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W. S. LIBBEY
METHOD OF COATING AND TREATING A PILE FABRIC
TO SET THE FIBERS IN THE UPSTANDING POSITION
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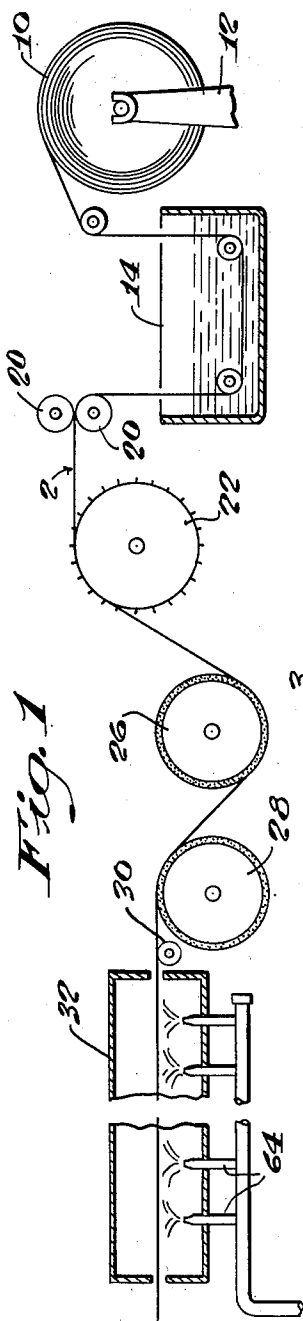


Fig. 1

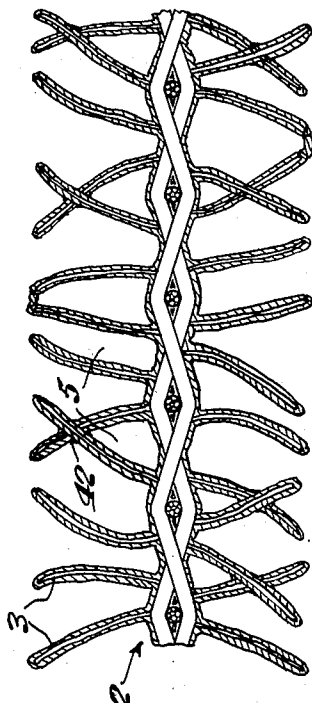


Fig. 3

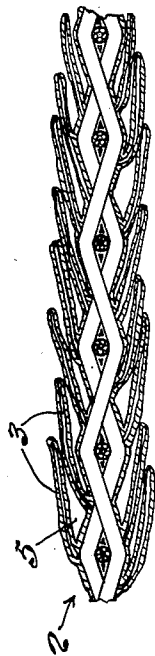


Fig. 2

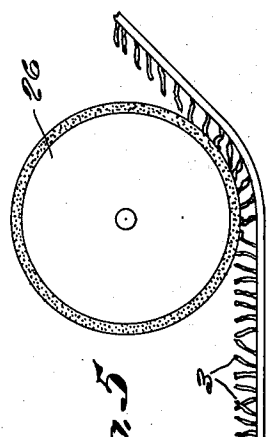


Fig. 5

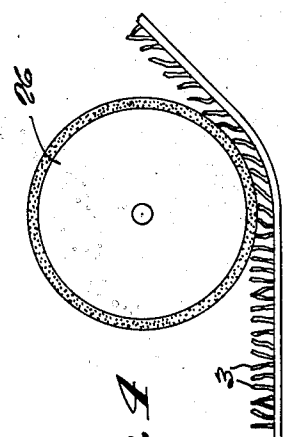


Fig. 4

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METHOD OF COATING AND TREATING A
PILE FABRIC TO SET THE FIBERS IN THE
UPSTANDING POSITIONWinfield Scott Libbey, Lewiston, Maine, assignor
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2 Claims. (Cl. 117—62)

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This invention relates to a resilient low density textile fabric and to a method of producing the same.

One object of the invention is to provide a novel method of producing a resilient low density textile fabric of a type wherein a fabric base having upstanding fibers is treated to individually coat a major portion of the fibers with a fluid coating of a resilient nature, and the coated fibers are then treated to permanently set the coating thereon while the fibers are upstanding. Such a fabric is illustrated in my United States Patent No. 1,922,444.

A further object of the invention is to provide novel apparatus for producing an improved resilient low density textile fabric of the type set forth in my said Patent No. 1,922,444 and which is capable of producing the improved fabric in an efficient, economical, and practical manner.

With these objects in view, and such others as may hereinafter appear, the invention consists in the method of making the low density and resilient fabric and the apparatus for producing the same, together with the structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawing illustrating the preferred embodiments of the invention, Fig. 1 is a diagrammatic view of apparatus for coating or impregnating a fabric of the type referred to with a resilient material and then raising the fibers to an upstanding position of controlled angularity with respect to the base of the fabric and then permanently setting the fibers in their upstanding positions; Fig. 2 is a vertical section illustrating the textile fabric after it has been passed through the coating bath and prior to having its fibers raised to their upstanding positions; Fig. 3 is a view similar to Fig. 2 illustrating the present product produced by the present process and apparatus, with the majority of the fibers in an upstanding position of increased and controlled angularity with respect to the base; and Figs. 4 and 5 are similar details in section illustrating the operation of the adhesive surfaced roll in causing the fibers to assume positions of increased and controlled angularity in the operation of the present process.

The general type of fabric which may be used in the production of the present resilient low density fabric comprises any of those fabrics having fibers which are capable of being raised to an upstanding position. Among such fabrics may be mentioned the napped fabrics, blanket fabrics, pile fabrics, raised goods, teaseled goods, needle felts, and the like. The major portion of the

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upstandable fibers of such textile fabrics are in accordance with the present invention individually coated with a resilient fluid coating material capable of being subsequently treated to become permanently set and at the same time to possess the desired resilience. As set forth in my patent above referred to, preferably the fabric base is first dipped into the solution of a desired coating composition which may comprise a rubber coating composition and the excess solution is squeezed out, and the product may be dried in thirty minutes at 140° F. and then vulcanized for one hour at 260° F. in hot air. In the process, as it has been practiced in accordance with the disclosure of my said patent the excess of coating composition was removed by passing the fabric after it had been coated through closely set gauge or squeeze rolls, and with ordinary blanket material these rolls would ordinarily be set within .020 of an inch. After passing through the rolls during the evaporation of the solvent in the coating composition, reliance was placed upon the ability of the fibers themselves because of their inherent resiliency to spring back more or less to an upstanding position and in separated relation so that when the coated fibers were subsequently vulcanized, the fabric possessed resiliency and a large number of air spaces through and between the upstanding fibers. On the other hand, because of the fact that the process relied upon the inherent resiliency in the coated fibers themselves to effect their return to an upstanding position, experience has shown that sometimes many of the fibers did not return to an upstanding position to the extent desired; that no accurate control was possible of the amount of angularity with respect to the base at which a majority of the fibers of any particular fabric became permanently set, because of variations in the resiliency and ability to spring back of individual coated fibers; that in many instances the variations in the angularity of the upstanding fibers detracted somewhat from the uniformity of the completed product, and that the completed vulcanized product did not possess the degree of resiliency desired for some commercial purposes.

In accordance with the present invention, provision is made for subjecting the coated fibers to treatment to exert upon the fibers a positive lifting action so that when the coating is subsequently set, the fibers may be caused to assume upstanding positions of a substantially predetermined angularity, thereby enabling the characteristics of the completed fabric to be more accurately controlled. In the preferred apparatus an adhesive roll or a roll having an adhesive

surface is utilized in order to accomplish this result, and in practice after the fabric has been passed through the coating bath or the fabric has been otherwise coated, and the excess coating removed by the squeeze rolls, it is conducted over the surface of this adhesive surface roll, and as it leaves the roll the adhesive surface of the roll adheres to the fibers and causes them to rise to a substantially uniform angular position with respect to the base of the fiber. The degree of angularity may be controlled by the speed of the adhesive roll and by the character of the adhesive surface. If desired, the angularity may be increased substantially as compared with comparable fabrics produced by my prior process. The fabric in this condition is then passed through a drier and provision is preferably made in the drier for mainly supporting the fabric on an air cushion so that the fabric may be for the most part retained out of contact with mechanical supports. In the preferred apparatus currents of hot air may be directed from below the fabric as it is being passed through the drier, and this serves to exert a pneumatic lifting effect on the fabric to minimize contact thereof with mechanical supports until the coating composition has become sufficiently set so that during further handling the fibers remain in the positions of angularity to which they have been raised by the operation of the adhesive roll.

The present invention contemplates the coating of the fibers upon one or both sides of the fabric, and that the fibers upstanding from either one or both sides be permanently set in their positions of controlled angularity.

Referring now to the drawing, which as stated illustrates more or less diagrammatically the preferred apparatus for practicing the present process, the fabric is supplied in the form of a roll 10 mounted upon a suitable support 12 and from which it may be fed into a coating bath 14 to have the fibers thereof individually coated. The fabric itself, as above stated, may comprise a textile fabric having fibrous components designated generally by the reference character 2 and characterized by a substantial amount of fibers more or less upstanding from one or both surfaces of the fabric base, and such a fabric may comprise a napped fabric, blanket fabric, pile fabric, raised goods, teaseled goods, needle felts, and the like, and by the term "upstanding" it is intended to include fibers which stand vertically in relation to the surfaces of the base and also at various angles relative thereto.

During passage of the fabric through the coating bath, the majority of the upstanding individual fibers are provided with individual coatings of vulcanized rubber, rubber compound or equivalent resilient coating composition, as will be hereinafter described. The individual coatings conform to the individual fibers so that a general fibrous appearance and the fibrous characteristics of the original fabric are present in the ultimate coated product. The individual coatings for the fibers reinforce the same and materially increase their resiliency and their ability to recover their upstanding positions after having been flexed under compression. Because of the fact that the rubber or equivalent coating conforms to the individual fibers, the product is provided with a large number of air spaces or voids distributed among the coated fibers. These air spaces or voids may be of varying size and cooperate with the individual rubber or equivalent

coated fibers to enable their flexibility and resiliency to be availed of in giving to the complete fabric the desired characteristic quick recovery when subjected to compression. In Fig. 3 I have illustrated diagrammatically the present coated fabric showing the individual coated fibers 3 and the air spaces 5, and by reference thereto it will be apparent that the air spaces comprise a very essential part of the structure of the present coated product. As further illustrated in Fig. 3 it will be observed that a substantial number of adjacent fibers when coated with the present resilient coating composition will bind together by reason of their cross relation to one another, and the bonded fibers form an effective truss, the supporting members of which are resilient, thus adding to the resiliency of the complete product and assisting in imparting the desired quick recovery to the product when the latter is compressed and the compression is removed.

Referring now to Fig. 2, which shows a textile fabric of the type above referred to and which is used to produce the present coated product, in such a textile fabric the fibers occur in various degrees of angularity with respect to the base, and such fibers will when passed through the coating bath, such as the rubber coating solution referred to in my said Patent No. 1,922,444, be more or less flattened down against the base or body portion of the fabric in a position more or less as illustrated in Fig. 2. This is particularly true because of the excess of the coating material which remains on the fabric as the fabric leaves the coating bath. In accordance with the commercial process as heretofore practiced, and as illustrated in my said patent, the excess of the coating material was removed by passing the fabric through the squeeze rolls with the result that when the excess of coating was squeezed out, the inherent resiliency of the coated fibers was sufficient to raise them to various and random degrees of angularity, and in many instances such inherent resiliency was not sufficient to raise them to positions of controlled or substantially uniform angularity, and frequently not to those of maximum angularity.

Referring now to Fig. 1, after the fabric has been removed from the coating bath it is passed between the feed rolls 20 and then conducted over a pin roll 22 by which movement of the fabric is assisted through the remaining portion of the machine, and thence conducted to a vulcanization chamber (not shown). The excess of coating material is removed from the fabric as it leaves the bath by squeeze rolls 20. From the pin roll 22 the fabric passes around an adhesive roll 26 and then preferably around a second adhesive roll 28. Such adhesive rolls may each comprise a roll provided with a permanently adhesive rubber or other plastic adhesive surface. In practice, I have found that by using a roll of any suitable material the surface thereof will accumulate a sufficiently tacky layer of the coating from the fabric passing thereover to perform satisfactorily the above-described function of an adhesive roll. By reference to Fig. 1 it will be observed that the adhesive rolls are spaced a substantial distance from the coating bath permitting opportunity for the solvent to evaporate somewhat from the coating on the fabric and so that the coating transferred from the fabric to the adhesive roll is substantially more tacky and adhesive than the fresh coating as it exists in the coating bath or the freshly supplied film of coating on each squeeze roll. Experience has shown,

for example, that the coating on the squeeze rolls possesses little, if any, tackiness.

The surface of the adhesive roll is made sufficiently adhesive by any suitable means so that as the fabric leaves the roll the tips of the individual fibers are caused to adhere to the sticky surface of the roll, and in this manner caused to be raised substantially uniformly to a position of substantial angularity with respect to the base of the fabric. The degree of angularity may be thus increased over the angularity produced under comparable conditions by the prior process, and may be controlled by proper speed, size, and operation of the adhesive roll or rolls. After the fabric with its fibers in such a position of controlled angularity has left the adhesive rolls, the fabric is then conducted over an idler roll 30 and through a drier indicated generally at 32. This drier may comprise any usual or preferred form of drier, and in practice may comprise a chamber or tunnel of sufficient length so that when the fabric emerges from the drier the individual coated fibers will be semi-permanently set in their positions of controlled angularity, such positions being illustrated more or less diagrammatically in Fig. 3.

In practice, the progress of the fabric through the machine may be accomplished by the feeding effect of the pin roll and also by draw rolls at the end of the machine. The adhesive roll itself may or may not be driven, depending upon the length of the machine and the amount of tension required to effect satisfactory movement of the fabric through the machine, and the degree of fiber angularity desired in the finished product.

Depending upon the direction of extension of the nap or of the upstanding fibers of the original fabric, the effect of the adhesive roll will follow more or less either of the forms shown in Figs. 4 and 5. If the nap and the fibers extend in a general rearward direction with respect to the travel of the fabric around the roll, then the operation will be more or less as illustrated in Fig. 4 wherein as the fibers leave the roll the tips of the fibers adhere to the sticky surface of the roll and are positively elevated from their rearwardly extending position to a position of substantially uniform angularity with respect to the base of the fiber. On the other hand, if the direction of the extension of the nap of the fabric is as is illustrated in Fig. 5 wherein the fibers extend forwardly with respect to the direction of travel of the web, then the action of the adhesive roll in elevating the fibers will be as illustrated in Fig. 5, and in that instance the forwardly extending fibers will be retarded by the adhesive roll and positively caused to assume their upstanding position, and in either instance after leaving the adhesive roll a majority of the individual fibers will be maintained in positions of controlled and substantially uniform angularity. The fabric then proceeds over the idler roll 30 and enters the drier 32 where it is subjected to streams of air. These air streams may be directed from nozzles 64 at suitable locations in the drier such as to exert a lifting effect on the portion of the fabric within the drier to minimize any surface contact which would have a tendency to lay or flatten the upstanding fibers. In practice it has been found that such a drier can successfully support the fabric in the desired manner for approximately 98% of its travel through the drier, and by the time the material has reached the end of the drier the upstanding fibers are semi-

permanently set in an upstanding position. As a result of this procedure a maximum of upstanding fibers in both number and degree of angularity and the production of a maximum number of air spaces between the fibers is insured so that the final product possesses greater resiliency than products of this nature which have been heretofore produced by any of the processes of the prior art.

In accordance with the preferred process utilizing vulcanizable rubber compositions as set forth in my patent above referred to, I have found it possible to dry the fabric within the drier for a period of not exceeding seven minutes at 220° F., with the result that the rubber composition becomes sufficiently solid and semi-permanently set as to enable the fabric to be passed to a vulcanizing chamber and subjected to vulcanization at 305° F. for a period of approximately sixteen minutes, and in this respect the times for drying and vulcanization and the temperatures thereof vary somewhat from those recommended in my said patent above referred to, but have been found to be satisfactory for commercial operation.

The process set forth in my patent recommended the passing of the fabric between the squeeze or gauge rolls when removing the excess of coating composition in such direction that the squeeze rolls either acted with the nap or against the nap of the fabric. When acting with the nap of the fabric a thinner and less porous product was produced, whereas when the fabric was passed so that the rolls acted against the nap a much thicker and much more porous product was produced. In the present process, however, it is of less importance, as above set forth and as illustrated in Figs. 4 and 5, as to which direction the fabric is passed through the machine inasmuch as the present adhesive rolls function to positively raise the individual coated fibers, after the excess of the coating material has been squeezed out, to their positions of the desired degree of angularity. It has been found that increased fiber angularity of substantial amounts may be obtained with my present improved process, and substantially thicker, more porous fabric may be produced.

Another effect which my present improved process may produce is an increase in the fibrous characteristics of the surface of the final product. I attribute this to the positive action of the adhesive roll in elevating the coated fibers in a positive and uniform manner. This appears to cause the ends of the coated fibers to project substantially above the cross ties indicated at 42 in Fig. 3. In other words, the present process may be operated to produce a coated fabric wherein the surface is provided with a large number of individual free ends of coated fibers imparting a superior fibrous character to the surface.

The present method contemplates the use of any of the fabrics referred to in my patent, and in practice I prefer to utilize a rubber coating composition which may include the following formula:

	Parts
Rubber -----	100
70 Sulphur -----	3¾
Accelerator -----	1½
Anti-oxident -----	1
Whiting -----	65
Zinc oxide -----	5
75 Stearic acid -----	1

Two pounds of this composition may be dissolved in one gallon of naphtha, 72 degrees naphtha with a low end point being satisfactory.

Instead of the rubber composition referred to or any other equivalent composition embodying rubber or synthetic rubber as its base, other thermoplastic or thermosetting resinous compositions may be used, of such character that the coatings produced upon the individual fibers are resilient in nature. For example, I may prefer to utilize any of the following formulations:

	Pounds
1. Styrene	80
Dibutyl phthalate	10
Whiting	45
Toluol	60
2. Ethyl cellulose	20
Castor oil	16
Blanc fixe	19
Aromatic naphtha	36
Ethyl alcohol	14
Lactol spirits	21
3. Cellulose acetate butyrate	80
Dibutyl phthalate	40
Acetone	400
4. Polyvinyl acetate	16
Isopropyl alcohol	64
Water	40
5. Phenolic resin	56
Sodium hydroxide	1
Water	6½
Hycar latex (stable suspension of butadiene acrylonitrile)	6
6. Polyvinyl chloride latex	100
Diocetyl phthalate	20
Sodium carboxy methyl cellulose	5½
Dibutyl phthalate	20

By varying the amount and the nature of the above compounds used in coating the fabric the characteristics of the treated fabric may be modified for the purpose for which the product is intended to be used and also the degree of resiliency may be increased or decreased according to the resiliency of the resulting coating composition. In practice these coating compositions remain fluid until they are subjected to heat in the drier to render them semi-permanently set.

While the proposed embodiment of this invention has been illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In a method of making a resilient and porous

fibrous fabric sheet having upstanding pile fibers, the steps of; coating said fabric and said fibers with a liquid rubber coating composition, allowing said coating on said fabric and fibers to partially dry to a tacky state, engaging the tip portions of said fibers with the outer continuous and tacky surface of a rotatable cylindrical roll, simultaneously rotating said roll and moving said fabric therepast so that said fibers in contact with said tacky surface move in the same direction as said surface then tangentially away therefrom to pull said fibers to substantially upstanding position relative to said fabric and to then separate said tacky surface from said fibers leaving the latter in said substantially upstanding position, thereafter passing said coated fabric and upstanding fibers through a drying zone while supporting said fabric on an air cushion in said zone.

2. In a method of making a resilient and porous fibrous fabric sheet having upstanding pile fibers, the steps of; coating said fabric and said fibers with a liquid rubber coating composition, allowing said coating on said fabric and fibers to partially dry to a tacky state, engaging the tip portions of said fibers with the outer continuous and tacky surface of a rotatable cylindrical roll, simultaneously rotating said roll and moving said fabric therepast so that said fibers in contact with said tacky surface move in the same direction as said surface then tangentially away therefrom to pull said fibers to substantially upstanding position relative to said fabric and to then separate said tacky surface from said fibers leaving the latter in said substantially upstanding position, thereafter passing said coated fabric and upstanding fibers through a drying zone while supporting said fabric on an air cushion in said zone, then vulcanizing said dried coating on said fabric and upstanding fibers.

WINFIELD SCOTT LIBBEY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,353,599	Lovell	Sept. 21, 1920
1,922,444	Libbey	Aug. 15, 1933
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