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NON-WATER SPOTTING BACKING OF RUBBER LATEX CONTAINING ALKALI METAL FORMATE

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9 Claims. (Cl. 260—29.7)

This is a division of application Ser. No. 302,469, filed Aug. 15, 1963, now U.S. Patent No. 3,264,246.

This invention relates to backing compositions for tufted and woven carpets and more particularly to improved backing compositions which do not create stains when the face of the carpet has been wetted by a liquid such as water.

During the past few years, a considerable poundage of various fibers has been employed in the manufacture of tufted carpets. This may be attributed primarily to two developments, the use of tufting machines to tuft fibers into a fabric such as jute and the use of latex adhesives on the back of the jute fabric to backsize or backcoat the loops of the tufted fibers in order to lock them in place and to give the carpet stiffness and dimensional stability.

The use of fibers in addition to wool or nylon for tufted carpets was a natural development in the carpet industry since such other fibers offered diversification in properties and price structure.

One of the fibers employed for tufted carpets with a jute fabric base is lofted or textured cellulose acetate.

Unfortunately, it was discovered if water was spilled on such a carpet a brown discoloration appeared upon the face of the carpet.

This invention is the result of extensive work done to determine the causes of this water spotting and to find methods for eliminating the formation of such water spots.

As our investigation into the cause of water spotting proceeded, the following conclusions were made.

The water stains observed were not due to decomposition products of the acetate fiber. The amount of colored matter found on the tufts of water-spotted carpet was considerable, while practically none was extracted from an equivalent amount of acetate. Also, a carpet made by tufting lofted acetate into an acetate fabric, rather than a jute fabric, which was backcoated in the usual way did not waterspot.

Of the various types of fibers available for testing, all gave some water-spotting when tufted into the same kind of jute fabric and backed with the same commercial backsizing latex. The degree of waterspotting increased with the fibers, in the following order: wool (least), nylon, acrylics, cellulose acetate cotton, and regenerated cellulose (most).

Thus, with the exception of wool, the hydrophilic fibers showed the most waterspotting and the hydrophobic fibers showed the least waterspotting and it is possible that the exception of wool is due in part at least to the slightly acid condition prevalent in the drying operation. This indicated that the fibers were merely serving as wicks when moisture evaporated from the tips of the fibers and the fibers were thus having colored bodies deposited on them in drying.

Compositions employed for carpet backing are composed of natural rubber or synthetic latices such as neoprene, butadienestyrene copolymers, or nitrile latices, together with loading or extending materials such as

Dixie clay, McNamee clay, calcium carbonate, titanium dioxide, bentonite clay, and the like. In addition to the latex and fillers, other materials are often present in the backing composition.

Alkalis.—Ammonia, caustic potash, and sodium hydroxide are used as latex stabilizers. Dispersions of materials used in compounding usually have a pH between 9 and 10.

Protective colloids.—Protective colloids of various types including casein, soaps, synthetic surfactants, starches, gelatin or glue are used to impart mechanical stability to natural and synthetic rubber latex compounds.

Thickening agents.—Synthetic thickeners, such as sodium carboxymethyl cellulose and sodium or potassium polyacrylate, or casein, alginates, karaya gum, locust bean gum, gelatin, starches, and so forth, are used for viscosity control and to prevent the settling out of ingredients.

Wettings agents.—Various anionic or non-ionic surfactants are added to latex formulations to improve the penetration of the backing composition into the material which is being backed so that better adhesion will be obtained.

Dispersing agents.—It is necessary to use dispersing agents to prepare slurries or dispersions of water-insoluble materials that are necessary for proper latex compounding. Very small individual particles of these water-insoluble materials must be obtained by the use of a dispersing agent so that homogeneous dispersions will be obtained when they are added to the latex. The presence of these dispersing agents prevents settling and agglomeration of the water-insoluble materials when the total latex formulation is stored. Sodium petroleum sulfonates, sodium or potassium oleate, and any other anionic and non-ionic surfactants are commonly used for this purpose.

Vulcanizing agents.—Vulcanizing agents are used in order to cause a cross-linking of the latex molecules and a resultant improvement in tensile strength, dimensional stability, an increase in elasticity, elimination of tack and decreased solubility of the latex for improvement of other properties. Sulfur is the main material used as the vulcanizing agent for natural and synthetic latices whether used as a sulfur dispersion or obtained from the decomposition of a sulfur-bearing material. An activator, such as zinc or magnesium oxide, has an effect on vulcanization of latices like that of sulfur and is used in the formulation to minimize the deleterious effect of too much sulfur.

Accelerators.—Accelerators are necessary in latex formulations in order to allow vulcanization of the latex to proceed at a much faster rate and at a lower temperature than if sulfur is used alone. The most commonly used accelerators are thiazole, thiuram, and dithiocarbamate derivatives.

Antioxidants.—Since vulcanization and aging results in the formation of free radicals in the latex, it is necessary to add antioxidants to the latex formulation in order to terminate the chain reaction initiated by the free radicals. Antioxidants must be chosen for both their aging protection and the amount of color formed by their oxidized products. Most of the materials used as antioxidants in latices are aromatic amines or phenols.

Miscellaneous components.—Various other materials such as softeners, plasticizers and perfumes may be added to latex formulations for particular applications.

Compounding of the total backing formulation is accomplished according to the following general procedure.

The latex which has been chosen for the particular formulation is well stirred and the pH is usually adjusted to approximately 10–10.5 with the desired base. Stabilizers,

such as ammonium caseinate, are added and the dispersion containing zinc oxide, sulfur, antioxidants, and accelerators is blended into the mix. Fillers and thickeners are then added to obtain the desired loading and viscosity.

For rug backing, fillers such as clay, calcium carbonate, and titanium dioxide are necessary in order to modify the cost of the total formulation as well as to impart specific physical properties to the latex. Since loading for carpet backing formulations is usually in excess of one part filler to one part latex, the measurement of tensile strength, elongation, and modulus by the usual methods does not result in any useful information. For this reason, it is necessary to resort to studies comparing end-use properties such as cracking, stiffening, color, tuft-locking characteristics and hand when comparisons of various formulations involving high loading are made. For most commercial rug backing compositions the amount of filler material employed will usually be from about 0.5 part to 10 parts by weight for each 1 part by weight of rubber solids.

A latex formulation for rug backing should spread easily on the base fabric, should accept high loading by fillers, should be non-dusting, should give good antislip properties, should impart body to the rug, should impart dimensional stability to the rug, should retain good flexibility on aging, should show good heat and light stability and should furnish the desired hand.

The above compositions when cured as is normal in carpet manufacture, have been found subject to water spotting when water has been applied to local areas and allowed to dry. The severity of this water spotting depends upon the type of fiber used in the carpet. Those fibers which are more hydrophilic such as viscose and cellulose acetate spot very badly. Fibers which are more hydrophobic show this water spotting less severely.

Evaluation of various latices, natural and synthetic, did show a range of water spotting with a given fiber. A correlation was found to exist between the pH of the applied latex backcoating and the degree of water spotting found with a standard carpet. The most basic backsizing compositions employed, stabilized at a pH of 10 to 10.5, were natural rubber and butadiene styrene systems. These caused the most severe water spots. Reduction of the pH of these backsizing compositions lowered the water spotting severity on the resulting carpets. However, lowering of the pH also lowered the stability of the aqueous latex composition, and thus interfered with the backcoating operation. This led to a search for other latices which could be stabilized and cured at a more neutral pH, or even at an acidic pH.

Studies of the jute in water solutions of various pH's indicated that in the pH range of 10 to 10.5, where most of the conventional carpet backsizing compositions are stabilized, colored materials were extracted from the jute. Heating the basic solution containing jute caused a tremendous increase in the amount of colored material extracted. The jute used for this purpose was the "stainless jute" which had been cleaned of excess surface oils which would be expected to give oil spots. This test indicated that the application of an aqueous backsizing composition at a pH of 10 to 10.5 to the jute fabric, followed by heating in order to cure the backsizing composition, would cause colored water-soluble materials to be formed in and around the jute.

Further tests involved replacing the jute fabric with other materials as a means of determining the necessity of the jute as a participant in the water spotting process. It was found that when fibers were tufted into an acetate fabric, backsized with conventional high pH formulations, and cured, practically no water spotting occurred on subsequent wetting. When fibers from the same stock were tufted into jute, backsized with conventional high pH formulations, and cured, water spotting did occur on subsequent wetting. This is proof that the jute did contribute to the water spotting mechanism.

With the information described above, a working theory was formed as follows: The basic aqueous latex dispersion formed water-soluble colored salts in the jute backing. These colored salts remained in and around the jute since the carpet backsize was cured almost immediately after application to the carpet back. Heat applied to the carpet in order to cure the latex increased the amount of colored materials formed. Subsequent wetting by water resulted in solvation of these colored salts and since the water evaporated primarily from the fiber tips, the solution containing colored salts migrated up to the fiber and deposited the colored salts on the fiber. A confirmation of this theory was found when an absorbent towel was laid on the top of a carpet after it has been wetted by water. Upon drying, the color was found to have migrated onto the towel, leaving the fibers clean. The role of the fiber then, was that of a wick drawing the color containing solution up the fiber as evaporation proceeded. This explained the variation in water spotting which occurs between hydrophilic and hydrophobic fibers. The hydrophilic fibers absorb moisture rapidly and allow most of the evaporation to occur from them. On the other hand, hydrophobic fibers absorb water much less readily and cause evaporation to proceed primarily around the base rather than from the surface of the fibers.

Based on the above conclusions as to the source of colored materials and the mechanism of water spotting, a means of eliminating the water spotting of carpets was sought.

The primary object of the present invention is to prepare a carpet backing composition which will not cause water spotting of the carpet and yet will retain all the desirable properties of conventional carpet backing compositions. Another object is to prepare a carpet backing composition which will not manufacture water-soluble colored materials on contact with the jute base fabric. A further object is to prepare a carpet backing composition which will not permit colored water-soluble materials to be wicked up onto the carpet fibers. Other objects will appear hereinafter.

Since the basic ions, such as potassium and sodium, solubilize the color forming materials in the jute, the first method tried for the purpose of reducing the water spotting of carpets was to reduce the basicity of the applied latex dispersion as far as possible, even to the point of using an acidic latex, if practical. The natural rubber and most of the synthetic latices, however, were found to be stable only at a pH of 9.0 or above. At lower more acidic pH's coagulation of the latex prevented satisfactory application to the carpet backsize. However, some latices were found which could be applied at a pH around 8.0. The water spotting induced by these lower pH latices was much minimized but was still evident. Out of this work on lower pH latices, several backing compositions were developed which were almost satisfactory from the water spotting standpoint. They were, however, more expansive than the backing formulations in use, and so other methods which would be more commercially acceptable were studied.

The second approach involved the incorporation of waterproofing agents into the aqueous backing compositions, the object being to prevent water penetration into the cured backing and around the base of the fibers, thus preventing solvation of the colored materials by water. Such a waterproof backing was found to be very effective in elimination of the water spot formation.

One drawback, however, was that the water proofing materials were largely incompatible with dispersions of the high pH latices being modified. Some water proofing materials were formed which could be raised in pH to approximately 10 and then blended into the backsizing composition satisfactorily. Although in several cases coagulation of the waterproofing material may have occurred, the high viscosity of the latex composition prevented particles of the waterproofing materials from

settling out. It was found that some of these textile waterproofing agents incorporated into the backsizing compositions in this manner waterproofed the highly basic backing after the initial curing and some did not. It was necessary to add so much of these waterproofing agents, however, that the increase in cost of the non-water spotting backing composition was considered prohibitive for competitive commercial use.

A third method investigated was that of adding a buffer to the commonly used latex backing composition so that upon curing, the acidic group in the buffer could compete with the available color forming materials for the basic ions, and thus minimize or eliminate the formation of colored salts. Many chemical buffers were added to latex dispersions and the resulting dispersions were used to backsize carpets for testing. One of the most promising appeared to be ammonium dihydrogen phosphate. Subsequent testing, however, revealed that a residue of phophoric acid, which was formed while curing the backsizing composition containing ammonium dihydrogen phosphate on the back of the carpets, attacked the jute and tenderized it, causing the jute to lose its strength. It became clear that the buffered latex should not become permanently acid as occurred when this ammonium phosphoric salt was thus employed.

A milder salt of a phosphate ester, the diethylaminoethanol salt of a mixture of mono and dioleyl acid phosphates, was found to work very well as a buffer in the latex dispersions. Carpets backsized by a composition consisting of 100 parts (dry) of a commercial latex dispersion and 8 parts of diethylaminoethanol oleyl phosphate did not spot when wetted by water. However, the cost of the diethylaminoethanol oleyl phosphate was considered prohibitive for commercial use.

Other acid salts were, therefore, evaluated and in accordance with one feature of the present invention, we have discovered that certain salts when incorporated into carpet backing formulations, effectively eliminate the subsequent migration of colored materials onto the carpet fibers when the carpet has been wetted with water.

Salts of ammonia, amines, sodium hydroxide, lithium hydroxide and potassium hydroxide with formic acid, acetic acid, oleyl acid phosphate and polyacrylic acid have been found to suppress effectively the formation of colored spots on areas of carpet onto which water has been poured. The amounts of these salts employed vary somewhat with each particular composition and is influenced by the total basicity of the composition.

We have found the preferable amine to be diethylaminoethanol and the preferable acid to be formic acid. We have also found that sodium formate, potassium formate and lithium formate are particularly effective in carrying out the objects of our invention.

A commercial backsizing composition comprising 10 parts by weight of sodium, potassium or lithium formate for each 100 parts of wet backsizing composition (60% solids) when used to backsize a standard carpet, produced a carpet which water spotted very slightly. In other respects, the carpet backing appeared to be satisfactory. There was, however, some modification of the feel or hand of the carpet backing. The carpet backing containing potassium formate was softer and smoother to the hand than was the unmodified carpet backing itself. Sodium formate had less effect on the hand of the carpet backing than potassium formate, while lithium formate had practically no effect in that respect.

In using the potassium, sodium, or lithium formates as additives to presently available commercial backsizing compositions, we have found in accordance with another feature of the invention, that it is desirable to employ additional amounts of emulsifier to stabilize and to control the viscosity of the modified backsizing dispersion. Without the additional emulsifier the commercial backsizing formulations containing the formate salts may become too viscous for the normal application of the backcoating compositions by means of rolls to the carpet backside. The non-ionic class of emulsifiers was found by us to be very effective as viscosity controllers in some of the modified carpet backing compositions; in other various compositions, anionic emulsifiers were satisfactory. Small amounts of these emulsifiers are required for stabilization and viscosity control, ranging from 0.5 part in some compositions to 3 parts in others, based on 100 parts of backsizing dispersion. Care should be taken in choosing additional emulsifiers so that unnecessary amounts are not added. Our work has shown that when the unmodified backing was used, the effect of using the most favorable emulsifiers was not enough to decrease the water spotting appreciably. When the non-water spotting backing was used, however, it became clear that some emulsifiers promoted water spotting more than others and that large amounts of any emulsifier were undesirable.

The mechanism of the alkali formates in diminishing the severity of water spots is believed to be based on two factors. The first is a salting out effect. Water spilled on the carpet becomes saturated with formate salts and this saturated solution becomes a poor solvent for the colored materials at the base of the carpet fibers. Thus, very little color is drawn up onto the fibers as the water evaporates. The formate salt itself has not been found to color the fibers appreciably. The second factor is the presence of a strong competing anion, the formate ion, for the basic ions which normally solubilize the color forming anions. The slight amount of spotting which remains when the sodium formate modified backing is used may be further reduced by using 7 parts of sodium formate and 3 parts of the N,N-diethylaminoethanol salt of formic acid instead of the 10 parts of sodium formate, for each 100 parts of wet backsizing composition. The function of the N,N-diethylaminoethanol salt of formic acid is to raise the concentration of the formate ions available to compete with the color forming acidic components from the jute. This is accomplished by volatilization of the diethylaminoethanol when the back coated carpet is cured by heating. The escape of diethylaminoethanol during the heating period is accompanied by neutralization of the less volatile formate ion by those basic ions which would otherwise be free to solubilize colored compounds at the base of the fibers. Diethylaminoethanol is the preferred volatile amine for this use because it does not discolor cellulose acetate by side reactions with it.

Subsequent tests made on carpet backsized with sodium formate-diethylaminoethanol formate buffered compositions have shown no adverse effects such as tendering of the jute, altered abrasion resistance of the carpet, or deterioration of the latex backsize. When carpets backsized with the buffered compositions were subjected to several commercial wet or dry cleanings, it was found that the non-water spotting characteristics persisted through the several cleanings.

Our invention is illustrated in but not limited by the following examples:

EXAMPLE 1

Part A

The following typical carpet backing formulation was used as a standard formulation for the evaluation of material to accomplish our objectives.

	Dry wt. (grams)
Styrene-butadiene type 2105 latex (26% by weight styrene–74% by weight of butadiene)	100.0
10% KOH solution	0.5
10% sodium petroleum sulfonate	2.0
50% sulfur dispersion	2.0
50% zinc oxide dispersion	3.0
65% 2,5-di-t-butyl-p-cresol dispersion	2.0
50% butyl zimate dispersion	2.0
50% clay dispersion	100.0
10% potassium polyacrylate	1.0

When this formulation was used as a backsizing material for acetate carpet yarn tufted into jute, cured, and splashed with water, a very severe discoloration was obtained on the carpet fibers.

Part B

A carpet backing composition was prepared as follows:

	Dry wt. (parts)
Part A	86
Potassium formate	14

This backsizing material was applied to acetate carpet yarn which had been tufted into jute, the carpet sample was cured at 130° C. for 25 minutes, and subsequently splashed with water. After drying, there was no water spot or discoloration on the carpet fibers.

EXAMPLE 2

Carpet backsized with a commercial formulation similar to that described in Part A, Example 1, above was found to water spot seriously. This commercial formulation was treated as follows:

	Dry wt. (parts)
Commercial backing formulation	84
N,N-diethylaminoethanol salt of formic acid	16

When this backsizing was applied to acetate carpet yarn which had been tufted into jute, cured at 130° C. for 25 minutes, and subsequently splashed with water, no discoloration or water spotting was obtained on air drying.

EXAMPLE 3

A commercial carpet backsizing formulation was treated as follows:

	Dry wt. (parts)
Commercial backsizing formulation	80.5
N,N-diethylaminoethanol salt of oleyl acid phosphate	19.5

When this backsizing formulation was applied to acetate carpet yarn tufted into jute, cured at 130° C. for 25 minutes, and then splashed with water, no discoloration due to water spotting was observed on air drying.

EXAMPLE 4

A commercial carpet backsizing composition was modified as follows:

	Dry wt. (parts)
Commercial backsizing formulation	87.2
Sodium formate	12.8

When this backsizing composition was applied to acetate carpet yarn tufted into jute, cured at 130° C. for 25 minutes, and then splashed with water, no discoloration due to water spotting was observed on air drying.

EXAMPLE 5

The following carpet backsizing composition was applied to the back of a carpet consisting of nylon yarn tufted into jute and cured at 130° C. for 25 minutes.

	Dry wt. (parts)
Commercial backsizing formulation	86.0
Sodium formate	9.5
Diethylaminoethanol formate	4.2
Polyoxyethylene sorbitan monolaurate	0.3

When the face of this carpet was splashed with water, no spotting occurred after the carpet dried. The carpet backed with the same composition but not containing the formate salt additives did water spot.

EXAMPLE 6

The following carpet backsizing composition was applied to the back of a carpet consisting of Acrilan yarn tufted into jute and cured at 100° C. for 25 minutes. Acrilan is a proprietary designation for an acrylic fiber.

	Dry wt. (parts)
Commercial backsizing formulation	79.8
Polystyrene	1.9
Sodium formate	17.0
Sodium alkyl sulfosuccinate	1.3

When the face of this carpet was splashed with water, no spotting occurred after the carpet dried. When this carpet was backed with the same composition not containing the sodium formate additive, this carpet did water-spot. The polystyrene was added to this formulation in order to give a stiffer cured backing on the carpet. The use of such a modifier as the polystyrene to adjust the stiffness of a given carpet is optional and depends upon the desires of the manufacturer.

EXAMPLE 7

The carpet backsizing composition in Example 5 was applied to the back of a carpet consisting of Verel yarn tufted into jute and cured at 100° C. for 25 minutes. When the face of this carpet was splashed with water, no spotting occurred upon drying. This carpet backed with the same composition but not containing the sodium formate diethylaminoethanol formate additive did water spot upon drying. Verel is a proprietary designation for a modacrylic fiber.

The amounts of non-water spotting compounds which may effectively be incorporated into the backing compositions range from approximately 10 to 20 parts based on the dry weight thereof for each 100 parts by dry weight of backing composition.

Our invention has overcome the problem of water spotting when a jute backing is employed in the fabric.

This application is a continuation-in-part of application Ser. No. 33,963, filed June 6, 1960.

It is to be understood that the above description and examples are illustrative of this invention and not in limitation thereof.

We claim:

1. A carpet comprising tufts secured in a jute backing fabric, said jute backing fabric being coated with a backing composition comprising:
   (a) cured rubber,
   (b) 0.5 part to 10 parts by weight filler material for each part by weight of rubber solids, said filler material being substantially uniformly dispersed throughout the cured rubber,
   (c) and a water spotting-preventing compound selected from the group consisting of sodium formate, potassium formate and lithium formate, said water spotting compound being present in an amount equal to from about 10 to 20 parts by dry weight for each 100 parts by dry weight of backing composition.

2. A method for the prevention of water spotting of carpets made of tufts secured to jute backing fabric including the step of backsizing said fabric with a backsizing composition comprising:
   (a) rubber latex,
   (b) from about 0.5 part to 10 parts by weight of filler material for each part by weight of rubber solids in said latex, and
   (c) a water spotting-preventing compound selected from the group consisting of sodium formate, potassium formate and lithium formate, said water spotting-preventing compound being present in an amount equal to from about 10 to 20 parts based on the dry weight for each 100 parts by dry weight of backing composition.

3. A method for the prevention of water spotting of carpets made of tufts secured to jute backing fabric including the step of backsizing said fabric with a backsizing composition comprising:
   (a) rubber latex,
   (b) from about 0.5 part to 10 parts by weight of filler material for each part by weight of rubber solids in said latex, and

(c) as a water spotting-preventing compound, sodium formate present in an amount equal to from about 10 to 20 parts based on the dry weight for each 100 parts by dry weight of backing composition.

4. A method for the prevention of water spotting of carpets made of tufts secured to jute backing fabric including the step of backsizing said fabric with a backsizing composition comprising:

(a) rubber latex,

(b) from about 0.5 part to 10 parts by weight of filler material for each part by weight of rubber solids in said latex, and

(c) as a water spotting-preventing compound, potassium formate present in an amount equal to from about 10 to 20 parts based on the dry weight for each 100 parts by weight of backing composition.

5. A method for the prevention of water spotting of carpets made of tufts secured to jute backing fabric including the step of backsizing said fabric with a backsizing composition comprising:

(a) rubber latex,

(b) from about 0.5 part to 10 parts by weight of filler material for each part by weight of rubber solids in said latex, and

(c) as a water spotting-preventing compound, lithium formate present in an amount equal to from 10 to 20 parts based on the dry weight for each 100 parts by dry weight of backing composition.

6. A backing composition for tufted and woven carpets comprising:

(a) rubber latex,

(b) about 0.5 part to 10 parts by dry weight of filler material for each part by weight of rubber solids in said latex, and

(c) 10–20 parts by dry weight of a mixture of sodium formate and N,N-diethylaminoethanol salt of formic acid for each 100 parts by dry weight of backing composition.

7. A carpet comprising tufts secured in a jute backing fabric, said jute backing fabric being coated with a backing composition comprised of cured rubber and from about 0.5 part to 10 parts by weight for each part by weight of rubber solids of filler material substantially uniformly dispersed throughout the cured rubber and containing as a water spotting-preventing compound sodium formate, said water spotting-preventing compound being present in an amount equal to from about 10 parts to 20 parts based on the dry weight for each 100 parts by dry weight of backing composition.

8. A carpet comprising tufts secured in a jute backing fabric, said jute backing fabric being coated with a backing composition comprised of cured rubber and from about 0.5 part to 10 parts by weight for each part by weight of rubber solids of filler material substantially uniformly dispersed throughout the cured rubber and containing as a water spotting-preventing compound potassium formate, said water spotting-preventing compound being present in an amount equal to from about 10 parts to 20 parts based on the dry weight for each 100 parts by dry weight of backing composition.

9. A carpet comprising tufts secured in a jute backing fabric, said backing fabric being coated with a backing composition comprised of cured rubber and from about 0.5 part to 10 parts by weight for each part by weight of rubber solids of filler material substantially uniformly dispersed throughout the cured rubber and containing as a water spotting-preventing compound lithium formate, said water spotting-preventing compound being present in an amount equal to from about 10 parts to 20 parts based on the dry weight for each 100 parts by dry weight of backing composition.

No references cited.

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