Oct. 18, 1927. 1,645,635

W. B. WESCOTT

PAVING

Filed Dec. 5, 1923

Fig. 1.

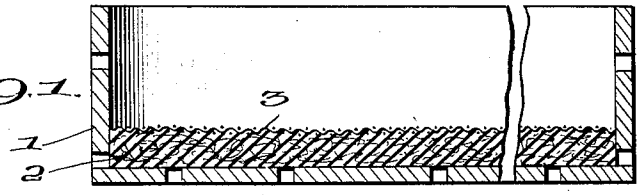


Fig. 2.

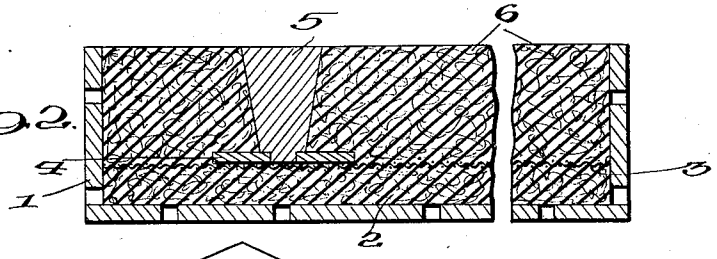


Fig. 3.

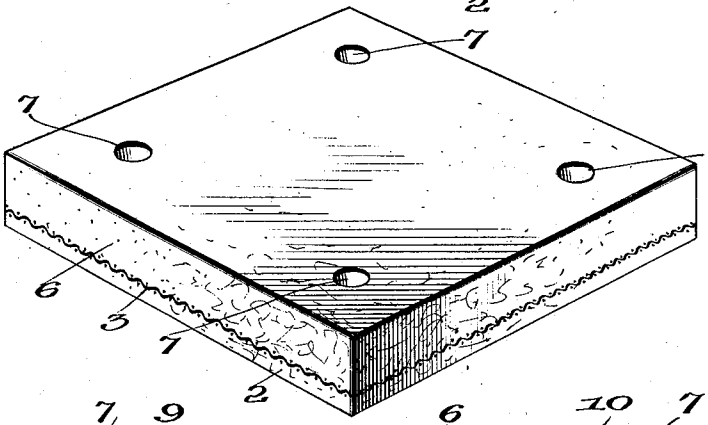
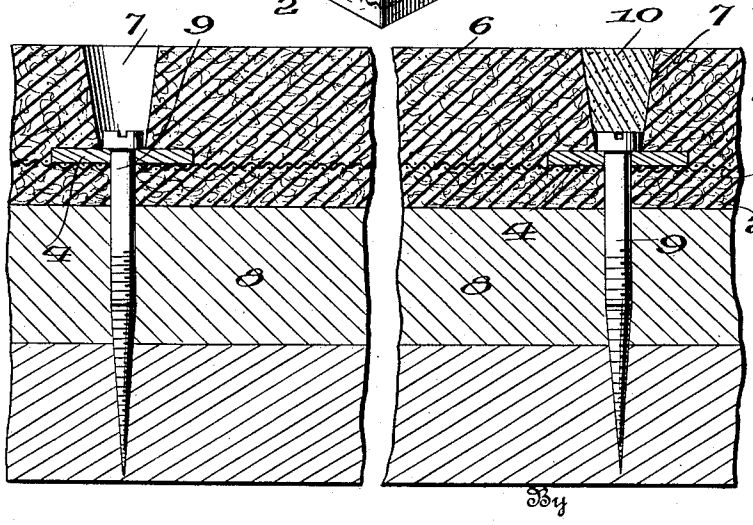


Fig. 4.



Inventor

W. B. Wescott

By

K. P. McElroy

Attorney

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UNITED STATES PATENT OFFICE.

WILLIAM BURTON WESCOTT, OF QUINCY, MASSACHUSETTS, ASSIGNOR TO THE RUBBER LATEX RESEARCH CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

PAVING.

Application filed December 5, 1923. Serial No. 678,673.

This invention relates to paving and processes of producing the same; and it comprises as a new manufacture a paving block or sheet, consisting essentially of rubber and relatively long spun cotton cords or threads in intimate association, reinforcing means being located in the block or sheet near its lower face, said block or sheet carrying perforations extending from its upper face to said reinforcing means; and it further comprises a paving consisting of said blocks, an underlying foundation, screw or spike means extending through the continuous rubber of the lower portion of said block into said foundation, and plugging means above the heads of said screws or spikes; all as more fully hereinafter set forth and as claimed.

For many reasons, rubber compositions form an ideal material for paving and parqueting purposes, notably for hospitals, steamships, road surfaces, etc., but for practical reasons, they have not been successfully used to more than a limited extent. In a broad way, the lack of success of the various propositions which have been made has been due to a failure to appreciate the properties of rubber. Rubber is a practically uncompressible material; and, unlike all other paving materials, it distributes an impressed load instead of transmitting it directly. In other words, considering a rubber brick used for paving, a load at one point results in distributed stresses at all points within the brick and along its base. For this reason, it is difficult to hold a rubber paving in place. For example, if it be kept in place with screws or nails, traffic tends to pull the screws, since a downward thrust at the middle of the brick means an upward pull at other points. Nor can a resilient rubber brick be retained in position by a cemented union with a foundation at its base.

In the present invention, I provide the brick or block with a reinforcement, usually of metal screen or metal netting, located in the lower third of the block. Ordinarily, for paving purposes, I make these blocks about 2 inches thick in the finished state and I find it best to locate the reinforcement about half-an-inch from the bottom of the block. The size of the wire mesh or screen, of course, depends upon the particular purpose for which the brick is to be used. In making blocks for heavy traffic purposes of, say, 36x18x2 inches, I may employ a heavy steel wire screening with a relatively small mesh, such as #8 wire with a half-inch mesh. On this mesh, I apply heavy washers at intervals and then mold the brick in such a manner as to leave cylindrical holes from the upper surface down to these washers; these holes serving for the subsequent use of screws or nails passed through the washers and screen into a supporting base below. It is convenient to give these holes a certain taper. The base may be of wood, such as pine. Or the base may be of concrete provided with inset wooden sleepers or plugs. When the base is concrete, without wooden sleepers, I use bolts of the expansion type. In applying the paving, the screws or nails are put in place and the holes closed by suitable plugs of the same composition as the body of the block. In making parqueting, which is usually rather thin, I use a finer mesh screen, usually of metal. However, woven jute or cotton fabric is applicable and may be used in lieu of metal. Parqueting is usually laid in thicknesses ranging from a quarter of an inch, or perhaps a little less, to half-an-inch. In making parqueting, I proceed in the same way as for making paving blocks, except that commonly I prefer the more convenient sheet making operations to those used in molding. Parquetry material is thin and with it, it is not necessary or practicable to use the relatively heavy anchoring means desirable for the retention of paving blocks. The deep recesses or holes described in connection with the paving blocks are not usually employed with parquetry strips.

As the composition for making these blocks, I desire one of such a resiliency that a steel ball dropped on it will rebound to a height of one-tenth that from which it falls. The resiliency required to meet conditions of exceptional vibrations, as on bridges, may be higher than this; but a "10 per cent" resiliency is about what is required on the average. For the purposes of structural strength and to meet paving requirements, I incorporate relatively long spun cotton fibers, that is, cord or thread, into the composition; say fiber ranging from half-an-inch to one and a half inches. While it is not practicable to incorporate fibers of a length such as this into rubber compositions by the ordinary

milling processes, since milling disintegrates the fibers, yet it can be done by the use of special expedients hereinafter indicated. Long fibers can, of course, be "frictioned" with rubber; or treated with rubber by what are known as "rubber solutions"; rubber taken up by benzol and the like. But with these methods of bringing rubber and fiber together, there is not the union which I find desirable for the present purposes. To accomplish my ends, the bonding rubber of the composition must be distributed through the fiber; not merely enter its surface irregularities.

A convenient and cheap source of fiber of the character I desire is comminuted tire stock. Such tire stock carries a varying amount of partially cured rubber which has been "frictioned" on the fabric; there being a greater or less proportion of irregularly shaped pieces of partially cured rubber ranging in size from dust particles to pieces just small enough to pass through the sizing screens which are used to return coarser fragments to the comminuting mills. The size of comminuted tire stock I find most advantageous is that which will pass through a $\frac{3}{16}$th inch mesh screen.

In old tires, the average ratio of partially cured rubber to cotton is about as 1:1, while for my purposes, I desire a somewhat higher ratio of fiber; that is, to meet the requirements of surface coefficient of friction and a relatively low resiliency, such as the 10 per cent mentioned, there should be somewhat more cotton than occurs in scrap. And I do not desire to use the short fiber, lint, fine particles and dust, such as occur in the product of the comminuting mills in making paving blocks, as these tend to decrease the strength of the finished material. Therefore, I usually further screen the tire stock to get rid of fines, preferably in a revolving tumbling screen, as this tends to brush up the ends of the cut fiber cords, so that each little cord has a shaving brush appearance at the end.

While fiber and rubber from other sources may be used, comminuted tire stock, especially when treated as described, is cheap and convenient, and gives particularly good results for my purposes. Scrap from rubber frictioned cotton conveyors and power transmission belting gives much the same material. The mutual relation of rubber and fiber in tire stock is, for reasons previously stated, not as good as is desirable for my purposes; but this I remedy by an expedient.

In a practical embodiment of my process, presuming that I am making 2-inch paving blocks, 36 x 18 inches, to be laid on a firm foundation, the dry comminuted and screened tire stock is impregnated with a rubber latex which is advantageously concentrated to carry about 50 per cent rubber. This concentration is advantageous over unconcentrated latex, although not necessary, since it cuts down the length of a subsequent drying operation. Latex is a material of freely penetrating properties and it permeates the fiber and unites with the rubber, forming in a subsequent operation a unitary body or composition. Impregnation is best carried out by the usual vacuum method, though ordinary immersion and churning furnish a fairly satisfactory product. It is ordinary desirable so to treat the latex as to cause a partial or slight coagulation to take place at the time of impregnation. This may be accomplished by partially neutralizing the ammonia which is usually present as a preservative; a suitable acid being added in such amount as to cause merely a slight thickening of the latex mass. In so doing, while there is some agglomeration of caoutchouc particles, a large proportion of the caoutchouc particles will remain in their normal latex state and are capable of entering the interstices of the tightly twisted cords of the tire scrap. Such a limited coagulation at this stage facilitates subsequent manufacture, since the molded mass is easier to remove as a whole from compression and drainage molds without crumbling or disintegration. The mass containing the latex is placed in a suitable mold having foraminous walls. In the present instance, making a 2-inch block, I fill the mold with the mass to a height of one-half an inch and then insert the reinforcing wire screen. On the screen at the desired places are located metal washers and above each of these washers and holding it in place is a conical mold piece. The mold is then completely filled with the latex-wet mass. Before putting this mass in the mold, there is incorporated into it such vulcanization agent as may be subsequently necessary. The amount of vulcanization agent may be the same in the first portion of the mass put into the mold, which forms the base of the brick, as in the second portion added, which forms the upper portion, or it may be different. Ordinarily, I find that a simple addition of about 5 per cent of sulphur (on the rubber in the latex) is sufficient to give the best cure in subsequent treatment. The mass in the mold is compressed to a definite volume, excess of watery liquid being expelled. By so doing, I obtain for a given quantity of tire stock a definite latex addition. In general, not less than 10 nor more than 15 per cent latex rubber is required to satisfy the cottom cord interstices and thoroughly bond the mass.

In general, because of the after-curing and ageing effect of the proteids contained in raw latex, I believe it advantageous to purify the latex somewhat, freeing it to a greater or less extent of its non-rubber constitutents and particularly of its proteids.

The more nearly the latex approaches a watery emulsion of relatively pure rubber derived from normal latex, the better. Concentration and purification may be effected by a particular treatment and washing in a centrifugal, as more fully described and claimed in my copending application, Serial No. 601,909 filed November 18, 1922.

In making parqueting, where a lower compressive strength is adequate, the screened out portions of tire stock not used for paving stock, short lengths of cord, lint, rubber dust, etc., may be used. Sometimes, for light duty, in offices, hospitals and the like, no special metal or other reinforcement may be required. But for heavy duty purposes, such as factory floorings and the like, the reinforcement is advantageous, as tending to reduce buckling under load.

Returning to the example, after the block has been formed and shaped under pressure, it is transferred to suitable drying means, such as a vacuum drier of the shelf type. At this time, the brick blanks are relatively soft and contain a considerable amount of water. This is removed in the drier, leaving a highly resilient, porous, sponge-like, but very tough mass. Advantageously, in the drying, the moisture is reduced to 1 per cent, or lower. Rubber does not satisfactorily adhere to damp fiber. The dried blank is placed in a suitable mold and vulcanized. I find it desirable to carry out vulcanization under rather higher pressures than are commonly employed in the ordinary curing of rubber articles. For paving material carrying the long cotton cord or thread, in general I find it desirable to have a pressure not less than 1000 pounds per square inch. In curing parquetry material, pressures of this order of magnitude are generally also desirable; but it is sometimes expedient, for various reasons, to use lower pressures, say, pressures of 500 pounds or thereabouts. Vulcanization may be accelerated in the usual way, by the use of accelerators in connection with the sulfur.

In using the finished block, I ordinarily apply it to a wooden foundation which may be of pine boards, laying the bricks in a self-curing rubber cement. Spikes of the drive screw type are driven down through the holes passing through the washers and the screen and the lower quarter of the material into the underlying wood. I ordinarily aim to use these spikes in such a way as to compress the lower half-inch (in a two-inch block) of rubber by about 10 per cent. This insures a constant upward pull on the drive screw and tends to prevent the loosening of these retaining means by vibration. I then close the holes, usually with tapered plugs of the same composition, wet with the self-curing cement and driven home in their pockets.

The ordinary fillers, zinc oxid, whiting, etc., may be used in the composition, as may various rubber substitutes; but these I do not ordinarily recommend. I find that the best material for paving purposes is rubber and cotton in nearly the relation as that in whch they exist in old tire stock. As stated, I usually find it better to increase the ratio of cotton to rubber in the scrap somewhat. Old tire stock, having about equal quantities of rubber and cotton, gives a brick having a compressive strength comparable to good concrete and a resiliency of about 40 per cent. When the ratio of rubber is reduced to 25 per cent, the resiliency drops to about 10 per cent and the compressive strength goes up to nearly three times that of good concrete.

In the accompanying illustration, I have shown, more or less diagrammatically, various stages in the operation of producing a complete paving block and paving.

In Fig. 1, element 1 shows a perforated or foraminous mold of steel or other suitable material. As illustrated, it contains the first or bottom layer of latex-wet material 2 with a reinforcing screen 3, shown here as of metal, lying upon it. In Fig. 2, the showing is the same, but upon the screen has been placed a washer 4. Upon this washer is placed a molding plug or core 5, shown as entering the washer. Around this molding core is placed a second, but thicker, layer 6 of latex-wet material.

Fig. 3 shows, in elevation, a complete block of paving material. As here shown, it is provided with four orifices 7 in the upper portions for receiving screws or spikes to attach it to a foundation. The view shows a complete block ready for laying. While as shown it has four points of attachment, there may be more or fewer.

In Fig. 4 is shown, fragmentarily, the block in position. In the left hand fragmentary view, the block is shown attached to a wooden foundation 8 by means of drive screws 9 passing through orifices 7 and seated on the washer described. In the right hand portion of the view, the showing is the same, save that the space above the drive screw is closed by plug 10. As shown, this plug is tapered to correspond to the contour shown of orifices 7. Other contours than that shown may be employed. In practice, I ordinarily wet plug 10 with a suitable rubber cement before attaching it. Ordinarily, also, I wet the lower face of the paving block with rubber cement before placing it on the foundation 8. Rubber cement may also be used between the contacting lateral faces of the adjacent blocks.

In the present invention, the strip of reinforcing material in the lower third of the block prevents stresses producing longitudinal stretch of the block as a whole; and it limits the upward pull on retaining or

anchoring elements outside the area of compression. In the present invention, it is desirable to produce a paving material of relatively high resilient character and the reinforcement located as described prevents difficulties with anchoring means. Brick made as described are little affected by temperature change and have a very low water absorption and a high surface coefficient of friction, even though wet or oiled, as by the grease dropped from passing automobiles. Because of the firm anchorage, and unlike rubber pavements of other types, the wear on the under surface is reduced to a minimum, and the pavement will remain in place throughout its effective life. Sometimes, for special purposes, I incorporate slightly more sulfur or accelerating agent into the lower third or quarter of the article than into the upper portion; or cure in such a manner as to produce greater hardness on the lower surface. Curing of the lower surface may even go so far as to make it of the nature of ebonite or hard rubber. In general however, when I do this, for the sake of economy and for other reasons, I may incorporate into the base a little hard rubber, as in the form of hard rubber buffings. Or I may use some granular filler here. But for reasons already stated, I do not ordinarily desire filler in the top portion, or wearing portion, of the block. This portion I prefer to be composed only of rubber and relatively long fiber, as I secure the best results in this way. With a paving block made as described, the poor heat conductivity of the upper portion tends to minimize the loosening of the deep-seated drive screws by expansion and contraction, and the lower half-inch or so of rubber, which the drive screw pierces, being compressed about the screw shank, makes a substantially waterproof joint, protecting the head of the screw and the underlying washer against corrosion. Ordinarily, I arrange things so the lower layer of the brick is compressed by the drive screw about 10 per cent of its normal thickness. This aids in minimizing motion between the blocks and the foundation, and affords a means of taking up such contraction and expansion of the anchoring bolts, screws or spikes as may occur under temperature changes. Ordinarily, I make my paving bricks with smooth lateral sides perpendicular to the wearing surface. The bricks may, or may not, be cemented together with a self-curing cement for the purpose of waterproofing the joint. The ratio of partially cured old rubber to cotton or, for that matter, the ratio of total rubber to cotton, is the most important single factor affecting resiliency and compressive strength and this ratio may be varied at will to meet any special requirements. The characteristics of great toughness and relatively low cost per unit weight make the present material suitable for various uses, such as fenders for ferry slips, mattings for use in lightering, that is to say, mattings to receive discharged cargo as it is landed by hoists, or for any other purpose where a strong rubber mass of moderate resiliency is required. In laying parqueting, I find it desirable (usually, though not always), to brush up or buff the lower surface of the sheet before applying rubber cement. Otherwise, the parqueting is laid in the customary way.

Ordinarily, old rubber used in new articles is further vulcanized; that is, the degree of vulcanization becomes enhanced; that is, the rubber becomes harder. And in the usual practice, the reclaimed rubber is plasticized. In the present invention, however, it is found as a matter of fact, that this greater vulcanization or hardening of the rubber in the tire stock used does not occur. In the finished article, it remains substantially at the stage of vulcanization where it was in the tire. Under the heavy vulcanization pressure here used, there is a thorough bond between the latex rubber and the little pieces of cut rubber coming from the tires, with as little as 5 per cent sulfur in the latex rubber. The whole rubber mass becomes substantially integral and homogeneous without appreciable hardening of the previously cured rubber, that is, of the old rubber. Without committing myself to any theory, it is perhaps possible that sulfur from the old tire migrates, under suitable vulcanization conditions, into the new rubber, giving a cured homogeneous product having substantially the same combined sulfur ratio throughout. In the article of the present invention, the old rubber of the tire scrap is not foreign matter, but is integral with the rubber derived from the latex.

While I have described paving and parquetry articles of the invention as applied to a special base or flooring, it is possible to use a sectional base attached to the block or sheet; as by curing or vulcanizing the block or sheet to a wooden or other slab. In some embodiments of my invention, such a basal rigid body may be used in lieu of, or to co-operate with, the contained reinforcing fabric.

What I claim is:—

1. A paving block or sheet consisting of comminuted tire stock carrying relatively long threads or cords and impregnating latex rubber, said block or sheet carrying a horizontally placed reinforcement near its lower face and interlocking with said fibers.

2. A paving block or sheet consisting of comminuted tire stock carrying relatively long threads or cords and impregnating latex rubber, said block or sheet carrying a horizontally placed metal reinforcement near its lower face interlocking with said

fibers and being provided with orifices extending from its upper face to said reinforcing means.

3. A paving block or sheet consisting of an assemblage of rubber and cotton fibers between an inch and an inch and a half in length, part of said rubber being latex rubber, said block or sheet carrying a horizontally placed metal reinforcement near its lower face interlocking with said fibers and being provided with orifices extending from its upper face to said reinforcing means.

4. As a new paving, a base and rubber paving material attached thereto, said material having the general composition of tire scrap containing vulcanized rubber and relatively long threads or cords containing impregnating latex rubber and having the contained rubber as an integral mass.

5. A paving block comprising a body of relatively long threads of fibrous material and vulcanized rubber, and a reinforcing screen disposed adjacent the lower portion of the block in parallel relation to the lower surface thereof, the threads being interlocked with each other and with the screen, and the vulcanized rubber extending as an integral continuous mass throughout the block and interspersed with and surrounding the threads and the screen, the proportion of rubber to fibers being less than 1:1.

In testimony whereof, I have hereunto affixed my signature.

WILLIAM BURTON WESCOTT.