

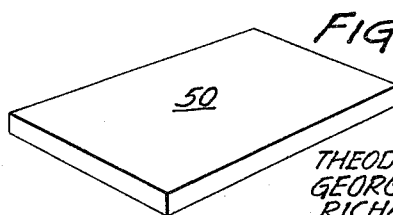
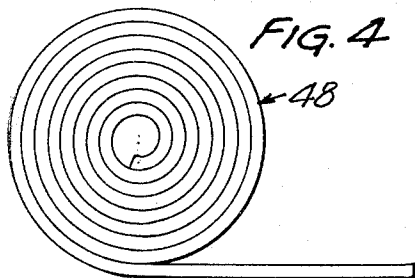
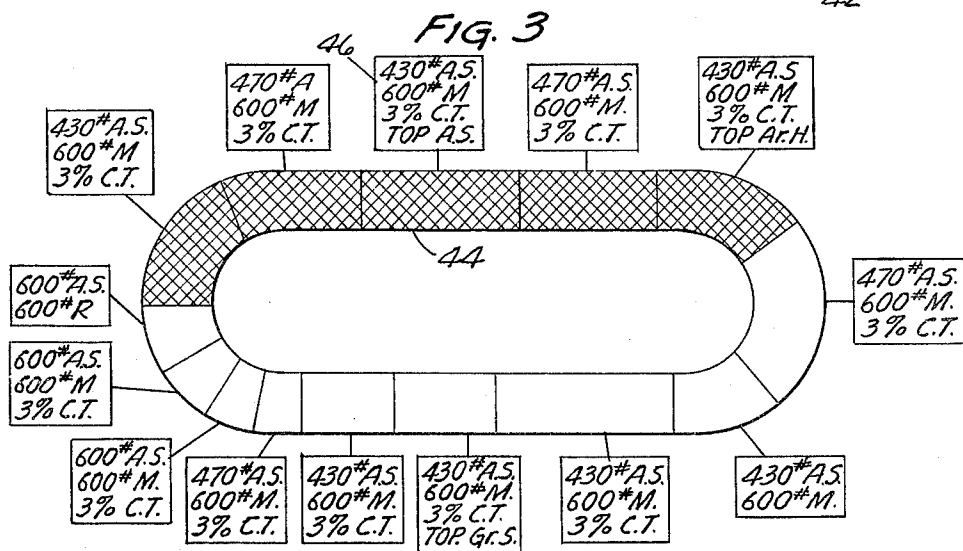
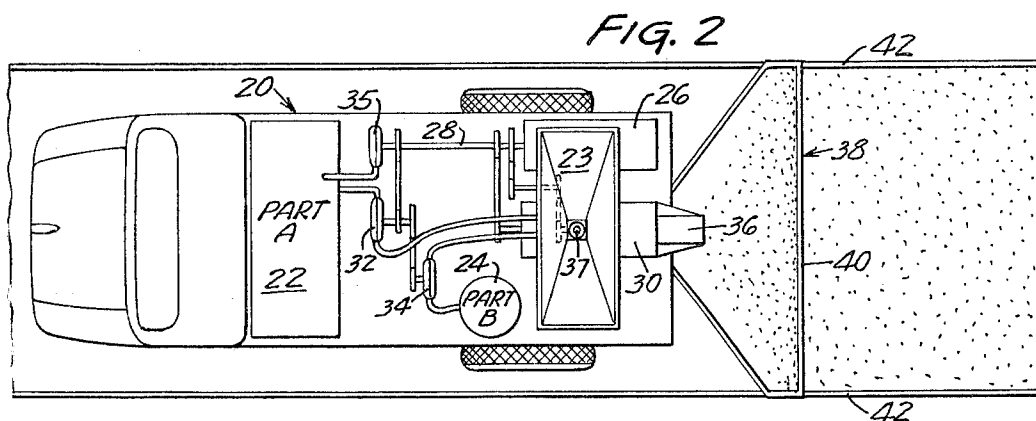
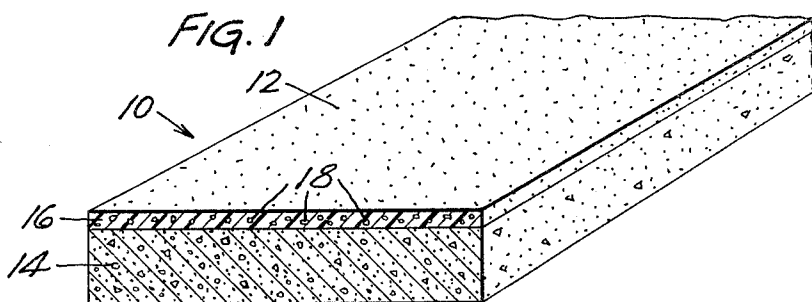
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T. BUCHHOLTZ ET AL

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PAVING MATERIAL AND PAVING SURFACING

Filed July 23, 1962



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3,272,098

PAVING MATERIAL AND PAVING SURFACING

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The present invention relates to new and useful paving materials and to the paving surfaces made therefrom. More particularly this invention relates to new and useful self-hardening synthetic paving materials based on urethane elastomers which paving materials are advantageously used in the paving of pedestrian walkways, athletic running tracks and playing surfaces, horse racing tracks, roof surfacings, roadways, floors and the like.

Many proposals have been made over the years to provide rubbery paving surfaces, ranging from the use of preformed rubber blocks to combinations of natural rubber latexes or latices with cement or the like. None of these prior known proposed systems has enjoyed any extensive commercial use to the best of our knowledge. Among the more prominently advanced reasons for the limited use of prior proposed rubbery pavings are the difficulty of curing rubbers in situ, the inability to properly bond natural, and simulated natural, rubbers to solid substrate materials over which the paving is formed, poor weatherability, difficulty of repair, and, in the case of in situ hardening rubber latex-cementitious or latex-asphaltic compositions, the absence of rubberiness in the final product.

Whether it is for the foregoing reasons or for others that rubbery paving compositions have not heretofore enjoyed extensive use is problematical; nevertheless, there remain many areas where suitable rubbery pavings would satisfy long standing needs. Thus, in the construction of paved surfaces of all kinds, e.g. roadways, athletic tracks for field events, athletic playing fields, indoor and outdoor play courts, playgrounds, tennis courts, baseball diamonds, handball courts, football fields, etc., floors, walkways, etc., there is along standing need for satisfactory rubbery pavements to reduce injury hazards, absorb shocks, etc. and which will stand up under weathering and rough use.

A particularly acute area of need is in the construction of racetracks for horses. As presently constructed such tracks are usually composed of some sort of a sandy loam surfacing of several inches in depth on top of a clay base to provide a running surface to protect the horse's hooves and legs from undue shock and injury while maintaining a sure-footed running surface. Such tracks develop pits and potholes down to the clay base under heavy use, and erode and become slippery and muddy in wet weather; they are almost completely weather dependent and the track surface cannot be banked around curves.

Scrupulous maintenance of these tracks is necessary at all times. Even with such maintenance incidence of broken sesamoids, bowed tendons, and lame knees is quite high on these conventional track surfaces. Since it is not unusual for a champion thoroughbred racing horse to be valued at several hundred thousand dollars, or more, such horses are often pulled from races when the tracks are muddy to protect the owner's investment. Thus, on wet days only the less valuable horses are permitted to run and since these "mudders" are known to be quite unpredictable both track attendance and track receipts suffer considerably. Ofttimes, many of the racing days of a season may pass on a track without races being run because the track is in such bad shape. The problems are somewhat the same, and in a way more acute in harness racing,

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where the driver sits behind the horse and is invariably the one who gets the mud kicked up in his face.

It is a principal object of this invention to provide a new and useful synthetic paving material which can be poured in situ and which is self-hardening under ambient conditions to a tough rubbery paving which provides a durable paving that is unaffected by weather, which is capable of fast and simple repair, which adheres well to hard substrates such as concrete or asphalt, and which maintains good, non-skid characteristics under all conditions. An important object is to provide a rubbery paving which provides an excellent and useful all-weather surfacing for horse racing tracks and the like which requires little maintenance and on which horses run with confidence and sure-footedness.

Further objects of the invention are to provide a new and useful rubbery paving which is tough and abrasion resistant, which can be mixed and poured and cured in situ under ambient conditions within a matter of a few hours, which can be readily applied to large areas in minimal time by machine operation, and which can be preformed into blocks, or tiles, or into tough, self-sustaining flexible, resilient strips for lay-down application in the manner of carpeting.

Other objects and advantages will become apparent as the description proceeds.

In accordance with this invention a self-hardening, screedable, fluid paving material which hardens to a tough, elastic, abrasion and tear resistant all-weather rubbery urethane pavement is provided which material comprises a matrix forming binder of a urethane polymer-forming liquid, preferably a pourable reaction mixture of polyalkylene ether polyol and organic polyisocyanate containing from 0 to about 50% by weight of a finely divided filler, and a rubbery granular aggregate comprising from about 20% to about 50% by volume of the material, the granules of the aggregate having an average size in the range of from about one sixteenth of an inch to about one half an inch.

Pourable reaction mixtures of polyalkylene ether polyol and organic polyisocyanate which harden from a liquid state to a solid elastomeric state under ambient temperatures and pressures may be readily formed by mixing approximately equivalent quantities, i.e., 0.8:1 to about 1.2:1, of organic, and preferably aromatic, polyisocyanate, and polymeric polyalkylene ether polyol, and preferably 1,2-propylene oxide derived polyols. The reaction mixtures are preferably reacted in the presence of a suitable polyol-soluble metal catalyst for the reactants so that the reaction proceeds at ambient temperatures with great rapidity, e.g. one hour or less from a liquid to a substantially completely reacted solid state.

A number of soluble metal compounds have been found to catalyze such reaction mixtures under ambient conditions as for example, organo-tin compounds, lead salts of carboxylic acids, mercuric compounds, etc.; however, a preferred catalyst has been found to be a combination of a calcium or lead salt of a carboxylic acid, such as calcium or lead octoate, an ionizable monoorgano-mercuric compound, such as phenyl mercuric hydroxide, and lead oxide. The total amount of the catalyst should not be less than about 0.1% of the reaction mixture, and, to hasten the setting-up or hardening time desired, may be adjusted upwardly to about 3%; or to such higher percentage as desired before the accelertaing effect is lost or undesirable side effects become apparent.

For the elastomer to form as a tough, wear and abrasion resistant rubbery product, some trifunctionality must be present to facilitate cross-linking of the reactants as well as chain extension thereof. This is readily accomplished by including some triisocyanate or triol or both

in the reaction mixture. Thus, for example when the reaction mixture is comprised essentially of an aromatic diisocyanate and polypropylene glycol a certain amount of trifunctionality can be built in very readily by pre-reacting about 5 to 15% of a triol such as trimethylol propane with the aromatic diisocyanate to form some triisocyanate or by including as part of the monomer charge for making the starting polymeric polyol from about 5 to 15% of a triol such as trimethylol propane, glycerine or the like. The resulting hardened product is a result of the one stage continuous reaction of this reaction mixture.

A unique control system enables the production of rubbery elastomers having Shore A₂ durometers, ranging from 25 to about 80 and higher. The system enables control of the durometer within ± 5 Shore A₂. This control is achieved by adding to the reaction mixture predetermined amounts of a chain terminating agent such as butyl cellosolve (mono-butyl ether of ethylene glycol), butyl carbitol (mono-butyl ether of diethylene glycol) oleyl alcohol, and similar high boiling monofunctional alcohols to adjust the final hardness to a desired range.

By finely divided fillers are meant fillers in the form of powders or powder-like substances wherein the particles are in very fine size ranges, smaller than about 100 microns and generally down in the below 10 micron range such as in powdered clays, talcs, etc. Coarse fillers tend to make the product punky and much less tear resistant without noticeably reinforcing the tensile strength of the product. Preferred reinforcing fillers are ground tripoli or clay; but, in addition to, or in lieu thereof, carbon black, titanium dioxide, hollow beads, e.g., polystyrene, glass, urea formaldehyde, and like micro beads, and other materials such as ultra-violet light absorbers, antioxidants, pigments, stabilizers, etc. can be used.

Because paving materials are usually formulated to cover vast areas in the most economical manner commensurate with the desired end result of the paving, it is generally preferable to utilize the maximum amount of finely divided filler which provides a useful product and the reaction mixture may contain as much as 50% finely divided filler by weight of the liquid reactants before the mixture becomes too dry for proper mixing with conventional techniques. With more sophisticated mixing equipment higher filler loadings may be possible. From 30 to 45% filler comprises a preferred range.

With respect to the rubbery aggregate, it is important that at least about 10% of the total volume of the paving material be composed of aggregate to prevent undue slump of the material when first laid and prior to hardening. Preferably the aggregate should comprise about 35 to 45 volume percent of the paving material. But as much as 50% of the total material volume may be made up as aggregate. Any resilient solids compatible with the urethane matrix such as chopped up vulcanized rubber, both natural and synthetic cork, etc. can be used. Preferably, however, the aggregate is composed of rough, irregular granules of prehardened urethane elastomer having the same approximate composition as that provided by the matrix forming liquid reaction mixture. To provide these granules a previously hardened urethane pellicle may be simply chopped or shredded to the desired aggregate size range. When granules of this type are used as the aggregate, little or no settling of aggregate occurs and the entire surfacing, both matrix and aggregate, has uniform physical properties throughout from the standpoint of weathering, tear resistance, abrasion resistance, etc. Further, a very tight, uniform, cohesive-appearing bonding of the urethane matrix and granules to one another takes place, the granules being bonded to the matrix with an adhesive bond apparently as great as the cohesive bond of the matrix to itself.

The size of the granules is based on screen classification. Thus, if the particle passes through a $\frac{1}{16}$ " square

screen opening but not through the next smallest opening it is considered a $\frac{1}{16}$ " particle. Granules smaller than $\frac{1}{16}$ of an inch do not appear to impart sufficient deformability to the hardened paving to enable it to absorb shocks without unduly rapid recovery. Granules larger than about $\frac{3}{4}$ of an inch are unwieldy and tend to create relatively large void areas which unduly weaken the paving. A preferred granule size range is from about $\frac{1}{16}$ " to $\frac{1}{2}$ ".

Highly decorative effects can be achieved by utilizing aggregate granules of colors different from the matrix or binder. Likewise, the degree of roughness of the surface of the paving can be varied by varying the granule size and/or sprinkling further granules on the paving surface before the binder has hardened. In fact, if desired, the paving may be topped by a coating of elastomer to provide an absolutely smooth rubber-like surface.

The invention will be further explained with reference to the accompanying drawings and the specific examples which follow.

In the accompanying drawings,

FIGURE 1 is a perspective view, with one end shown in cross-section of a paving made in accordance with this invention;

FIGURE 2 is a schematic illustration of a procedure for applying the paving in a continuous manner;

FIGURE 3 is a top view of a track made in accordance with this invention;

FIGURE 4 is a side elevational view of a roll of preformed paving; and

FIGURE 5 is a perspective view of a paving tile made in accordance with this invention.

In FIGURE 1 there is disclosed a pavement 10 comprising a paving surfacing 12 of the urethane paving of this invention anchored to a rigid substrate 14, which may be asphalt, concrete or other rigid foundation useful as a paving or flooring substrate.

As is apparent, the urethane paving 12 comprises a continuous matrix or binder 16 and aggregate granules 18. For ease of illustration no attempt has been made to show the various other additives which may be in the urethane pavement such as the antioxidants, ultra-violet light stabilizers, pigments, finely divided filler, etc.

In the preparation of the paving, the rigid substrate or foundation 14 is first laid. Then, the urethane paving 12 may be laid on top of this previously laid substrate either as a preformed strip or tile or as an in situ hardened paving.

Various methods can be utilized to lay the urethane surfacing in situ, one of these being depicted in FIGURE 2 wherein a top view of a truck bed or the like 20 is disclosed as being provided with a storage tank 22 labeled "Part A" and a storage tank 24 labeled "Part B." In the Part A storage tank 22 the polyalkylene ether polyol, filler, catalyst, pigments, etc. may be stored as a liquid mix. The aggregate is carried in a hopper 23, from whence it is fed directly into the mixer 30. The Part B tank 24 simply contains a liquid polyisocyanate. Mounted also on the truck bed is a motor 26 having a power takeoff 28 suitably operatively connected by gears or the like (unnumbered) to a mixer 30, pumps 32, 34 and 36, and to auger 37 for feeding aggregate from the hopper 23 into mixer 30.

Mixer 30 may comprise a conventional tube-type mixer (cylindrical outer shell and axial mixing and propelling shaft) wherein the Parts A and B are thoroughly mixed with one another and with aggregate granules as these components are fed from their respective storage containers. Upon mixing the resulting paving material is deposited by means of chute 36 or the like onto the surface to be paved within the confining screed frame 38. As the truck moves forward the screed frame 38, which is in the form of an open frame having a screed bar 40 levels out the paving material between guide strips 42 which guide the screed frame and also control the height

of the urethane paving. When poured in situ on firm substrates such as asphalt, wood, concrete, etc., the paving is self anchoring and adheres strongly to the substrate. This procedure is illustrated in the example following.

EXAMPLE 1

Utilizing a procedure as described in FIGURE 2, a one half inch thick urethane paving about eight feet wide was laid on asphalt at the rate of about 2.5 feet a minute with the time from pouring and screeding for each linear foot of paving surface to hardening being about 7 minutes, the paving setting up to a hardened, resilient paving of about 60 durometer.

The component formulation was as follows:

Part A

	Parts by weight
Polypropylene glycol, 2025 molecular weight	51.5
Cabosil (colloidal silica)	0.5
Litharge	0.1
Partially calcined clay	46.5
Calcium octoate (hexogen calcium)	0.1
Weather stabilizer (2,6-di-tertiary butyl 4-methyl phenol)	1.0
Phenyl mercuric acetate	0.2
Mono-n-butyl ether of ethylene glycol	1.0

Part B

	Parts by weight
80:20 mixture of 2,4- and 2,6-tolylene diisocyanate isomers	86.7
Trimethylol propane-propylene oxide adduct of approximately 440 molecular weight	6.0
Trimethylol propane	7.3

About 40% by volume of total material was composed of an aggregate of granules having about the same chemical composition as the matrix. These granules were made by first mixing and reacting Parts A and B similar to those preceding to form a solid elastomeric pellicle which was then ground into aggregate granules of an average size of approximately $\frac{1}{16}$ ".

Part A and Part B were mixed to provide about an equal number of —NCO and —OH reactants in a continuous tube-type mixer and deposited from a chute into a screed frame and laid to a depth of about $\frac{1}{2}$ inch thick on already laid and weathered asphalt surfacing. By this procedure an approximately 8 foot wide strip of urethane paving surfacing was laid at the rate of about 2.5 feet per minute. Within 7 minutes after pouring the first linear foot, this area had hardened and could be walked on; the surface was tack-free and the paving appeared to be completely set up for general use at the end of this period of time. The paving adhered tenaciously to the asphalt and had a durometer of approximately 60.

EXAMPLE 2

A one furlong ($\frac{1}{8}$ mile) horse exercise track was made in accordance with the plan shown in FIGURE 3, the track being designated in its entirety by the numeral 44. The checkered portion of the track indicates that the urethane paving surface was laid on a concrete substrate, whereas the clear portion of the track represents that the urethane paving was laid over an asphalt substrate. The track was 10 feet wide and the urethane paving was one inch thick. The track is divided into sections, each section being somewhat different than the one next to it, the differences being noted in the block descriptions relating to each track section. With reference to these block descriptions, the "A." stands for aggregate; the "S." stands for soft; the "M." stands for matrix; the "H." stands for hard; and the "C.T." stands for chain terminating agent (which is given as a percentage of the total weight of the urethane paving material). Where aggregate granules were sprinkled over the urethane surface to increase surface roughness, this is also indicated in the block description of the drawing.

Thus, taking the block description designated by the numeral 46 it is seen that this section of track was paved with a one inch thick, 10 foot wide urethane surfacing which was composed of 470 lbs. of aggregate granules and 600 lbs. of matrix to which mixture was added 3% by weight of a chain-terminating composition. The surface of the strip before settling up was thereafter sprinkled with soft aggregate granules to increase the surface roughness.

The soft aggregate was composed of granules having a Shore A₂ durometer of about 40 to 45 and the hard granules had a Shore A₂ durometer of from about 55 to 70.

Those sections of the track which contained about 3% chain terminant possessed an over-all durometer average of about 40. The section without any chain terminant displayed a general durometer of about 60, even though 50% by weight (or volume, since the specific gravity of the granules and the matrix was about the same) of the material was in the form of a soft aggregate having a durometer of about 45.

With reference to the illustrated track, the aggregate and the top surfacing granules were in a size range of approximately $\frac{1}{8}$ of an inch through about $\frac{1}{2}$ an inch and were basically of the same urethane composition as the matrix so that they were completely compatible therewith. In fact, after hardening of the urethane pavement and mechanical disruption of samples corresponding to the paved sections, breaking in tensile was found to occur just about as often through the middle of the aggregate granules as around them.

The general over-all formulation of both the matrix and the aggregate is given hereinafter, the difference between the hard aggregate and the soft aggregate being simply that to produce the hard aggregate, no chain terminating agent was added to the reaction mixture whereas to produce the soft aggregate, 3% of a chain terminating agent was added to the mixture.

Part A

Ingredient:	Percentage by wt. (approx.)
Colloidal silica	1.15
Polypropylene glycol, 2025 molecular wt.	26.00
Polypropylene glycol, 1025 molecular wt.	24.45
Green pigment paste	.80
Calcium oxide	.20
Calcium octoate	.20
Lead octoate (hexogen lead)	.80
Partially calcined clay	46.00
2-ethyl hexyl octyl phenyl phosphite	.40

In the foregoing Part A formulation, the green pigment paste provides color to the mixture; the lead octoate acts as a catalyst to trigger the reaction of the secondary hydroxyl groups of this mixture with the isocyanate groups of the second part of the reaction mixture, listed hereinafter as Part B. The partially calcined clay is filler whereas the phosphite is a weathering stabilizer. The colloidal silica is an aid in maintaining the clay filler in suspension and the calcium octoate is a thinning agent to aid in maintaining the fluidity of the glycol even with the high clay loading. The calcium oxide serves to prevent catalyst deterioration on storage.

Part B

Ingredients:	Percentage by wt.
80:20 mixture of 2,4- and 2,6-tolylene diisocyanate isomers	90
Trimethylol propane	10

Ingredients of Part B were prereacted to form an adduct before mixing with Part A and Part B was made anhydrous by vacuum drying with only about half the lead octoate in, the rest of the lead octoate being added after the vacuum distillation.

Part A and Part B were mixed with one another in the matrix formation in the ratio of about 92 parts of Part A for each 8 parts of Part B resulting in an approximate 1:1 ratio of NCO to OH reactant groups.

The chain terminating agent used in both the formation of the matrix and the aggregate granules was "Flomax 25," (a product of National Lead Company normally used as a vinyl stabilizer and composed of barium and calcium carboxylates in a solvent mixture containing a kerosene-like hydrocarbon fraction, phenol and butyl cellosolve). The track sections were laid by first mixing the aggregate with Part A and thereafter mixing the resulting mass with Part B in a turbine cement mixer, pouring them in place from the mixer on the asphalt or concrete substrate and troweling or screeding the mixture to the proper level.

Within about an hour after laying, the track was in condition for use and for a period of 6 or 8 months after laying under all weather conditions the track was used as an exercise track for horses to ascertain which sections of the track appeared to be preferential.

Almost all of the track sections appeared to be usable, but it was the general consensus of the horse trainer after observing horses exercising on the track over a period of several months that the track sections having the 40 durometer hardness were generally favorable; no particular advantage appeared to result from putting granules on the top of the track before it set up as horses maintained their surefootedness on the track sections not having this addition just as well as on those sections with it. The track surface was nonporous and sloped so that water simply ran off either side. The track was not cut by horses wearing toe plates, stickers or caulks. Horses could be stopped short, or even turned and stopped from a gallop without gouging the track surface. Horses appeared to have perfect confidence in their footing on the track whether the track was dry or wet and galloped readily on the track. It was reported by jockeys and trainers alike that the usual jar transmitted through the horse's legs to the jockey riding the horse was quite muffled, or even absent, when horses were galloped over this track as contrasted with ordinary dirt tracks. In at least one instance, a horse which ran lame on ordinary tracks ran without favoring the lame leg over the others on this track. Thus in addition to the use of this track in all weather the resilience of the track will greatly reduce the incidence

be laid down much in the manner of carpeting or formed into paving tiles 50 as illustrated in FIGURE 5. To anchor preformed sheets or tiles the substrate on which the surfacing is to be placed or the undersurface of the urethane tile, or both, may be first coated with a suitable primer before laying the strip if it is desired that the strip be adhered permanently to such substrate. To enhance the non-skid properties of the paving when wet, the additional surface roughness provided by sprinkling further aggregate granules on the paving surface before paving hardening is recommended, particularly for vehicular traffic use.

While the specific examples herein set forth relatively precise details of the formulation of the binder and granules which form the paving material of this invention, it is to be understood that these formulations are subject to considerable variation in both ingredients and proportions depending on the use to which the paving is to be put, the environment in which it is to be laid, and the requirements of the user.

While many soluble metal compounds can be utilized to catalyze the reaction of the secondary hydroxyls of the polypropylene glycol with isocyanate groups, catalyst compositions which include as a part or all thereof, an ionizable monoorgano-mercuric compound such as phenyl mercuric acetate, butyl mercuric hydroxide, etc. are preferable as it has been found that reaction mixtures catalyzed thereby seem to adhere to wet surfaces as well as dry surfaces and to be less sensitive to environmental conditions, particularly humidity, than systems hardened with other catalysts.

These new urethane elastomer paving surfacings are water resistant, readily laid and repaired, durable, and adaptable to almost any paving requirement; they provide a rubbery paving surface possessing a versatility of application and repair heretofore unknown to the art. Some concept of the variations possible in the paving properties simply by varying the amount of the chain terminating agent present is set forth in the example following.

EXAMPLE 3

Using a liquid paving material composition similar to Example 2 in a weight ratio of Part A to Part B of 10/1, with varying amounts of chain terminating agents, the physical properties of the resulting rubbery urethane paving were varied as illustrated in the table following.

TABLE I

Chain Terminating Agent	Percent Used (as percent of reaction mixture)									
		1	2	4						
"Flomax 25"-----										
Phenol-----					.5	1	2			
Butyl Cellosolve-----								.5	1	2

Effect of Chain Terminating Agent on Physical Properties										
Tensile, p.s.i.-----	515	320	254	209	352	286	180	305	207	82
Elongation (percent)-----	175	160	206	343	206	225	375	180	223	307
Durometer (Shore A ₂)-----	75	65	52	40	60	54	31	65	50	14
Time to Harden, minutes-----	5	5	7	20	6	7	13	7	20	60

of broken sesamoids, chipped hooves, bowed tendons, and other now prevalent leg injuries.

After several month's weathering and the exercising of many thoroughbred horses with all kinds of shoes, the track was deliberately gouged and pieces taken out of it. Liquid elastomer forming urethane mixture was poured in the gouged areas, smoothed over and sprinkled over with granules, to form patches which set up in a few minutes and became a homogeneous part of the track surfacing, illustrating the ease of maintaining the track.

The difficulty encountered in tearing up the track from its substrate showed that the track had adhered well both to the concrete substrate and the asphalt.

The urethane paving surfacing of this invention can also be made in preformed sheet or strip form and wound into rolls such as 48 shown in FIGURE 4 so that it can

As is apparent from the table, tremendous property variations in the paving are possible with the most elementary control technique.

The paving is inert to attack by soil microorganisms. This versatility in selection of physical properties further adapts the use of this new rubbery urethane paving to any environment in which a rubbery paving is desired.

The foregoing examples have been directed to a preferred kind of polyurethane rubber for use both as the granular aggregate and as the binder for the paving as these materials are, in comparison with other urethanes, quite economical in addition to being readily handled for paving in situ, capable of rapid repair, and rapidly hardenable to a desired durometer range with minimum skill of application. All of these features are desirable from the standpoint of producing a use-

ful paving. By controlling the amount of catalyst, and combining catalyst addition with curing, or by heat curing without catalyst the curing times may be widely varied.

Further, other rubbery forming urethane materials can be used either as the aggregate or the binder or both. This is particularly the case where the paving surfacing is to be made at the point of manufacture in the form of tiles, slabs, flexible sheets or the like and the rubber hardening conditions, mixing, temperature controls, etc., can be factory controlled. Thus, incompletely reacted polymers, or prepolymers, which are still in a liquid state but which possess further reactive isocyanate or hydroxyl groups for finishing off or hardening the polymer have been successfully used. For example, paving slabs have been made having the following formulation:

Paving composition

Ingredients:	Parts by weight
"Adiprene-L" -----	1
"MOCA" -----	1/10
Reclaimed rubber chopped to about 1/8 inch average size -----	1

"Adiprene-L" is a trade designation of E. I. du Pont & Co. for a partially reacted urethane polymer of a 1,4-butylene oxide based polyurethane prepolymer having excess NCO groups for further reaction and finishing off to a solid state. "MOCA" is a tradename of Du Pont for 4,4'-methylene bis (2-chloroaniline).

Slabs cast from this mixture of aggregate and liquid prepolymer and cured for 3 hours at 225° F. provide excellent, long weathering paving surfacings having a rough appearing non-skid surfacing.

We claim:

1. A tough resilient paving surfacing adhered to a rigid substrate which paving surfacing is capable of quick, simple repair and which maintains good non-slip characteristics when wet, said surfacing being resiliently deformable and having a Shore A₂ scale durometer in the range of about 30 to 80, said surfacing comprising in combination about 90% to 50% by volume of a cross-linked resilient polymeric organic polyol based polyurethane rubber and about 10% to about 50% by volume of resilient aggregate, said aggregate being of an average size in the range of about one-sixteenth of an inch to about three-quarters of an inch, said surfacing being directly bonded to said substrate and being the solidified product of a substantially volatile solvent free 100% solids forming liquid material carrying said aggregate therewithin and being capable of solidifying at ambient temperature to a non-flowing slump resistant state in a period of about one hour said liquid material comprising a reaction mixture consisting essentially of organic polyol and organic polyisocyanate in amounts providing an approximately equivalent number of NCO to OH groups, and an ambient temperature curing catalyst therefor.

2. The surfacing of claim 1 wherein said liquid material contains from about 20% to 50% by weight of finely divided filler.

3. The surfacing of claim 1 wherein said surfacing has a topping of resilient aggregate granules thereon.

4. A tough resilient paving surfacing adhered to a rigid substrate which paving surfacing is capable of quick, simple repair and which maintains good non-slip characteristics when wet, said surfacing being resiliently deformable and having a Shore A₂ scale durometer in the range of about 30 to 80, said surfacing comprising in combination about 90% to 50% by volume of a cross-linked resilient polymeric polyalkylene ether polyol based polyurethane rubber and about 10% to about 50% by volume of resilient aggregate, said aggregate being of an average size in the range of about one-six-

teenth of an inch to about three-quarters of an inch, said surfacing being directly bonded to said substrate and being the solidified product of a substantially volatile solvent free 100% solids forming liquid material carrying said aggregate therewithin and being capable of solidifying at ambient temperature to a non-flowing slump resistant state in a period of about one hour, said liquid material comprising a reaction mixture composed principally of polyalkylene ether polyol and organic polyisocyanate in amounts providing an approximately equivalent number of NCO to OH groups, and an ambient temperature curing catalyst therefor.

5. A tough resilient paving surfacing adhered to a rigid substrate which paving surfacing is capable of quick, simple repair and which maintains good non-slip characteristics when wet, said surfacing being resiliently deformable and having a Shore A₂ scale durometer in the range of about 15 to 80, said surfacing comprising in combination about 90% to 50% by volume of a cross-linked resilient polymeric polyalkylene ether polyol based polyurethane rubber and about 10% to about 50% by volume of resilient aggregate, said aggregate being of an average size in the range of about one-sixteenth of an inch to about three-quarters of an inch, said surfacing being directly bonded to said substrate and being the solidified product of substantially volatile solvent free 100% solids forming liquid material carrying said aggregate therewithin and being capable of solidifying at ambient temperature to a non-flowing slump resistant state in a period of about one hour, said liquid material comprising a reaction mixture composed principally of polyalkylene ether polyol and aromatic polyisocyanate in amounts providing an approximately equivalent number of NCO to OH groups, and an ambient temperature curing catalyst therefor.

6. A tough resilient paving surfacing adhered to a rigid substrate which paving surfacing is capable of quick, simple repair and which maintains good non-slip characteristics when wet, said surfacing being resiliently deformable and having a Shore A₂ scale durometer in the range of about 15 to 80, said surfacing comprising in combination about 90% to 50% by volume of a cross-linked resilient polymeric polyalkylene ether polyol based polyurethane rubber and about 10% to about 50% by volume of resilient aggregate, said aggregate being of an average size in the range of about one-sixteenth of an inch to about three-quarters of an inch, said surfacing being directly bonded to said substrate and being the solidified product of substantially volatile solvent free 100% solids forming liquid material carrying said aggregate therewithin and being capable of solidifying at ambient temperature to a non-flowing slump resistant state in a period of about one hour, said liquid material comprising a reaction mixture consisting essentially of polyalkylene ether polyol and aromatic polyisocyanate in amounts providing an approximately equivalent number of NCO to OH groups, and a polyol soluble organic compound of a metal in the presence of which the reaction mixture cures to a solid state at ambient temperatures.

7. A method for paving concrete and other substrates with a tenaciously adherent solvent-free, rapid room-temperature curing surfacing which comprises mixing about 50% to 90% by volume of a self-hardening, solvent-free 100% solids forming liquid reaction mixture composed principally of organic polyol, aromatic polyisocyanate, and catalyst in the presence of which said polyol and polyisocyanate cure at room temperature to a Shore A₂ durometer of about 15 to 80, with about 10% to about 50% by volume of resilient aggregate, said aggregate being of an average size in the range of about one-sixteenth of an inch to about three-quarters of an inch, then applying the resultant slurry to the substrate to be paved and allowing it to solidify.

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