

Oct. 5, 1937.

H. A. SHAW

2,094,853

DOWEL PIN FOR CONCRETE CONSTRUCTION

Filed Dec. 16, 1935

3 Sheets-Sheet 1

Fig. 1

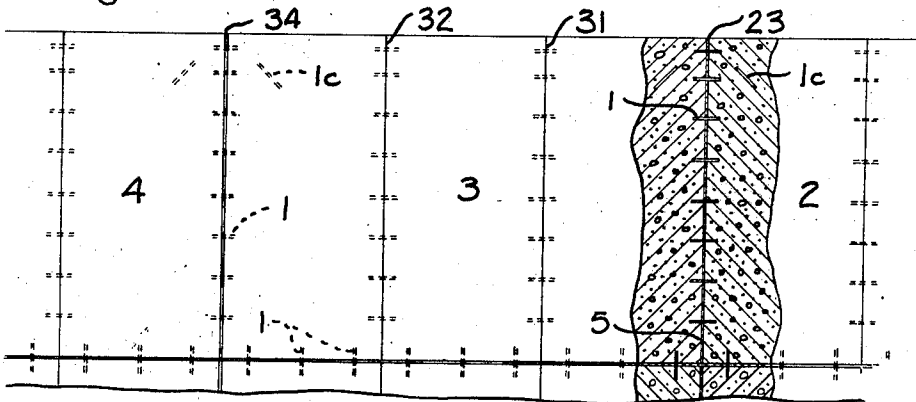


Fig. 2

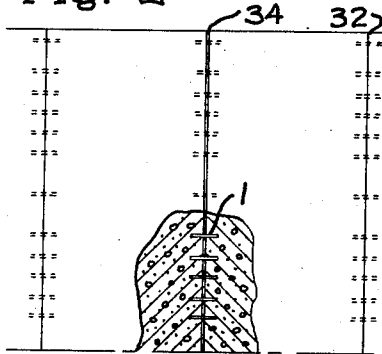


Fig. 3

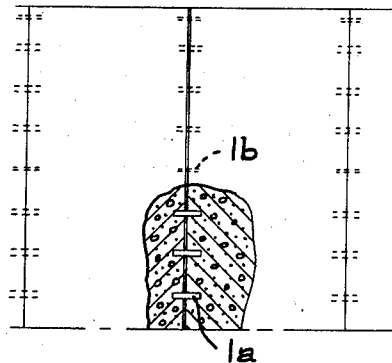


Fig. 4

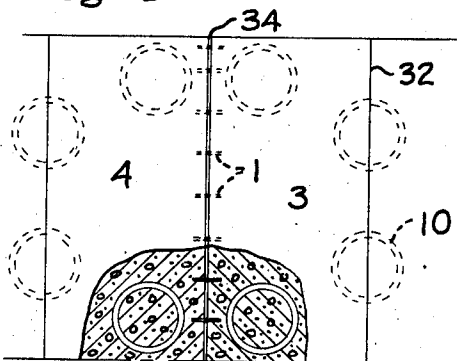
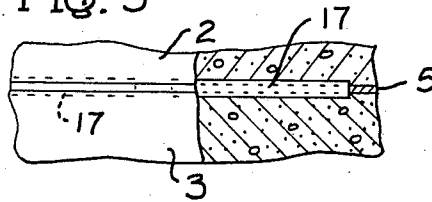


Fig. 5



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Fig. 6

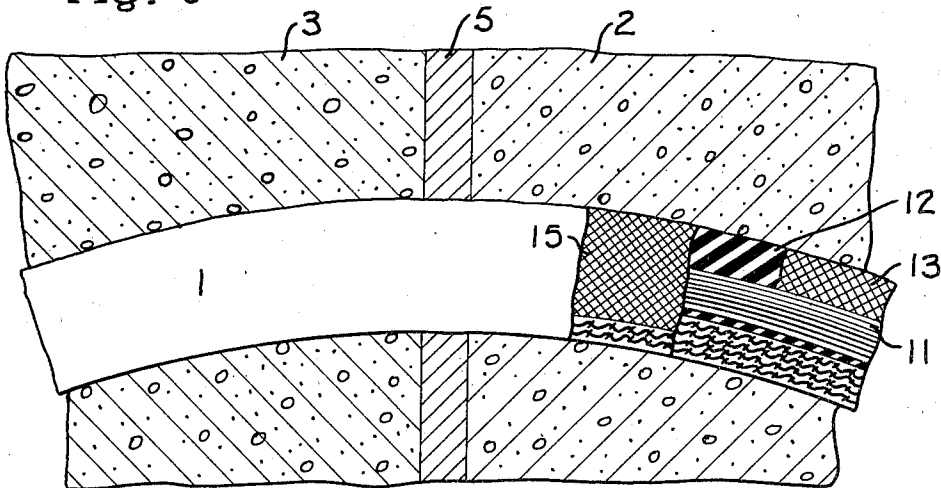


Fig. 7

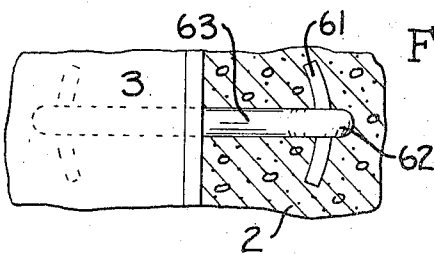
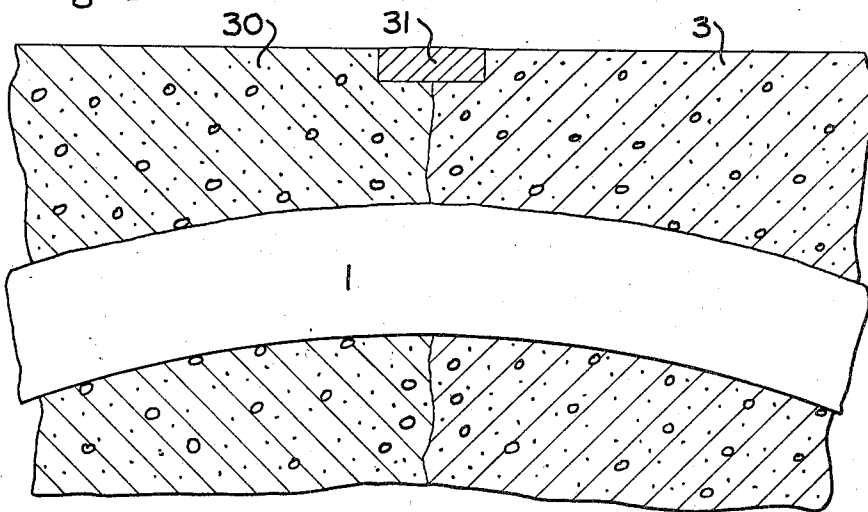


Fig. 12

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Fig. 10

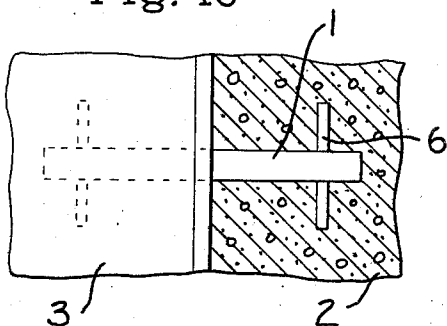


Fig. 11

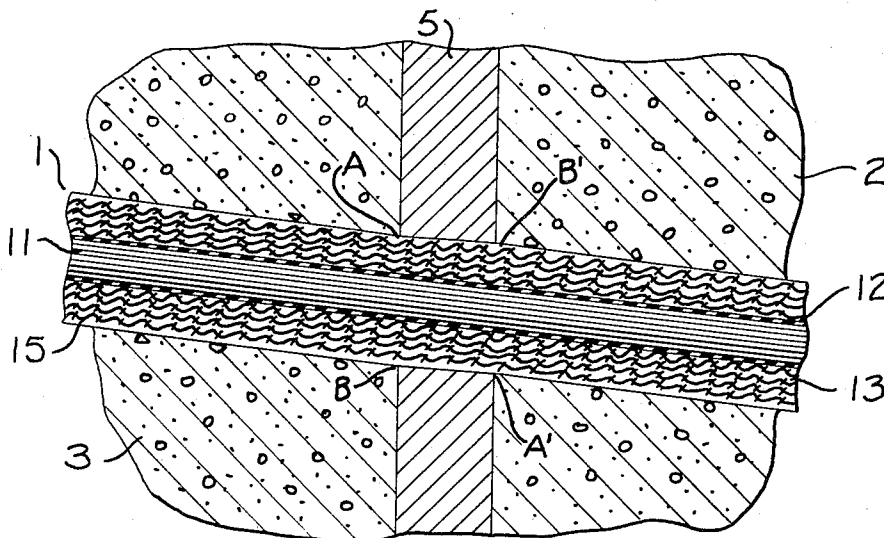
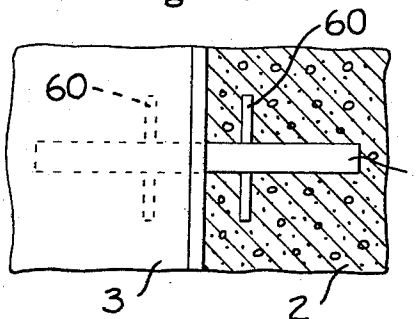


Fig. 8

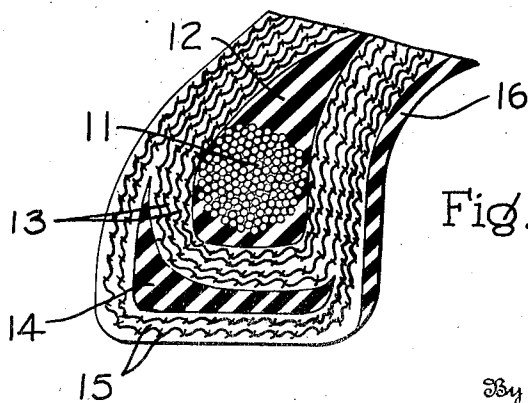


Fig. 9

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UNITED STATES PATENT OFFICE

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DOWEL PIN FOR CONCRETE CONSTRUCTION

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10 Claims. (Cl. 94—8)

My invention relates specifically to paving, and more particularly to means for transmission of loads from one slab of concrete paving across a joint such as an expansion joint, to the adjoining slab. Such stress-transmitting means are commonly termed dowel pins, hence my present invention is in the nature of a dowel pin for joining and transmitting stresses between two adjoining concrete slabs or sections, actually or potentially separate. When I speak of slabs, however, I do not intend to exclude wall sections and the like, as my invention will be found valuable wherever dowel pins are or should be employed, and indeed my element may be used whether there is an actual joint, a dummy joint or line of weakening for the purpose of directing and controlling fracture, or indeed in any place where a potential or an actual joint is located or may occur. Furthermore, while my invention will find its greatest field of usefulness in concrete paving, the principles thereof are valuable and applicable in other paving, as with aggregates coated and bonded with bituminous coatings. More broadly speaking, then, my invention relates to the reinforcement of paving or the like in such manner as to transmit stresses between two adjoining slabs, as broadly defined above, whether those parts be actually or only potentially separate.

My invention will be described in conjunction with paving slabs, since it is in this field that it will probably find its greatest use, with the reservations indicated above, namely, that the invention may be applied in various types of concrete construction and in various locations in any such construction.

It is customary in such paving construction to employ in the so-called expansion joint between slabs a filler strip which has a number of holes through it, in which holes are received steel dowel pins, so that when the concrete is poured on either side of the expansion strip, the ends of the steel dowel pins become embedded in the adjoining edges of two different slabs. To provide lengthwise slippage, one end of the dowel pin is greased and painted, so that as the concrete expands or contracts at a rate different from the rate for the pins, slippage will occur at this treated end because the painting and greasing breaks the bond between the pin and the concrete. Theoretically, then, these dowel pins will transmit stresses between the two slabs, so that they mutually support each the other. In practice, however, it has been found that their action is considerably more complicated than this. Due to climatic or atmospheric changes, the concrete

tends to contract and expand, or to curl, and thus the rigid steel dowel pin, which expands and contracts at a different rate, and which cannot curl, acts as a rout or drill to grind away the concrete immediately surrounding it, and thus to enlarge its hole, and this action is progressive as time passes. Moreover, the hole being enlarged, room is permitted for play, so that as the concrete slab is flexed slightly by the passage of traffic, it begins to pound upon the steel dowel pin, which acts as an anvil, and this again breaks down the concrete immediately surrounding the pin and progressively enlarges the hole and weakens the slab. When any enlargement of the hole, surrounding the dowel pin, occurs there is a reduced area of bearing of the concrete on the round dowel pin. This concentrates loads on the concrete along a small area, resulting in a more rapid crushing action, later in bending of the dowel pin, and progressive deterioration of the concrete.

While these difficulties have been recognized, and efforts have been made to avoid them, as mentioned above, by coating one end of the dowel pin with bitumen or by encasing it within a cap, so that play is permitted lengthwise of the dowel pin, as the concrete expands and contracts, this has been found not altogether satisfactory, particularly so as the dowel pin must be precisely parallel to the direction of expansion and contraction, or otherwise a bending moment is set up in the dowel pin, further tending to grind away and break down the concrete, and from the manner of embedding these dowel pins in the slabs, they being held merely by their projection through the rather flimsy expansion strip material, it is, practically speaking, impossible to have all such dowel pins, or any considerable number thereof, precisely in line with the direction of contraction and expansion. Moreover, as the rate of contraction and expansion varies in different slabs, owing to their being exposed differently to shade and sun, they will not always expand and contract along longitudinal lines; hence even though the dowel pins may be set precisely longitudinally, they may still tend to be bent under some circumstances.

Furthermore, if these steel dowel pins are once bent beyond their elastic limit, they tend always to remain bent, and in such an event tend to grind and wear away the concrete to a greater extent, and tend actually to set up stresses which will crack the concrete. Thus, instead of preventing cracking of the concrete, under some circum-

stances steel dowel pins may act to cause and accelerate such cracking.

Steel dowel pins being, of necessity, rigid, but the two slabs joined thereby being repeatedly flexed by traffic, or by atmospheric conditions, these dowels may, of themselves, constitute a potentially destructive force, in that they may hold the edges so rigidly in alignment that their elastic limit is exceeded, and they crack around—that is, outside of—the dowels.

So many difficulties have arisen from the employment of such dowel pins that their use is being discontinued in some new constructions, it being felt that the disadvantages (including cost) rather outweighed the advantages of using them. There are, however, certain advantages, theoretically at least, in that each slab will cooperate with adjoining slabs to mutually support the traffic loads as they pass from the edge of one slab onto the edge of the other, and these are particularly the weak points of such paving slabs, owing to the fact that the concrete, being exposed to sun, snow, and other extremes of weather, will curl away from the subgrade, or the latter from repeated pounding will be permanently compressed, or will settle, so that the slab will at times have its edge unsupported by the subgrade, the latter being affected more slowly and to a lesser extent by weather and climatic changes than the slabs. Therefore, to retain the advantages of dowel pins, yet to eliminate their disadvantages, is the general aim of the present invention.

A still further object of the invention is to utilize a material which is a waste material, and therefore cheap, a material which is eminently suited to the purpose, and of which there are large quantities available in all parts of the country (and will be, so long as there are roads), namely, tire bead material.

The casings of tires, less the beads, may be used for a variety of purposes. They may be stamped into various shapes, and thus used, as for example, in the making of mattings or marine fenders. They may be ground up and the rubber reclaimed or reused. In manufacture of the tire bead the material is subjected to tremendous pressure, greater than any other part of the casing, is of the purest rubber compound of any in the tire casing, and incorporates many plies of the finest cotton fiber manufactured into cord or fabric strips. Moreover, it incorporates groups of steel wires of high flexibility and strength, and this is in all cases surrounded by a matrix of rubber, usually a high grade rubber compound which impregnates the group of wires and all the plies of the fabric. Such tire bead material, then, incorporates the finest materials, but it has never heretofore found any practical use on a large scale, and is so constructed that it is difficult or uneconomical to reclaim the rubber from it. Instead of having value, such tire beads have constituted a liability heretofore, as they must be disposed of. Such material, I have discovered, makes a dowel pin having all the desirable qualities of the steel pin, lacking the undesirable qualities of the steel pin, and possessing additional advantageous qualities which make it the ideal dowel pin material.

My invention is illustrated in the accompanying drawings, in various forms, and illustrating various ways of employing the invention.

Figure 1 is a plan view of half of a typical road, illustrating a simple manner of using my invention.

Figures 2, 3, and 4 are similar plan views, each showing a modified way of using the invention.

Figure 5 is a plan view, on a somewhat enlarged scale, of part of an expansion joint and the two adjoining slabs, illustrating a further modification.

In all the above views parts of each slab are broken away and shown in section.

Figure 6 is a vertical section through two adjoining slabs at the expansion joint, illustrating the dowel pin in place, parts being broken back and shown in section.

Figure 7 is a view similar to Figure 6, showing my dowel pin employed in a dummy joint.

Figure 8 is a sectional view on a generally horizontal plane, through such a dowel pin and the two adjoining slabs.

Figure 9 is a transverse section through a typical tire bead.

Figure 10 is an elevation and part section of such a dowel pin in place, showing an anchoring means which may be employed in connection therewith, and Figure 11 is a similar view showing a modified disposition of the anchoring means.

Figure 12 is a view similar to Figures 10 and 11, showing a still further modification of the anchoring device.

When I refer to tire bead material I refer to material which incorporates at least that part of the tire casing usually termed the bead, and which, as shown in Figure 9, usually consists of a bundle of wires 11 embedded within and impregnated by a matrix of rubber compound, as indicated at 12, this in turn surrounded by several plies of fabric at 13, sometimes incorporating a mass of rubber compound at 14 to shape the bead, outer plies 15, and sometimes an outer layer of rubber compound at 16. The group of wires at 11 may be merely a single wire or rod, wires laid side by side, or a plurality of twisted wires, or they may be braided into a stranded cable. Furthermore, when I refer to tire bead material it is not essential that all the elements named remain in the material as used, for it is possible to withdraw the wires 11, for example, and while they are valuable in reinforcing and stiffening the material, the fabric plies nevertheless give it great stiffness and strength, and it will still be valuable without the wires. Furthermore, there may be more or less of the side wall material left in place upon the bead. As a minimum requirement, the term "tire bead material" as used in this specification must incorporate a strong core of stress-transmitting material, such as wires or fabric plies, embedded in a resilient shroud, such as rubber, and which therefore can not easily be permanently deformed by subsection to repeated and material strains. The bead material would ordinarily be cut into lengths suitable for the purpose intended, but as will appear in Figure 4, I may at times employ the complete circular tire bead as a reinforcement, or as a dowel across joints.

In Figure 1 the slabs, designated 2, 3 and 4 to distinguish them, are poured in place on the subgrade, with expansion joints between them at intervals. These expansion joints are indicated at 23 and 34, respectively, and there may also be dummy joints 31 and 32 formed in the slabs to provide weakened lines so that, if the slabs crack, the cracking will occur here and will be localized. My dowels may be placed across the dummy joints as well as across the expansion joints. They may also be used along the longi-

tudinal joints, and in general in any place where there is or later may be two separate pieces.

As is seen in Figure 1, the dowel pins 1, formed of tire bead material, may be put in place by embedding them within the expansion strip 5 at intervals, or otherwise supporting them in the forms, so that they project into each slab 2 and 3. Owing to their cheapness, as many may be used as desired. It is not so necessary that they be as accurately placed as steel dowel pins, as they are inherently yieldable and elastic, nor is it necessary to provide an expansion space lengthwise of these pins, as they are compressible longitudinally. As the slabs are poured, with the expansion strip 5 in place, the dowel pins 1 will become embedded in each adjoining panel or slab. Preferably they extend lengthwise of the paving, in expansion, construction, or dummy joints, and transversely in longitudinal joints. As shown in Figure 1, they are all of the same strength and equally spaced. Angularly spaced dowel pins 1c are shown at the corners of panels, for the purpose of reinforcing the corners which are weak spots, and to hold parts together should breakage occur. However, it may be desirable to particularly strengthen certain parts of the joint, and in Figure 2 the dowel pins of the transverse joints are shown as all of the same strength and size, but more closely spaced at certain parts of the joint than at others. In Figure 3 there are shown equally spaced dowel pins, but the pins 1a are stronger and heavier than other pins 1b.

In Figure 4 is illustrated the use of complete tire beads, uncut except as they are cut away from the tire casing. Thus at 10 are shown complete tire beads embedded in the concrete, either across the false joint 32 or in the corners of the slab. Dowels 1 may be employed in the same manner as before, or the circular beads 10 may be extended across the expansion joint, if desired. Since concrete paving slabs frequently tend to break off across the corners it will be desirable to insert tire bead rings 10 in the corners of the slabs, to reinforce these corners and to serve as dowel pins should breakage occur.

These beads, made from heavy tires, are of considerable thickness, and since the expansion joint is ordinarily from one-half to three-quarters of an inch in width, the dowel pins in transverse joints may be placed transversely of the slabs, that is, lengthwise of the joint, as shown in Figure 5, instead of transversely of the joint. Such an arrangement is illustrated, the several connectors 17 being placed in the joint between the slabs 2 and 3, embedded partly in each slab.

While the precise manner of locating the dowel pins of tire bead material is immaterial, and it is immaterial whether they be precisely lengthwise of the direction of expansion and contraction, yet preferably, to take advantage of their curved form, they are placed in such a manner that the plane of their curvature is vertical, that is, their concave side is down, as seen in Figures 6 and 7. In Figure 6 such a dowel pin 1 of tire bead material is shown located between two slabs 2 and 3, with expansion strip material 5 between them. The slabs are assumed to have expanded. They tend thus to compress between them the entire length of the dowel pin, the surfaces of which slip with relation to the concrete in contact therewith, and this material, being of rubber compound, is elastically yieldable. It compresses more or less uniformly throughout, but upon contraction of the slabs 2 and 3 it will again resume its normal position. Because of the elasticity of

the material which comprises the tire bead dowel pin, it may yield in all directions without being permanently deformed. If the slabs 2 and 3 contract, to separate more than they were when poured, each dowel pin slips in its hole, later resuming its normal or initial position, all without abrasion or wearing away of the concrete. The factors of expansion or contraction of such dowel pins need never be taken into consideration, as their compressibility and elasticity will take care of such factors.

Such dowel pins being non-rigid, as pounding stresses are communicated to it by the passage of traffic from one slab to the other, it will not form an unyielding anvil, but rather will yield slightly, though still affording adequate mutual support between the two slabs. Since it does not wear or grind away the concrete surrounding it, the area of support is never lessened. If it is not put in place perfectly parallel to the direction of contraction and expansion, as shown in Figure 8, it will nevertheless yield, due to its inherent elasticity and flexibility, without grinding on the walls of its socket or the edges of the slab, and will always tend to return to its normal position. Thus at A and A' the material is shown as pressed inwardly, contracted, due to a force tending to separate the two slabs 2 and 3, and at B and B' it is shown as expanded somewhat, but because there is no hard material in contact with the concrete at these points, there is no wearing away of the concrete. Nor can there be any permanent bending of the wire 11, which acts as a beam, as this is embedded in rubber and rubber-impregnated fabric.

It may be desirable in some instances to lock the dowel pins in the slabs, and in this way to somewhat limit their extension or contraction. To this end, as shown in Figure 10, I may employ pins, preferably of steel or like metal, as shown at 6, passed transversely through the ends of the dowel pins 1 prior to their embedment, so that the cross pins 6 will be embedded in the concrete. By placing these cross pins 6 near the ends of the dowel pins 1, the latter are permitted the maximum of expansion and contraction. By placing the cross pins 6 in Figure 11 closer together the expansion and contraction of the tire bead dowel pins is lessened.

The tire bead material might be made use of as an anchor, as is shown in Fig. 12. Here a length 61 of tire bead material is used as a cross pin passed through the eye 62 of a steel dowel pin 63. This still takes advantage of the contractability and yieldability of the tire bead material at 61 while yet providing a steel dowel pin across the joint between the two slabs 2 and 3.

It is illogical to provide a dummy joint, where fracture is to occur if fracture is unavoidable (usually by fatigue resulting from repeated flexure), yet to provide a rigid steel dowel pin across the dummy joint, so rigid that it tends to prevent fracture in the joint. This sometimes results in the fracture extending, uncontrolledly, around the ends of such dowels. Moreover, after fracture has occurred, such steel dowel pins aggravate conditions and tend to increase the damage, for reasons given above. My dowel pin, being flexible and compressible, will not greatly serve to prevent fracture at dummy joints 31 (see Figure 7) but will not cause the fracture to run outside the weakened line of the dummy joint, and when fracture has occurred, as represented in Figure 7, the inherent flexibility, compressibility, and elasticity of the tire bead

material will conserve the material, transmitting stresses from slab 3 to fractured piece 30 without breaking down either.

What I claim as my invention is:

- 5 1. Means for transmission of stresses between two adjoining concrete slabs, comprising a piece of tire bead material, partly embedded in each slab.
- 10 2. Means for transmission of stresses between two adjoining concrete slabs, comprising a length of tire bead material, one end of which is embedded in one slab, and the other end of which is embedded in the other slab.
- 15 3. Means for transmission of stresses between two adjoining concrete slabs, comprising a group of wires embedded in rubber compound and constituting a dowel pin, whereof one end is embedded in one slab and the other end in the other slab.
- 20 4. Means for transmission of stresses between two adjoining concrete paving slabs, comprising a length of tire bead material, disposed across the joint between slabs with its concave side down, one end of such length being embedded in one slab, and the other end being embedded in the other slab.
- 25 5. Means for transmission of stresses between two adjoining concrete slabs, comprising a length of tire bead material, opposite ends of which are embedded in the respective slabs, and cross pins
- 30

secured to each end of the tire bead length, and embedded in the respective slabs.

6. A dowel pin for use in paving or like concrete construction, comprising a length of tire bead material.

7. A dowel pin for use in paving or like concrete construction, comprising an integrate stress-transmitting core incorporating overlaid fabric plies, which core is impregnated with rubber and vulcanized into a stiff, yet elastically yieldable bar.

8. In combination, two adjoining concrete paving slabs having an expansion joint therebetween, and a plurality of dowel pins extending across said joint at intervals, formed of lengths of tire bead material.

9. Means for transmission of stresses between two adjoining concrete slabs, comprising a composite member uniform throughout its length, including a stiff beam embedded in and integral with a cushioning shroud of resilient material, one end of said member being embedded in one slab, and the other end thereof being embedded in the other slab.

10. Means for transmission of stresses between two coplanar adjoining concrete slabs, comprising a stiff beam, having bonded thereto an outer cushioning surface of rubber compound elastically yieldable under stresses transverse to the beam.

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