May 28, 1963 P. C. WETTERAU 3,091,017

RESILIENT FABRICS

Original Filed Nov. 25, 1957 2 Sheets-Sheet 1

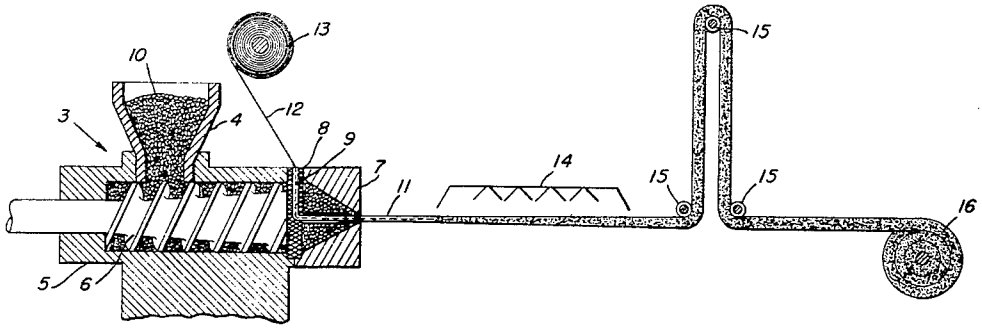


FIG. 1

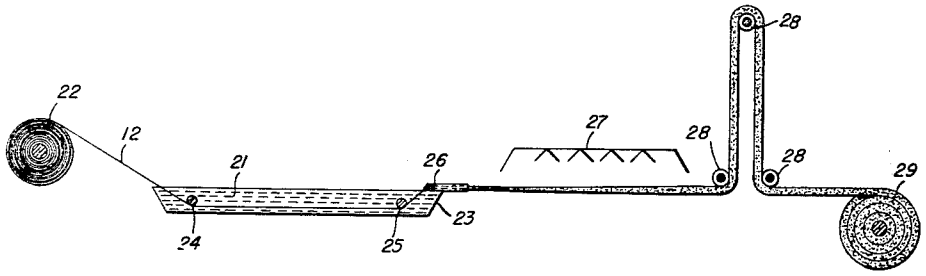


FIG. 2

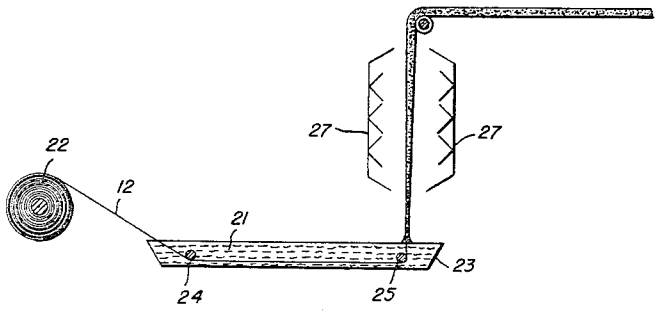


FIG. 3

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RESILIENT FABRICS

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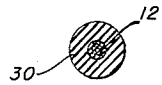


FIG. 4

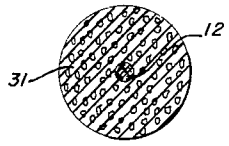


FIG. 5

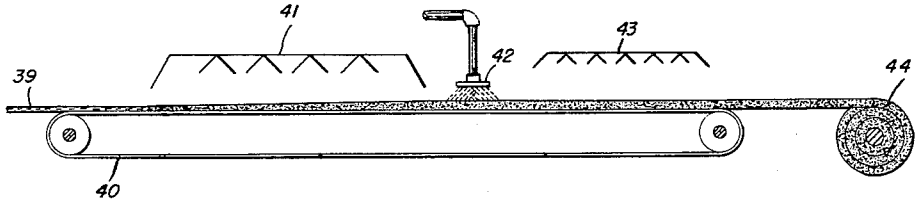


FIG. 6

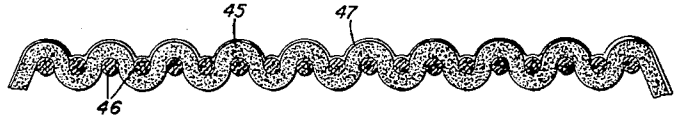
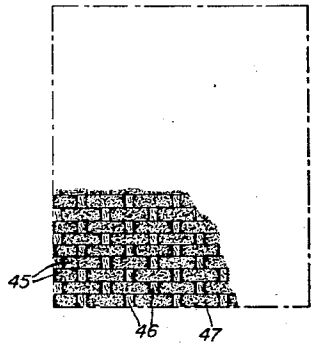


FIG. 7

FIG. 8



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3,091,017

RESILIENT FABRICS

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Original application Nov. 25, 1957, Ser. No. 698,477. Divided and this application Jan. 12, 1960, Ser. No. 2,078

9 Claims. (Cl. 28—75)

This invention relates to textile fabrics containing plastic fibers and to methods for their preparation and particularly to such fabrics having resilient characteristics.

This application is a division of co-pending application Ser. No. 698,477, filed November 25, 1957, entitled "Resilient Fabrics."

The desirability of using resilient materials for upholstery fabrics, floor and wall coverings and the like is well known. Such fabrics are usually produced by applying a resilient coating of rubber or the like to the back of the fabric. In some instances a solid or tubular rubber strand is woven into the fabric. The use of such rubber strands has found wide application in textile material in which extensibility or elastic qualities are desired, such as in bathing suits, under garments and similar articles. The primary disadvantages in using rubber strands are the increased weight of the product and the low tensile strength of the strands. In addition, because of the impervious nature and appearance of rubber, for certain application, it has been necessary to cover the rubber strands with a woven jacket of cotton, rayon or the like. It has been suggested to use such rubber strands in floor coverings. The amount of resilience that has been obtained in this application, however, is substantially less than that obtained with the conventional fiber or rubber impregnated fiber underpadding. It has also been suggested to coat the back of carpets with a foamed rubber compound as a substitute for the conventional underpadding. Such backings have found a great deal of success in floor coverings for automobiles and the like because of the ease of installation, but limited success in the home market because of the relatively high price and also the difficulty in cleaning since dirt accumulates in the woven material on top of the layer of foam where it cannot be easily reached by the conventional cleaning methods.

An object of the invention is to provide a resilient textile fabric which is free from the disadvantages set forth above. Another object of the invention is to produce a fabric having resilient characteristics which remains porous. Another object of the invention is to provide a resilient textile fabric which has an inherent gripping action to any surface which it covers. A further object of the invention is to provide a textile material which has softness and a high cushioning effect. A still further object of the invention is to provide a textile material which is highly resilient so that impressions formed in the material disappear after the pressure causing the depression has ceased. A still further object of the invention is to provide a textile material which may be cut to size and does not fray at its edges so that the customary stage of binding the edges with tape or the like may be dispensed with. A still further object of the invention is to produce a rug or carpet which will dispense with the necessity of using an underpadding thereby simplifying installation. Still further objects of the invention are to provide a textile material which is light in weight, has soundproofing characteristics and highly resistant to wear thereby giving a long service life. Other objects of the invention are to provide a resilient textile fabric which is dimensionally stable and highly resistant to deterioration in normal use.

These and other objects of the invention are accomplished by producing a resilient fabric incorporating a composite strand having high tensile strength and limited extensibility comprising a fiber core uniformly surrounded by a smooth foamed plastic composition. The composite strand can be used to make up the entire fabric or it can be woven or otherwise combined with conventional fibers to form a combination fabric. The amount of composite strands incorporated in any fabric will depend on the resiliency desired. The results obtained by incorporating this composite strand in a fabric are two fold in that it not only produces a resilient fabric but also a fabric having a high degree of tensile strength. Heretofore, it has not been possible to commercially weave a foamed plastic strand into a fabric because the strand did not have sufficient tensile strength to withstand the stresses of weaving and processing. The strand would also stretch thereby making it difficult to weave into a fabric with any degree of uniformity. These failings are overcome by placing the foam on a fiber core which gives the composite strand the necessary tensile strength to undergo processing and also limits its extensibility.

In accordance with one embodiment of the invention, the foamed plastic covering for the fiber core is formed of a thermoplastic material. The use of a thermoplastic material makes possible the locking of the composite strands into the fabric after weaving by heating the thermoplastic material to its softening point thereby uniting each adjacent fiber at its intersection. This procedure yields a product which has greatly increased utility since it can readily be cut without unraveling.

Other objects, features and advantages of the invention will be better understood from the following detailed description when it is read in conjunction with several figures of the drawing in which:

FIG. 1 is a side elevation partly in section showing apparatus for producing the composite strand.

FIG. 2 is a side elevation of a second method for producing the composite strand.

FIG. 3 is a side elevation of a third method for producing the composite strand.

FIG. 4 is an enlarged cross sectional view of the composite strand before foaming the plastic coating.

FIG. 5 is an enlarged cross sectional view of the strand shown in FIG. 4 after foaming the plastic coating.

FIG. 6 is a side elevation showing apparatus for foaming or heat treating and coating the composite strand when woven into a fabric.

FIG. 7 is an enlarged cross section of the fabric produced in accordance with the invention.

FIG. 8 is a plan view of the fabric shown in FIG. 7.

The composite strand used in the invention can be prepared in a number of ways. A particularly desirable method is by extruding a plastic composition containing a blowing agent around the fiber core and then subsequently subjecting the plastic coating to heat to cause the blowing agents to expand and give foam-like characteristics to the coating. A typical extruder for carrying out this process is shown in FIG. 1. The extruder generally indicated at 3 comprises a feed hopper 4, a hollow chamber 5, a screw 6 having a continuous helical projection which fills the hollow chamber, an extrusion head 7 at the end of the hollow chamber and a screen 8 located between the hollow chamber and the extrusion head. The granules or plastisol of plastic composition 10 containing the blowing agent is fed from the hopper 4 into the hollow chamber 5. The extruder is heated by suitable means (not shown) to bring the plastic composition granules within the extruder to a temperature where they become softened, extrudable and fused. The com-

position is then compressed and forced out of the extrusion head by the rotating of the screw.

The fiber core **12** is supplied from a spool and fed into the extruder through a tube **9** to the center of the extrusion head **7**. The fiber core **12** passes out of the extruder in the center of the plastic material, forced out of the extrusion head by the action of the helical screw. The strand **11**, thus formed, is heated by suitable means such as infra red heat lamps **14** to a temperature which causes the blowing agent contained in the plastic composition to decompose and give off gas thereby creating gas pockets throughout the plastic composition. The composite strand is then cooled by suitable means such as by passing over cooling rolls **15** and wound on a collection spool **16**. In a like manner, the foaming of the plastic composition can be simultaneous with the extrusion of the composition so that the composition foams immediately upon leaving the extrusion nozzle. This procedure has the advantage in eliminating the additional heating step. The composite strand can then be supplied to any conventional weaving apparatus to weave the strand into a fabric having high tensile strength and dimensional stability while possessing a high degree of resiliency.

The fiber core can also be coated with the plastic composition, as illustrated in FIGS. 2 and 3, by passing the fiber through a coating bath **21** containing the plastic composition in a liquid form. The plastic coating composition can be either liquid prefoamed plastic composition or liquid plastic composition containing a blowing agent. This method of coating is particularly suitable for coating a prefoamed composition. The fiber core **12** is supplied from a spool **22** and passed into a tank **23** containing liquid plastic composition **21**. The core passes under guides **24** and **25** which hold the core **12** beneath the level of the liquid plastic composition. The plastic composition is of such consistency that a limited amount will cling to and coat the strand as the strand passes through the tank. The excess coating carried by the fiber core out of the tank **23** can be conveniently stripped off by passing the coated fiber through a hollow tube **26** having an inside diameter corresponding to the desired thickness of the coating. The excess coating can also be removed by drawing the coated fiber vertically from the plastic composition **21**, as illustrated in FIG. 3 which allows the action of gravity to limit the thickness of the coating. The coated fiber core is then passed through a heating chamber **27** which causes the blowing agent contained in the composition to decompose thereby foaming the composition and fusing the plastic composition. If the plastic coating composition is prefoamed, then, the heating step is used to fuse or cure the plastic composition. The composite fiber is then passed over cooling rolls **28** and collected on a collecting device **29**. As can be seen by reference to FIGS. 4 and 5, the plastic coating **30** on the fiber core prior to blowing is a compact mass and after blowing the coating **31** is over three times larger in diameter and contains uniformly dispersed air cells throughout the composition coating.

The fiber which makes up the core of the composite thread is used to overcome the weak tensile strength of the foam alone. It can be formed of any of the conventional textile materials such as cotton, wood, hemp, flax, artificial fibers such as viscose, cellulose acetate, nylon, Orlon, Dacron, dynel, Velon and the like as well as animal fibers such as horse hair, pig hair or mineral fibers such as glass and the like. The particular fiber selected, however, will depend in great part on the processing condition to which it must be subjected. If a plastic composition is selected which has to be subjected to high temperature, it would not be possible to use fiber such as cellulose acetate and Velon which deteriorate under high heat. It is essential, therefore, for the fiber to have sufficient strength to stand up during processing and weaving. As a general rule, a tensile strength of at least 4 pounds is considered minimum, although with certain weaving operations, it is possible to use a core of lower tensile strength. A tensile strength of at least 8 pounds is preferred. The diameter of the fiber core will depend on the particular fiber but usually is of the order of from about 0.010 to 0.030 inch.

It is important to distinguish the fiber core used in accordance with this invention to form the composite strand with the fibers that have been used heretofore for rubber thread wherein, after the rubber coating is applied to the thread core, the thread is subjected to either mechanical or chemical treatment to either destroy it completely or break it into short discontinuous lengths. This type of product has inferior tensile strength and undesirable extensibility to that which is required to be woven into textile fabrics of the invention.

The foamed plastic composition can be any plastic material which can be either extruded or applied as a coating and which can be foamed by the use of blowing agents or mechanical action. As stated above, it is preferred to use a material which is thermoplastic since it enables an after heat treatment of the textile fabric to lock the strands in place. Such plastic composition can be prepared by forming a plastisol by dispersing a thermoplastic resin in the form of fine particles in a compatible plasticizer. Such plastisols can be blended with blowing agents which decompose when heated to their decomposition temperature to liberate a large volume of gas. Organic compounds containing the >N—N< or —N=N— linkages which decompose to liberate nitrogen are particularly useful as blowing agents in foaming a thermoplastic resinous plastisol composition. Alternately, a plastisol can have air incorporated in the mass by mechanical means and the whipped mass coated on the fiber core. In either method, the coating must be heated to a sufficiently high temperature to fuse the thermoplastic composition during processing.

Any thermoplastic resin which can be dispersed in a liquid medium can be used in the preparation of the plastic composition. Suitable plastic compositions include polymers or copolymers of vinyl chloride, vinyl acetate, vinylidene chloride, ethylene chloride, acrylic acid, methyl acrylate, methyl ethyl acrylate, ethyl acrylate and the like. Vinyl chloride polymers containing at least 60 percent vinyl chloride are particularly effective. The vinyl chloride polymer should preferably have a specific viscosity of between 0.17 and 0.31 as measured in a solution of 0.20 grams polymer in 100 milliliters of nitrobenzene at 20° C. The polyurethanes, which are thermosetting resins, are a class of composition which can be readily foamed and used in the invention. A polyurethane is produced by reacting a polyisocyanate with a reactant containing two or more active hydrogen atoms such as glycol and polyester and the like. In the preparation of polyurethanes, a solution of polyisocyanate is mixed with a solution of the active hydrogen containing molecules in the presence of a small amount of water immediately prior to the coating step. The solutions are mixed, the polymerization reaction starts and the water reacts to liberate carbon dioxide which expands the coating into a foam. Subsequently, the coating is subjected to heat in order to cure and cross link the polyurethane to produce a foam structure with the desired properties of strength and flexibility.

In certain instances, a rubber latex can be used as the foamable plastic composition. Generally rubber is undesirable for most applications, but when the fabric incorporating the composite strand is going to have a decorative covering or the like and the composite strand is not visible rubber is suitable. The formulation of a rubber latex is well known in the art. The rubber is in the form of finely divided particles dispersed in water in the presence of emulsifiers, vulcanizing and aging ingredients,

pigments and fillers. The rubber can be either natural rubber or any of the large groups of materials classified as synthetic rubber, such as butadiene-styrene copolymers, polymerized chloroprene and the like. A conventional rubber latex can be foamed by whipping a substantial volume of air into the latex to form a multiplicity of minute air bubbles uniformly distributed throughout the mass. It is conventional to add to the foam, when the foaming operation is complete, gelling or setting agents such as sodium silicofluoride so that the foam will not collapse prior to vulcanization. The rubber composition must be vulcanized to set the foam and this operation is usually carried out by heating in the range of about 200° F. to about 275° F.

The density of the foam layer applied to the fiber core or blown on the core varies in accordance with the particular plastic composition used. A low foam density is desirable from a cost standpoint since less plastic composition is used per yard of fiber core but low density foam can be undesirable from the standpoint of weakness with the resulting tendency to be permanently deformed by heavy loads. A foam with high density, although not subject to permanent indent, is costly and has poor resilience. In general, a range of 6 to 30 pounds per cubic foot gives satisfactory foam properties with a range of 10 to 25 being particularly desirable. Foam rubber compositions have the advantage that they can be highly filled (up to 100 parts filler per 100 parts rubber) which decreases the cost and also imparts resistance to permanent deformation. The use of plastic compositions has vastly superior properties for floor covering due to their high resistance to ordinary wear. The thickness of the solid coating on the fiber is about 0.005 to about 0.030 inch which will yield on blowing a strand having an over-all thickness of about 0.040 to 0.400 inch. The preferred over-all thickness is from 0.100 to about 0.250 inch. As a general rule, the plastic composition can be expanded from about two to about eight times its original thickness but an expansion of about four to six times is generally preferable.

After the fiber core has been coated with the resinous composition as a foam or as a thin uniform layer of a foamable composition, the mass is then subjected to heat. In the case of foam rubber, this heat treatment is necessary to vulcanize and cure the foam. In the case of a thermoplastic resinous composition, the heat treatment is required in order to decompose the blowing agent and fuse the composition. Heat can be applied by any of the conventional techniques used for high temperature treatment of sheets or strands; that is, radiant heating elements can be used or the sheet can be passed through a conventional hot air oven maintained at the desired temperature. After the product is removed from the heating means, it is cooled in order that the foam structure will become set and hardened. Cooling can be effected by permitting the product to stand for a sufficient length of time, or alternately, streams of cool air or other cool gas can be blown directly over the product.

The composite strand is then woven, knitted, braided or otherwise incorporated into a fabric by conventional textile procedures. The foamed strand can make up the whole fabric or it can be combined with other yarn such as cotton, wool, paper fiber or the like in the desired proportion. The use of other yarns, particularly paper fiber, reduces the cost of the finished fabric. A particularly desirable floor covering can be prepared by using paper fiber as the filling and the composite strand as the weft. The paper fibers are prepared by twisting together thin paper bands formed of kraft paper or the like. Additional decorative effects can be obtained by twisting together bands of colored paper. The woven textile fabric **39**, as it leaves the weaving device (not shown) can be conveyed by a continuous belt **40** to a heating chamber **41** where the fabric is subject to heat to soften the coating on the fibers so that they bind together at their junctions.

The surface of the textile fabric can be coated with a thin soil-resistant coating by spraying the coating composition from a spray nozzle **42** or by any other coating means. The coated fabric is conveyed to a second heating chamber **43** where the coating is heated to the fusion point of the composition to form a smooth hard film. The fabric can then be wound on a collecting roll **44**. A typical fabric is illustrated in FIGS. 7 and 8. The fabric is composed of composite strands **45** which give the fabric its resiliency, interwoven with conventional yarns **46**. The fabric can be provided with a thin coating **47** of soil resistant material.

The soil resistant coating is applied to permit ease of cleaning of the woven fabric and also increase the wear resistance of the product. Such a coating is particularly useful in the case of low density foams to close up any exposed pores. The layer of soil resistant composition can be formulated as a plastisol or organosol of a thermoplastic resin. Preferably a vinyl chloride polymer resin, as described above in connection with the foamable plastisol layer, is used in order to insure maximum compatibility with the foamed strands. Plastisols useful as wear layers comprise from about 50 to about 150 parts plasticizer per 100 parts resin. Organosols are similar to plastisols in that the resin is present in the form of fine, unplasticized particles uniformly dispersed in a fluid mass. The dispersion medium in organosol comprises in addition to plasticizer a volatile organic solvent, such as xylene, toluene, cyclohexane, methyl ethyl ketone, methyl isobutyl ketone and the like. Organosol compositions useful in the production of soil and wear resistant layers comprise from about 20 to about 150 parts plasticizer and about 20 to about 80 parts solvent per 100 parts resin.

Suitable soil resistant compositions are formulated in the conventional manner used in the formulation of plastisols and organosols. If the coloration of the fabric is being relied on for giving decorative characteristics to the product, it is necessary for the soil resistant coating to be transparent or translucent. The soil resistant coating by suitable coloration can give decorative effects to the product. Transparent coatings require formulation without pigments or fillers. If the coating is opaque, a larger amount of filler can be added to the composition. The composition contains the conventional heat and light stabilizers.

The soil resistant coating layer is preferably sprayed on the fabric to give uniform coverage, but it can be applied by other coating means such as roller coaters and the like. The use of roller coaters would have the tendency to coat only the high spots of fabric which, in certain instances such as for economy, would be desirable. After the coating is applied, the coated fabric is subjected to heat in order to fuse thet resin in the coating layer and firmly bond it to the fabric. The use of a coating has the additional advantage of bonding the individual fibers and threads in the fabric and thereby prevent unravelling at the edges of the fabric when cut.

A subsequent heating of the woven fabric incorporating ing the foam strand is highly desirable in certain cases to help lock the fibers in place. This feature is particularly advantageous in floor covering because it allows a piece to be cut from roll goods without the necessity of binding the ends as is required with the conventional floor covering. Instead of a soil resistant coating, a flexible film can be applied to the surface of the fabric. The film can either be transparent or translucent or it can have a surface decoration.

The following examples are given for purposes of illustration.

Example I

A suitable plastic composition for coating a fiber core can be prepared by blending the following ingredients:

	Parts
Vinyl chloride-vinyl acetate copolymer	100
Dioctyl phthalate	30
Dipropylene glycol dibenzoate	30
Stabilizer	6
Finely divided titanium dioxide	2.5
Azondiformamide blowing agent	2.5

The blended plastisol was extruded onto a glass fiber core having a tensile strength of nine pounds. The core had an average diameter of 0.020 inch and the coating an average thickness of 0.010 inch. The extrusion was carried out at a temperature of 315° F. The coated strand upon extrusion was subjected to infra red heat lamps to raise the temperature of the composition within the range of 360° F. to 395° F. thereby causing the blowing agent to decompose and expand the coating to about four times its original thickness. The composite strand was then formed into a flat woven rug as the filling. The weft was composed of paper strands formed by twisting thin bands of kraft paper together. The woven rug was then heated to within the range of 300 to 325° F. to soften the composite strands and bond them at their point of intersection with the paper strands.

Example II

The following ingredients in the proportions indicated were ground on a three roll mill to produce a suitable coating composition:

	Parts
Polyvinyl chloride (dispersion grade)	100
Petroleum hydrocarbon condensate[1] (plasticizer extender)	18
Butyl benzyl phthalate	52
Finely divided filler	3
Stabilizers	4
Axondiformamide blowing agent	3.5

[1] Conoco 300—Continental Oil Company, Ponca City, Oklahoma.

The composition was then extruded on a nylon core as described in Example I and woven into a rug using a conventional weaving loom.

Example III

The following ingredients in the proportions indicated were ground on a three roll mill to produce a suitable foam coating composition:

	Parts
Polyvinyl chloride (dispersion grade)	100
Didecyl phthalate	100
Stabilizers	5
Wetting agent	3.5
N,N'-dimethyl-N,N'-dinitroso terephthalamide blowing agent	5

The composition was then coated on a glass fiber core and heated at about 200° F. to decompose the blowing agent. The foam coated fiber was then subject to a temperature within the range of 300 to 350° F. to fuse the composition. After cooling, the composite strand could be woven into a fabric by any conventional weaving means.

Example IV

A rubber latex of the following composition was whipped into a froth by violent agitation in the presence of air:

	Parts
62% solids natural rubber latex	100
20% potassium oleate soap	1.8
50% zinc diethyldithiocarbonate	1.0
60% sulfur dispersion	2.0
50% zinc salt of mercaptobenzothiozole	1.5
Phenyl-B-naphthylamine dispersion aid	1.0

After the whipping process, 5.0 parts of zinc oxide as a 50 percent dispersion and 2.0 parts of sodium silicofluoride as a 20 percent dispersion were added to promote gelling.

The foam was coated on a cotton fiber core by passing the fiber through a coating bath, the excess stripped off and then the coated core subjected to a temperature of 250° F. for 30 minutes to cure and vulcanize the foam rubber. The resulting foam layer had a density of 14 pounds per cubic foot.

Example V

An organosol was formulated by grinding the following ingredients on a three-roll mill to produce a suitable coating composition:

	Parts
Polyvinyl chloride (dispersion grade)	100
Dioctyl phthalate	15
Tricresyl phosphate	15
Petroleum mineral spirits	20
Methylethyl ketone	2
Stabilizers	5

The composition was sprayed on the surface of the rug prepared in Example I to form uniform coating of about one to two mils thick. The coating was then heated to 325° F. to fuse the composition. The composition can be used as a clear soil resistant layer in the production of products in accordance with the invention.

Example VI

A soil resistant coating composition having the following formulation was prepared:

	Percent by weight
Long chain polyester[1] (Isocyanate equivalent[3] =173)	14.4
Long chain polyester[2] (Isocyanate equivalent =33)	14.4
Cellulose acetate butyrate (10% solution ethyl acetate)	5.8
Polyisocyanate compound[4]	23.0
Silica aerogel	4.3
Ethyl acetate	7.6
Butyl acetate	7.6
Toluene	7.6
Methyl Cellosolve acetate	15.3
	100.0

[1] Multron R–12, Mobay Chemical Co., St. Louis, Mo.
[2] Multron R–16, Mobay Chemical Co., St. Louis, Mo.
[3] Isocyanate equivalent defined as the number of milligrams of —NCO group equivalent to the active hydrogen atoms in 1 gram of the polyester.
[4] Polyisocyanate prepared by reacting 3 mils of tolylene diisocyanate with 1 mil of trimethylol propane. The resulting compound contains 3 free —NCO groups per molecule and has a molecular weight of 656.

In the preparation of the coating, the polyesters were blended with solvents and flatting agent and then added to a 75 percent by weight solution of the polyisocyanate in methyl Cellosolve acetate. The resulting coating had a viscosity of 50 centipoises and contained 56.6 percent non-volatile material. The coating formulation contained 150 percent of the theoretical amount of polyisocyanate required to react with the polyesters.

Any departure from the above description which conforms to the present invention is intended to be included within the scope of the claims.

What is claimed is:

1. A process for producing a fabric having a high degree of resiliency while being substantially inextensible which comprises extruding onto a thread core a smooth, uniform coating of a resilient plastic composition containing a blowing agent, heating said coated core to a temperature sufficiently high to decompose said blowing agent thereby foaming said plastic composition into a resilient coating on said core, weaving said foamed coated core with other threads into a fabric and heating said

woven fabric to soften said resilient coating to bind said threads together at their point of contact.

2. A process for producing a fabric having a high degree of resiliency while being substantially inextensible which comprises extruding onto a thread core a smooth, uniform coating of a resilient thermoplastic vinyl resinous composition containing a blowing agent, heating said coated core to a temperature sufficiently high to decompose said blowing agent thereby foaming said thermoplastic resinous composition into a resilient coating on said core, weaving said foamed coated core with other threads into a fabric and heating said woven fabric to soften said resilient coating to bind said threads together at their point of contact.

3. The process of claim 2 wherein said vinyl resin is a vinyl chloride resin.

4. The process of claim 2 wherein said thread core is a glass thread.

5. The process of claim 2 wherein said thread core is a nylon thread.

6. The process of claim 2 wherein said thread core is a cotton thread.

7. The process of claim 2 wherein said thread core has a tensile strength of at least 8 pounds and a diameter of about 0.010 to about 0.030 inch and said foam coating on said core has a density of about 6 to about 30 pounds per cubic foot and a thickness of about 0.040 to about 0.40 inch.

8. The process of claim 2 wherein prior to said heating the fabric is coated on one surface with a thin coating of a wear resistant vinyl resin composition.

9. The process of claim 8 wherein said thread core has a tensile strength of at least 8 pounds and a diameter of about 0.010 to about 0.030 inch and said foam coating on said core has a density of about 6 to about 30 pounds per cubic foot and a thickness of about 0.040 to about 0.40 inch.

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