Oct. 4, 1966 W. F. MIDDLESTADT 3,276,335

JOINT FORMING STRUCTURE

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FIG. 1

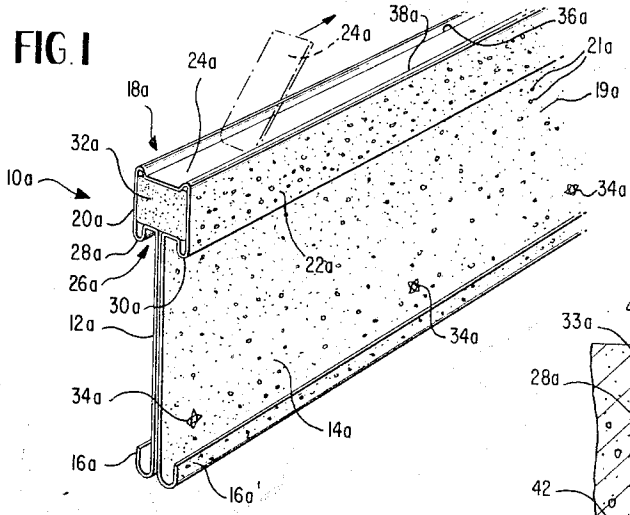
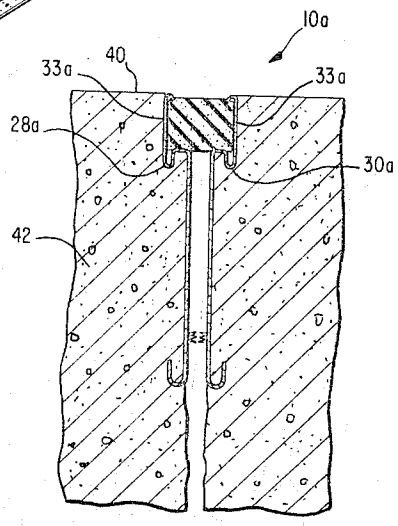


FIG. 2



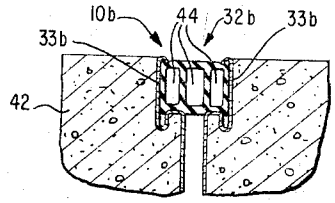


FIG. 3

FIG. 4

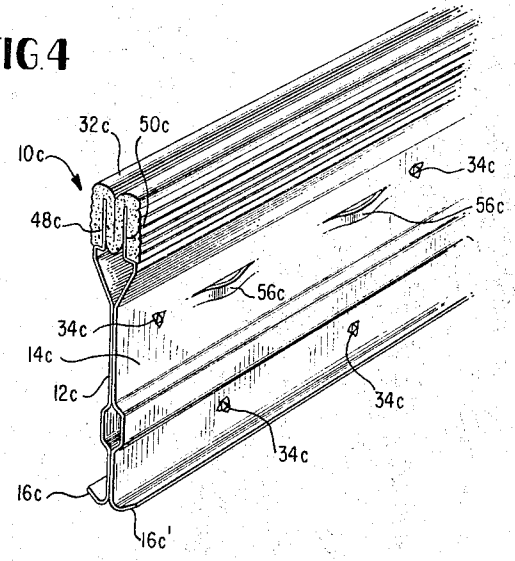
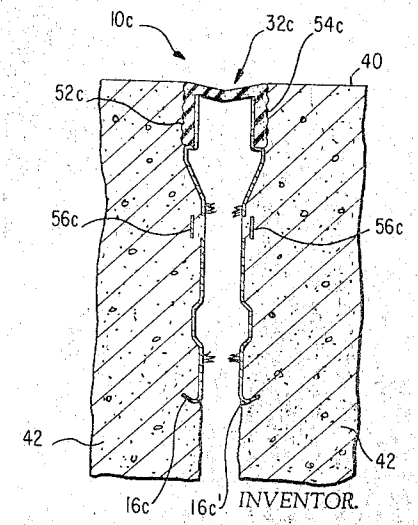


FIG. 5



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FIG.6

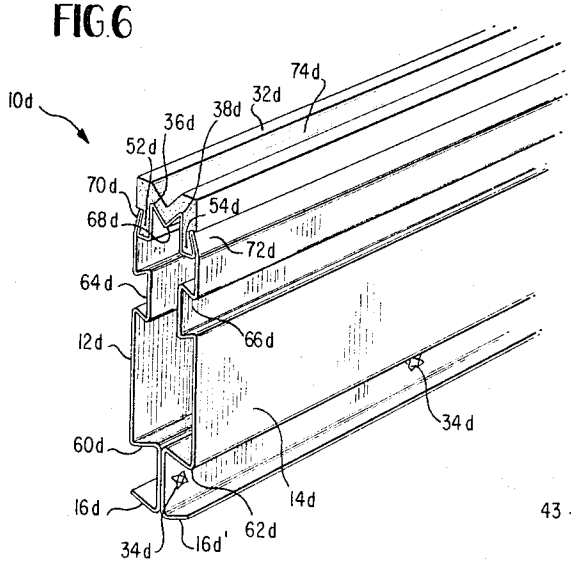


FIG.7

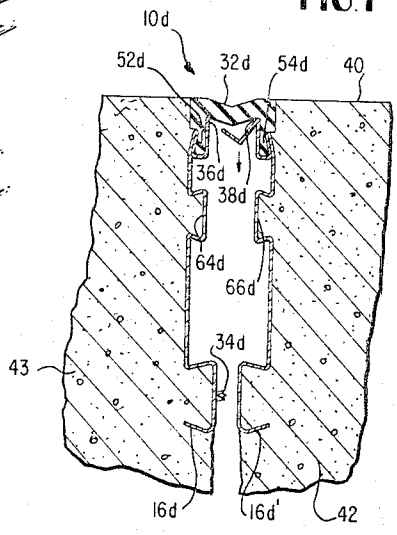
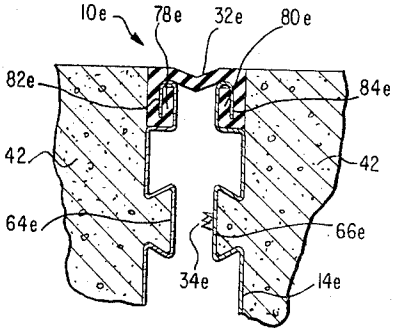


FIG.8



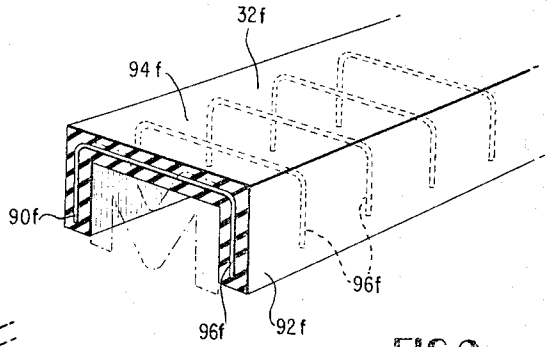


FIG.9

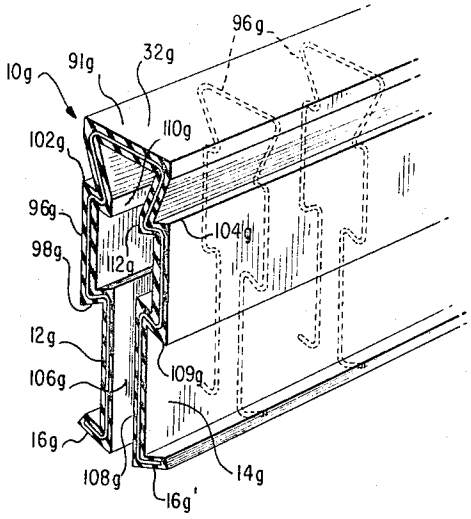


FIG.10

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JOINT FORMING STRUCTURE

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10 Claims. (Cl. 94—18)

This invention relates to an improved method for forming joints in a settable composition and to an improved joint forming structure.

The invention has particular utility in forming joints in concrete roadways, air strips, walls, and the like.

It is an object of the present invention to provide an improved method of forming joints in concrete pavement and the like which eliminates the possibility of infiltration of foreign material into the joints to be formed as the joint forming structure initially completely fills and forms the joint and maintains said joint to provide a smooth substantially uniform top surface generally coplanar with the extended surface of the pavement and the like.

A further object of the present invention is to provide such a joint forming method and structure which requires a minimum of sealing compound.

A further object is to provide such a method and structure which substantially reduces the on-the-job cost of forming joints in concrete pavements and the formation of the joints is not effected by the hardness of the aggregate in the concrete and concrete cracking is controlled to provide a smooth riding surface.

A further object of the present invention is to provide an improved method of forming joints in concrete and the like and a concrete and the like joint forming structure which requires a minimum maintenance.

These and other objects and advantages are provided in a joint forming structure which generally comprises a pair of opposed extended surface elements adapted to be embedded in a settable composition, resilient means between at least the upper opposed surfaces of said elements, and releasable means maintaining said elements in compressing relationship to the resilient means; and by a method of forming a joint in a settable composition comprising inserting a joint forming member having a pair of opposed extended surface elements with resilient means between at least the upper opposed surfaces thereof and releasable means maintaining said elements in compressing relation to the resilient means, into the surface of a mass of a settable composition with the resilient means substantially flush with an exposed surface of the settable mass, and thereafter bringing about the release of the releasable means.

The invention will be more particularly described with reference to the illustrated embodiments thereof shown in the accompanying drawings wherein:

FIG. 1 is a perspective view of a portion of a joint forming structure embodying the principles of the present invention;

FIG. 2 is a sectional view of the structure illustrated in FIG. 1 embedded in a concrete roadway with the releasable means removed;

FIG. 3 is a fragmentary view similar to that illustrated in FIG. 2 of a further form of the present invention;

FIG. 4 is a perspective view of a further form of joint forming structure constructed in accordance with the teachings of the present invention;

FIG. 5 is an enlarged fragmentary view of the structure illustrated in FIG. 4 embedded in a concrete roadway with the joint substantially at its maximum expansion;

FIG. 6 is a perspective view of a further form of joint forming structure constructed in accordance with the teachings of the present invention;

FIG. 7 is a fragmentary sectional view of the joint

forming structure illustrated in FIG. 6 embedded in a concrete roadway with the formed joint in a substantially fully expanded position;

FIG. 8 is a fragmentary sectional view of another form of the present invention illustrating the joint forming structure embedded in a concrete roadway;

FIG. 9 is a perspective view of a modified form of resilient means suitable for use with the assemblies shown, for example, in FIGS. 1, 4, 6 and 8; and

FIG. 10 is a fragmentary perspective view of another form of joint forming structure constructed in accordance with the teachings of the present invention.

Referring to FIGS. 1 and 2 of the drawings, **10***a* generally designates one form of the improved joint forming structures. The joint forming structure **10***a* is constructed from a single sheet of metal which is bent or folded to provide a pair of extended surface leg elements **12***a* and **14***a*. Each of the leg elements is provided with a recurved portion **16***a* and **16***a'* adjacent its lower end which form a pair of generally U-shaped channels. The upper portion of the metal sheet is folded or formed into a channel **18***a* generally rectangular in cross section having side walls **20***a* and **22***a*, a bottom **26***a* and a top **24***a*. The bottom **26***a* is formed with a pair of depending flange-like elements **28***a* and **30***a*.

Within the quadrangular channel **18***a* formed by the sides **20***a*, **22***a*, the bottom **26***a* and the top **24***a* is positioned a compressed elastomeric resilient member **32***a*. The elastomeric member **32***a* may comprise a natural or synthetic rubber or other resilient material. Preferably, the elastomeric material is one that will resist the solvent action of hydrocarbon fuels, oils and greases and will maintain its resiliency during normal atmospheric temperature changes. The elastomeric material known as neoprene has been found to provide very satisfactory results. The side walls of the resilient member **32***a* are bonded as indicated at **33***a* to the inner faces of side walls **20***a* and **22***a* of the sheet metal member and the assembly is maintained in its compressed illustrated configuration by the top **24***a* and by a plurality of separable fasteners **34***a*.

The separable fasteners **34***a* illustrated in FIGS. 1 and 2 are simply formed by merely spike-punching a portion of the metal forming, for example, leg **14***a* through leg **12***a*. In order to release the releasable means maintaining the elastomeric material **32***a* in its compressed assembled form, lines of weakness or score lines **36***a* and **38***a* are provided in the top **24***a* adjacent the line of juncture of the top with the respective side walls **20***a* and **22***a*.

In operation of this form of the invention, the assembly as illustrated in FIG. 1 is inserted in a settable composition such as a concrete roadway following the pouring of the roadway with the extended surface leg portions **12***a* and **14***a* projecting into the concrete and with the top wall **24***a* of the assembly generally flush with the extended top surface **40** of the concrete **42**. Referring particularly to FIG. 2 of the drawings, it will be seen that concrete sets within the channels **16***a* and **16***a'* at the lower end of the assembly and also within the channels formed by the depending portions **28***a* and **30***a* adjacent the bottom of the quadrangular channel formed at the top of the structure. As soon as the concrete **42** has received its initial set, the top **24***a* is stripped from the assembly as shown in broken lines in FIG. 1; the stripping of the top portion being rendered relatively simple in view of the lines of weakness **36***a* and **38***a*. With the top **24***a* stripped from the assembly as the concrete continues to set and assume its initial contracted form, the separable fasteners **34***a* release as the shrinking concrete gripping the U-channels at the upper and lower ends of the extended surface leg members **12***a* and **14***a* place parting forces on these ele-

ments whereby the assembly assumes a position such as illustrated in FIG. 2.

After the concrete **42** has set the roadway, as far as the joint forming structure is concerned, is ready for immediate use.

It will be particularly noted from the foregoing discussion of the operation of the improved joint forming structure that the joint forming structure permits the formation of joints in concrete roadways and the like with a minimum of on-the-job labor and provides a joint which is always maintained free of foreign matter.

Where desired, the outer surfaces of the extended surface leg members **12***a* and **14***a*, including the outer surfaces of the side walls **20***a* and **22***a*, may be provided with a surface which will bond to the settable composition during setting thereof. In FIGS. 1 and 2 the bond assisting surface comprises an adhesive coating **19***a* and granular elements **21***a* partially embedded therein. The adhesive may comprise a liquid rubber-like cement, a thermoplastic or thermosetting plastic composition and the like and the granular elements **21***a* may comprise relatively fine crushed silica rock, sand, iron powder or grains, etc., which will provide a rough surface which will readily bond to the concrete roadway. It is also contemplated that the coating may comprise a porous material.

Referring to FIG. 3 of the drawings, a modified form of the joint forming structure is illustrated in place in a concrete roadway **42**. The modified joint structure **10***b* is formed in a manner similar to the joint forming structures illustrated in FIGS. 1 and 2 except that the elastomeric resilient material **32***b*, bonded as at **33***b* to the upper ends of the metal sheets, comprises an extruded or molded rubber-like channel element having air channels **44** surrounded by integral webs of the resilient material. This form of sealing means obtains its resilience from the nature of the material and from the existence of the air chambers **44**.

With this form of the invention the ends of the resilient material **32***b* may be sealed and a vacuum drawn on the air channels **44**. The vacuum will hold or assist in holding the resilient member in compressed relationship to the extended surface leg members. Puncturing of the end seals, after the joint forming member is inserted in the settable concrete, will bring about release of the resilient member **32***b*. Further pressure fluid may be pumped into the channels **44** after the vacuum is released to increase the resilient pressure of the resilient member **32***b*.

Referring to FIGS. 4 and 5 of the drawings, another form of joint forming structure is generally illustrated at **10***c*. The joint forming member **10***c* depends solely on the shrinking of the settable composition to effect release of the compression of the compressed resilient member. In FIGS. 4 and 5, the joint forming member **10***c* includes a pair of extended surface leg members **12***c* and **14***c*. The lower edges of each of the leg forming members **12***c* and **14***c* are re-curved at **16***c* and **16***c'* and the top of each of the leg forming members are generally formed as opposed L-shaped structures **48***c* and **50***c*. Attached to the L-shaped members is a resilient web **32***c* which in its compressed position is generally M-shaped as illustrated in FIG. 4. and in its substantially fully expanded position is generally inverted U-shaped in cross section. The pair of legs **52***c* and **54***c* of the resilient web **32***c* are bonded by an adhesive or, for example, by heat sealing to the upright portions of the respective L-shaped elements **48***c* and **50***c*, respectively. The assembly is held in the compressed configuration as illustrated in FIG. 4 by a plurality of separable fasteners generally designated **34***c* which separable fasteners, in the illustrated form of the invention, are identical to the separable fasteners **34***a* of the form of the invention shown in FIGS. 1 and 2. The assembly also includes a plurality of struck-out portions **56***c*, in each of the leg members, which struck-out portions are adapted to be embedded in the concrete **42** as more clearly illustrated in the sectional view, FIG. 5, and cooperate with the re-curved lower edges **16***c* and **16***c'* of each of the leg members **12***c* and **14***c* in effecting release of the separable fasteners **34***c* upon shrinking or contraction of the concrete **42**.

In operation of this form of the invention, the assembly as illustrated in FIG. 4 is inserted in the unset concrete with the top edges of the resilient element **32***c* generally flush with the top **40** of the roadway. As the concrete sets and shrinks, the separable fasteners **34***c* are pulled loose by the contractional forces applied to each of the leg members by the concrete gripping the generally U-shaped re-curved portions **16***c* and **16***c'* and the struck-out portions **56***c*. Expansion of the formed joint causes the resilient member **32***c* to return generally to its folded or compressed configuration as illustrated in FIG. 4. It will be particularly noted that in this form of the invention once the element is inserted within the settable composition, no further steps must be taken by the paving contractor in order to provide the novel joint seal.

Another form of the joint forming structure of the invention is illustrated in FIGS. 6 and 7. The joint forming structure illustrated in FIGS. 6 and 7 is generally designated **10***d* and includes a pair of extended surface leg portions **12***d* and **14***d* having re-curved lower edges **16***d* and **16***d'*. The re-curved edges **16***d* and **16***d'* cooperate with re-curved portions **60***d* and **60***d'* to provide dovetailed-like channels which receive the concrete as illustrated in FIG. 7 and assist in releasing the separable fasteners **34***d*. Further, concrete gripping elements are formed by channels **64***d* and **66***d* in extended surface leg members **12***d* and **14***d*. The upper end of the element has a center section **68***d* of generally M-shaped configuration which cooperates with side walls **70***d* and **72***d* to grippingly engage the legs **52***d* and **54***d* for securing the resilient member **32***d* to the metallic extended surface leg elements. The generally M-shaped bridge member **68***d* is formed with a line of weakness at **36***d* which corresponds to one of the lines of weakness **36***a* or **38***a* of the form of the invention illustrated in FIG. 1.

In operation of this form of the invention, the assembly **10***d* is inserted when generally in the configuration illustrated in FIG. 6 into the unset concrete **42** with the top surface of the resilient element **32***d* generally flush with the top **40** of the concrete roadway. After the concrete has taken its initial set, a tool is inserted in the top of the portion **74***d* of the resilient member **32***d* and downward pressure causes the bridge element **68***d* to break loose at its line of weakness **36***d* thereby releasing the upper end of the assembly as generally illustrated in FIG. 7 while the lower end is released by contraction of the concrete which releases the separable fasteners **34***d*. It will be appreciated that said line of weakness may be either along line **36***d* or **38***d* or both or at the apex of the bridge member **68***d*. Where only one line of weakness is employed, the element is not free to fall into the space between the leg members **12***d* and **14***d*, thereby avoiding all possibilities that the released element might position itself at a point which would prevent complete reclosing of the joint during expansion of the concrete slabs **42**.

Referring to FIG. 8, **10***e* designates a modified form of the joint forming structures of the invention.

In this form of the device, the generally M-shaped resilient element **32***e* is provided with a pair of re-curved edges **78***e* and **80***e* which are received in re-curved portions **82***e* and **84***e*, respectively, of the upper ends of extended surface leg portions **12***e* and **14***e*. Since this form of the invention does not have a bridge member such as bridge member **68***d* to maintain the upper portions of the extended surface leg members **12***e* and **14***e* together when the device is in the resilient element compressed relationship, the re-curved channel forming portions **64***e* and **66***e* corresponding to the channel-forming portions **64***d* and **66***d* of the form of the invention illustrated in FIGS. 6 and 7 are provided with releasable fasteners **34***e* similar in construction to the releasable fasteners **34** *a*, *c* and *d* of

the forms of the invention illustrated in FIGS. 1 through 4 and 6.

The form of the invention illustrated in FIG. 8, like the form of the invention illustrated in FIGS. 4 and 5, does not require manual release of the resilient element **32***e* as the initial contraction of the concrete **42** brings about release of the upper releasable fasteners **34***e* and corresponding lower releasable fasteners not shown in FIG. 8 of the drawings.

Referring to FIG. 9, a modified form of resilient element is illustrated. The illustrated resilient element **32***f* is generally in the form of a U-shaped channel having depending leg portions **90***f* and **92***f* and a bridge portion **94***f* which bridge portion folds downwardly as illustrated in dotted lines when the leg portions **90***f* and **92***f* are urged toward each other. The resiliency of the resilient element **32***f* is augmented or provided by a plurality of spring wires **96***f* embedded within the top and leg portions of the element **32***f*. The particular configuration of the resilient element **32***f* is illustrated as adaptable for use with the forms of the joint forming members illustrated in FIGS. 4, 5, 6 and 7. It will be apparent, however, that with minor modifications of the configuration of the resilient element **32***f*, it may be employed with the other described forms of the invention.

A further form of the joint forming member is illustrated at **10***g* in FIG. 10. In this form of the invention, the extended surface leg portions **12***g* and **14***g* and the top bridge portion **91***g* of the resilient element **32***g* are integrally formed from, for example, a natural or synthetic elastomeric material and the elastomeric material is molded, cast or extruded with shaped resilient spring elements **96***g* therein. The elastomeric member **10***g* and its reinforcing spring wires **96***g* are shaped to provide concrete engaging re-curved bottom edges **16***g* and **16***g'* and **98***g*, **100***g*, **102***g* and **104***g*. In order to maintain the top **91***g* in the compressed configuration as illustrated in FIG. 9, opposed faces **106***g* and **108***g* and opposed faces **110***g* and **112***g* are attached by separable fastening means which may comprise suitable adhesives which are applied to portions of said opposed faces and the element thereafter clamped in the compressed configuration until said adhesives are set. Also, these faces may be secured by heat sealing where the composition of the elastomeric material is susceptible to a heat sealing operation or suitable gripper type fasteners may be molded into the elastomeric material during the formation of the element. This form of the invention, like the forms illustrated in FIGS. 4, 5 and 8, does not require an operator to release the releasable sealing means as initial contraction of the concrete brings about said release.

Further, where desired, the top element **91***g*, when folded into its compressed M-configuration, may be releasably held in the compressed form by a suitable adhesive. The release of the adhesive may be brought about by applying a solvent for the adhesive to the top surface **91***g* after the device has been inserted in the concrete and initial setting of the concrete has taken place.

It will also be apparent that an adhesive and solvent could be used with the forms of the invention shown, for example, in FIGS. 4, 5, 6, 7, 8, and 9 and that the spring wire elements **96***f* of FIG. 9 and **96***g* of FIG. 10 may be replaced by a mesh of spring elements or transverse spring elements may be included in the structures **32***f* and **32***g*.

From the foregoing description of various embodiments of the present invention, it will be apparent to those skilled in the art that the joint sealing structure fully accomplishes the aims and objects hereinabove set forth. Further, it will be appreciated by those skilled in the art that various modifications and changes may be made in the illustrated forms of the structures without departing from the scope of the present invention as defined in the appended claims. For example, the resilient means in all forms of the invention may be bonded, cemented, heat sealed or the like to the upper ends of the metal extended surface sheet means and such bonding may be in addition to mechanical sealing means such as illustrated in, for example, FIG. 8 and that the coating illustrated at **19***a* and **21***a* in FIG. 1 when applied to, for example, the form of the invention shown in FIG. 4, would also coat the outer exposed surfaces of the leg portions of the resilient member **32***c*.

I claim:

1. A joint forming structure comprising a pair of opposed extended surface elements having upper and lower portions adapted to be embedded in a settable composition, resilient means between at least the upper opposed portion of said elements, and releasable means maintaining said elements in compressed relation to the resilient means, said releasable means comprising means formed from the opposed pair of extended surface elements.

2. The invention defined in claim **1** wherein the resilient means comprises an elastomeric material.

3. The invention defined in claim **2** wherein the elastomeric material comprises a foam rubber like material.

4. The invention defined in claim **2** wherein said elastomeric material comprises a resilient elongated channel like structure.

5. The invention defined in claim **4** wherein said channel like member is provided with a plurality of resilient spring wires embedded therein.

6. A concrete joint forming structure comprising a pair of opposed extended surface metallic elements having an upper portion and a lower portion, said elements adapted to be embedded in a settable concrete, a hollow channel formed in the upper portion of the said metallic surface elements, a resilient element maintained in compression in said channel by said opposed extended surface elements, and means for releasing the compression on said compressed resilient element, said compression releasing means comprising a strippable top portion for said hollow channel.

7. The invention defined in claim **6** wherein the said strippable top portion of the hollow channel is formed with generally parallel score lines to assist in the removal thereof.

8. The invention defined in claim **6** wherein the outer surfaces of the joint forming structure are provided with a coating bondable with said settable composition.

9. The invention defined in claim **8** wherein said coating comprises granular material and an adhesive securing the granular material to said exposed surfaces of the joint forming structure.

10. The invention defined in claim **9** wherein said granular material consists of sand.

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