the conveyor element or cheesecloth so as

to obtain a more even and uniform distribution of the fibers.

The conveyor element or cheesecloth is fed from a roll 34 through a J-box 35 from which it moves forward as a continuous web beneath the ends of the traversing run-out chutes to receive the fibers and thence, to a needling machine 36 carrying the layers of fibers deposited thereon with it. After leaving the needling machine, the needled web of fibers with the cheesecloth incorporated therein passes into another J-box 37 and then to a pair of heated rolls 38 and 39 which contact with the exterior surfaces of the needled web or bat.

In order to fuse fibers of polypropylene having a melting point of between 310° to 320° F., the surface fibers should be heated briefly to a temperature between 325° and 350° F. by contact with the rolls. When heated in this manner, the fibers in the center or interior of the web do not reach their melting temperature and will remain unbonded or unfused. When the fused fibers on the exterior surfaces of the web have been permitted to cool, the backing fabric may be then wound into a roll 40.

The web may be run through a disc cutter to cut it to the desired width either before or after the surface treatment. Also, a suitable binder or solvent, such as an acrylic resin or a water resistant cure type latex may be sprayed on the surfaces of the web in liquid form and then dried to bind the surface fibers together in place of fusing them by heat.

The various pieces of apparatus mentioned above are conventional and hence need not be described in detail here.

It will be understood that various changes and modifications may be made by those skilled in the art in the particular embodiments of the tufted pile fabric and the method of producing the same which have been described above for illustrative purposes without departing from the scope of the invention as defined by the following claims.

We claim:

1. In a method of producing tufted carpet, the steps comprising:
 - (a) depositing fibers on a web of textile threads;
 - (b) then needling the fibers while supported on the web of textile threads into a cohesive sheet-like web;
 - (c) bonding the fibers at at least one surface of the sheet-like web to each other and to the textile threads at said surface while leaving the fiber portions in the interior of the web in an unbonded state; and
 - (d) then forming pile elements on the sheet-like web by tufting.
2. A method of producing tufted carpet as defined in claim 1 wherein:
 - (a) a majority of the fibers deposited on the textile threads are polypropylene fibers; and
 - (b) the polypropylene fibers which are bonded together as described in claim 1 are so bonded by heating those portions of said fibers at the one surface to a temperature above their melting point without similarly heating the remaining portions of the fibers in the interior of the web.
3. In a method of producing a backing fabric for tufted carpet, the steps which comprise:
 - (a) depositing one or more layers of fibers on a web of cheesecloth having warp filling threads;
 - (b) then needling the fibers throughout said layer into intimately intermixed relation relative to each other and into engagement with the threads of the cheesecloth;
 - (c) and then bonding fibers on at least one exterior surface of the needled material to each other and to the threads of the cheesecloth while leaving the fiber portions in the interior of the web in an unbonded state.
4. In a method of producing a backing fabric for tufted carpet, the steps as defined in claim 3 wherein:
 - (a) more than eighty percent (80%) of the fibers are of polypropylene; and

- (b) the polypropylene fibers are bonded together and to the cheesecloth threads by fusing those portions of said fibers at the one exterior surface without fusing the remaining portions of the fibers in the interior of the web.
5. In a method of producing a non-woven fabric, the steps which comprise:
- (a) depositing one or more layers of fibers on a supporting member;
 - (b) then needling the fibers throughout said layer into intimately intermixed relation relative to each other and into engagement with said member; and
 - (c) then bonding said fibers at at least one exterior surface of the needled layer to each other, while leaving the fiber portions in the interior of said layer in an unbonded state.
6. In a method of making a nonwoven fabric, the steps as defined in claim 5 wherein:
- (a) said fibers are synthetic and of thermoplastic material and the bonding is accomplished by heating.
7. In a method of producing a nonwoven fabric, the steps which comprise:
- (a) depositing a layer of fibers on a thin, sheet-like, flexible supporting member;
 - (b) then needling the fibers throughout said layer into intimately intermixed relation relative to each other, and into engagement with said member; and
 - (c) then bonding the fibers on at least one exterior surface of the needled layer into engagement with each other and with said member while at the same time leaving the fibers on the interior of said layer unbonded.
8. In a method of making a nonwoven fabric, the steps which comprise:
- (a) depositing a layer of fibers, most of which are of synthetic thermoplastic material, on a sheet-like, flexible supporting member;
 - (b) needling said layer throughout its thickness at a multiplicity of closely spaced points extending over its surface area and thereby displacing vertically relative to the thickness of the layer at said points of needling portions of fibers from different levels of the layer; and
 - (c) heat bonding surface fibers and the supporting member together without bonding the interior fibers of said layer.
9. In a method of making a nonwoven fabric, the steps as defined in claim 6 wherein:
- (a) said supporting member is a flexible moving sheet through which some of the needles and fibers are carried during said needling operation.
10. A method of producing a nonwoven fabric comprising the steps of:
- (a) distributing a layer of fibers on a thin, flexible, sheet-like carrier;
 - (b) needling the layer of fibers and thereby entangling said fibers and forcing portions of said fibers through the carrier, thereby forming a needled web characterized by the presence of fibers at both web surfaces;
 - (c) bonding adjacent fiber portions at at least one surface of the web to each other while leaving those portions of the fibers adjacent the center of the web unbonded.
11. The method of claim 10 comprising bonding adjacent fiber portions at both surfaces of the web to each other while leaving those portions of the fibers adjacent the center of the web unbonded.

12. The method of claim 11 wherein the fibers are thermoplastic and the bonding is accomplished by heating the fiber portions to be bonded to their melting point, and thus fusing them, while maintaining the fiber portions adjacent the center of the web below their melting point.
13. The method of claim 10 wherein the fibers are thermoplastic and the bonding is accomplished by heating the fiber portions to be bonded to their melting point, and thus fusing them, while maintaining the fiber portions adjacent the center of the web below their melting point.
14. The method of claim 13 wherein the heating is accomplished by passing the web through the nip of a pair of rolls, one of said rolls being heated to a temperature above the melting point of the fibers.
15. The method of claim 13 wherein the heated and fused fibers are those which have been forced by needling through the carrier.
16. A method of making a tufted carpet comprising:
- (a) depositing a layer of randomly oriented thermoplastic fibers on a thin, flexible, sheet-like carrier;
 - (b) forming a web by needling the fiber layer and thereby forcing portions of fibers from all parts of the layer down through the layer and through the carrier;
 - (c) fusing by heat portions of the fibers which have been forced through the carrier to each other while leaving those portions of the fibers which are located in the center of the web unfused;
 - (d) tufting the web with pile yarns.
17. The method of claim 16 comprising the step of applying an adhesive back coating to the rear face of the tufted fabric and thereby anchoring the yarn in place.
18. The method of claim 12 wherein the heating is accomplished by passing the web through the nip of a pair of rolls, both of which are heated above the melting point of the fibers.
19. A method of forming a nonwoven fabric comprising the steps of:
- (a) depositing a layer of randomly oriented thermoplastic fibers on a thin, flexible, sheet-like carrier;
 - (b) forming a web by needling the fiber layer and thereby forcing portions of fibers from all parts of the layer down through the layer and through the carrier;
 - (c) fusing by heat portions of the fibers which have been forced through the carrier to each other while leaving those portions of the fibers which are located in the center of the web unfused.
20. The method of claim 15 wherein the fused fibers are heated and compressed against the carrier while in a melted state and are thereby fused to the carrier.

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