Dec. 31, 1968 YOSHIKI FUJIHARA 3,418,899
METHOD OF FORMING CONCRETE JOINTS
Filed April 25, 1966

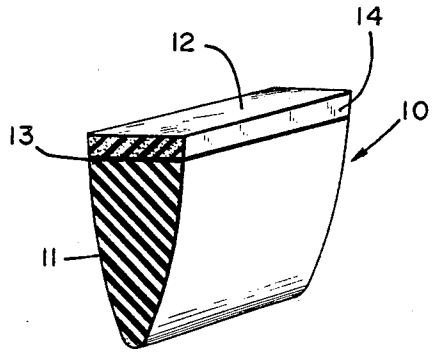


FIG. 1

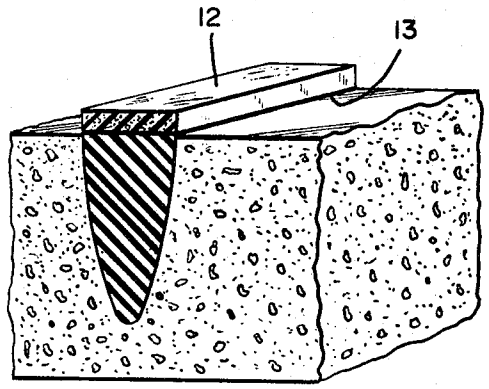


FIG. 2

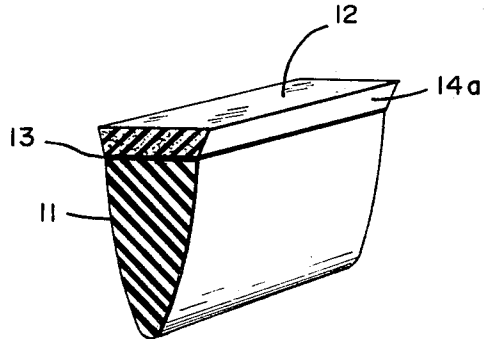


FIG. 3

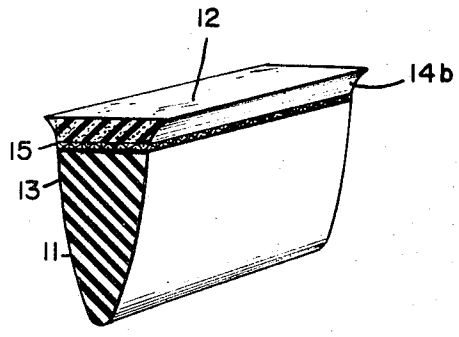


FIG. 4

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METHOD OF FORMING CONCRETE JOINTS

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ABSTRACT OF THE DISCLOSURE

Forms joints between sections of a concrete structure by the use of a divider strip having a top element formed of a sponge rubber. Divider strip is planted in the green concrete, and concrete is floated. The sponge of the strip compresses as the float passes over it, but immediately expands, holds the wet concrete back, and maintains a true margin without necessity for hand finishing.

This invention relates to joints in concrete pavements, and in particular provides a method and means of making expansion joints whereby the tedious job of hand-finishing the expansion joints in highway pavements, slabs, aprons, and like concrete structures is eliminated.

As this specification proceeds, it will become apparent that the method of forming a concrete joint herein disclosed is suitable for all types of joints in concrete structures and in other relations where, following pouring of the concrete, a surface finishing operation is required. Since the method remains the same whatever the type of joint, the construction of an expansion joint in a highway slab will herein be set forth as the illustrative and preferred example.

With seasonal temperature change, concrete pavements expand and contract. It is necessary, therefore, to place expansion joints transverse to the roadway so that the pavement may move. The degree of movement is small. An annual temperature variation of 120° F. will cause a concrete slab 20 feet long to expand 0.158 inch, or contract the same amount with falling temperature. If the highway slab be 60 feet long, the same annual temperature change will cause the pavement to move 0.475 inch.

To form a highway expansion joint, it is conventional to terminate each section of the highway pavement against a joint filler formed of a compressible substance such as Bagasse which has been impregnated with asphalt or special plastic compositions. The joint filler is inserted vertically at the end of each slab and extends from the highway subgrade to an inch to two inches below the intended highway surface. Load-transferring devices such as dowels may or may not be used.

A divider strip is then planted in the wet concrete directly over the joint filler. Divider strips are mdae of wood, metal, or plastic, and are of wedge shape and their upper faces are generally three-quarters of an inch wide. To form a highway contraction joint, it is conventional to insert vertically a temporary divider strip, level with the surface, to a depth of approximately ⅛ to ¼ of the thickness of the concrete slabs. In the finished highway each slab, therefore, is a separate entity, and each joint, after the divider strip has been removed, must be filled with a distortable substance, frequently a molten plastic composition or a preformed joint-sealing strip.

Conventionally, highway surfaces are finished first by running a machine float across the pavement, and subsequently by hand-floating. Only rarely will the divider strip lie exactly on the intended finishing line. In certain spots of limited length, the concrete, as it moves ahead of the machine finisher, piles up and sometimes pushes the divider strip beneath the excess concrete, and in

some places all of the excess concrete is not removed and swept ahead as the machine advances along the slab. Both of these conditions means that some smaller aggregate particles are left on top of the divider strip or partially project across the intended gap. Hand-floating, although it improves this condition, does not eliminate it. When the strip is removed, because the small particles of aggregate project across its pathway, the end of the concrete slab is left with a ragged margin. Hand-finishing this margin to produce a smooth, true edge is a requisite, for if the margin is left in a ragged condition, traffic later will cause the concrete at the margin and for a substantial distance back into the slab to break away, and large spalled areas result.

To avoid this difficulty and secure slab margins at the expansion joints which are straight, clean, and true, the divider strips are removed while the concrete is green enough to permit hand-finishing. This is a job usually requiring at least two skilled concrete finishers, and demands slow, careful workmanship. The hand work which must be performed at least every 60 feet is a very considerable fraction of the total cost of the pavement.

I have found that the operation of hand-finishing the concrete at the margins of the slab is unnecessary and that the margins will remain straight and true despite any action of the floats which are used to finish the highway surface if the top surface of the divider strip be a sponge layer, for then the float may pass over the divider strip without difficulty. The sponge which has been compressed by the float expands after the float passes over it, and pushes the wet concrete back. Thereafter, during the time that the concrete is hardening, the sponge maintains a straight, true, clean margin at the concrete boundary.

The invention may be best understood by reference to the figures in which:

FIG. 1 is a perspective view showing the improved divider strip;

FIG. 2 is a sectional elevation showing the strip embedded in a green concrete pavement; and

FIGS. 3 and 4 show the strips when provided with rubber layers having tapered or contoured vertical walls.

Referring to FIG. 1, the improved divider strip, **10**, comprises a rigid divider, **11**, which may be made of wood, steel, or plastic, and is of the shape and size demanded by the construction specifications. A layer of sponge, **12**, which forms the top surface of the divider strip is adhered to the rigid member, **11**, by a layer or coating, **13**, or a pressure-sensitive adhesive.

Desirable thicknesses of sponge are approximately ¼ inch. Open-cell sponge which has a density of between 2 and 10 lbs. per cubic foot will be found suitable. The sponge is made of "rubber" as the term is now generally understood, to denote a distortable and elastic substance. The actual material may be natural rubber or artificial rubbers such as the chloro-butadiene, butadiene-styrene, and butadiene acrylonitrile types, isobutene and isoprene or butadiene ethylene-propylene. Polyethylene sponge and polyethylenevinyl acetate mixtures are also useful.

As for the pressure-sensitive adhesive it must be stable in the caustic environment of wet concrete. Tackifier components of the adhesive, such as rosin, which can saponify in such conditions, are not suitable.

The divider strip **10**, the length of which should extend entirely across the pavement, is planted in the green concrete as shown in FIG. 2. The bedding operation may be performed by hand, but more usually is performed by a divider-planting machine which vibrates the strip into place and seats it so that the top of the rigid member **11** lies at or substantially at the intended concrete surface, leaving at least a major portion of the vertical walls **14** of the sponge projecting above the surface.

When the green concrete is floated, the float, as it passes over the projecting portion of the rubber sponge, compresses it sufficiently to allow the float to pass over it and sweep any excess concrete or cement paste away from the joint. But the sponge presses upwardly against the float and prevents any cement paste or small aggregate from overlapping in the joint area. The sponge compresses so easily that it has practically no effect in bedding the divider strip more deeply, but merely compresses as it contacts with the float. As soon as the float has passed beyond the joint, the sponge expands and establishes a straight, clean margin in the concrete along the vertical wall **14** of the sponge.

If the specification for the pavement demands contoured margins, the reverse or mirror image of such contours may be given to the walls **14**. The tapered margin **14***a* of the contoured margin **14***b* must extend outwardly from the top margin of the rigid divider **11**.

The assembly of the rubber strip to the rigid dividing member may be performed at the factory, but since most contractors prefer to reuse the strips, field assembly is the usual practice, and commonly the strip of rubber topping is furnished in rolls interleaved with Holland cloth or plastic film such as polyethylene to which the adhesive will not stick. Lengths from these rolls are cut off in the field and are stuck to the top surface merely by pressing them on to the divider strips. It is usually unnecessary to provide the compressible sponge with a dimension establishing base such as cloth or heavy kraft paper **15** for if the sponge is well stuck to the strip **11** its dimension and position will be sufficiently maintained, but should base rigidly prove desirable, the sponge can be provided with a base layer of cloth or paper which is adhesively secured to the rubber. In this case, the exposed face of the base layer carries a pressure-sensitive adhesive which permits the base layer, together with the adhered sponge, to stick to the strip **11**.

The sponge rubber can be removed from the divider strip **11** at any time after the concrete has achieved its initial set. Removal at this time may be required by the highway inspectors who wish to assure themselves that the margins of the slab are clean and straight, but the sponge may be left in position until the concrete has finally set, and until the time when the entire assembly is removed. Leaving the strip **11** in position until the concrete has achieved at least its early strength is the better practice, for then there is little danger that any green concrete will stick to the strip **11** and break the margins.

When the concrete has cured sufficiently to allow the divider strips to be removed, the gap that is left is brushed out and then filled with a joint compound such as asphalt, or packed with any of the common joint seals or packings which may be specified.

Although the rigid element **11** may be reused repeatedly, it is not advisable to reuse the sponge layer, since, shortly, it will become loaded with hardened cement paste and then compress irradically. It is recommended that a fresh sponge strip be used for each joint that is to be formed.

The process of this invention materially reduces the overall cost of a pavement, since hand-finishing is entirely eliminated. It also makes it possible to lay pavement without limiting the length to be laid to the number of concrete finishers available to hand-finish the joints before the concrete hardens. Highway work can, therefore, be considerably expedited when this joint-forming system is used.

What is claimed is:

1. The method of forming a joint between sections of a concrete structure which includes providing a divider strip, affixing a layer of sponge rubber to the top surface of said strip, pouring the concrete and inserting the said divider strips at fixed intervals in the green concrete to a depth at which the top surface of the rigid portion of said divider lies approximately at the intended surface of the concrete, floating the concrete while the concrete is green and compressing the rubber layer approximately to the pavement level, permitting the sponge to expand, allowing the concrete to harden, and subsequently removing the divider strip from the concrete, whereby the expanded sponge maintains the straight, true margin of the concrete slabs.

2. The method of claim **1** wherein, following the removal of the divider strip, said joint is completed by filling the gap between the concrete sections with a plastic composition.

3. The method of claim **1** wherein said joint is completed by filling the gap left by the divider strip with a pre-formed expansion element.

4. The method of claim **1** wherein the margins of the concrete bordering said joint are given predetermined contours by forming the mirror image of the said contour in the said walls of said rubber layer and maintaining the green concrete in contact with the expanded layer until said concrete has reached its hardened state.

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U.S. Cl. X.R.

94—18; 249—9