United States Patent

[11] **3,555,980**

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Division of Ser. No. 572,716, Pat. No. 3,394,640
[45] Patented **Jan. 19, 1971**

[54] **SEALING INSERTS FOR JOINTS IN CONCRETE**
10 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **94/18**
[51] **Int. Cl.** **E01c 11/10**
[50] **Field of Search** 94/18; 52/716, 400

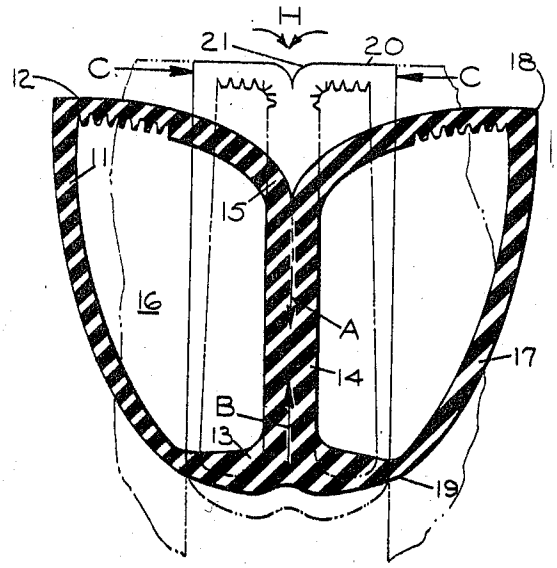
[56] **References Cited**

UNITED STATES PATENTS

2,954,310	9/1960	Truesdell	52/716
3,038,395	6/1962	Middlestadt	94/18
3,222,769	12/1965	Le Plae	52/716
3,297,294	1/1967	Middlestadt	94/18X
3,256,786	6/1966	Middlestadt	94/18
3,394,044	7/1968	Bright	52/716X

Primary Examiner—Jacob L. Nackenoff
Attorney—Pennie, Edmonds, Morton, Taylor and Adams

ABSTRACT: An elastomeric insert for sealing a variant joint space in concrete pavement, extruded with the operative ordinates upset in such manner as to cause deflection when compressed in the joint space with the top surfaces aligned horizontally and converging into the vertical plane of symmetry, the inboard portions thereof together with a supporting stem being motionable vertically as the joint space diminishes or enlarges ambiently, the stem being load-supported by an opposing substructure. Also disclosed are means for controlling the described vertical motion relative to changes in joint width, for reinforcing portions of inserts of this general type including X-metal strip, and for overlaying the exposable surfaces of such inserts.



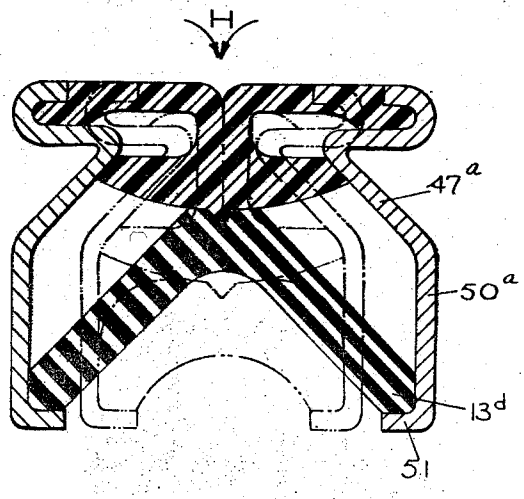


FIG. 8

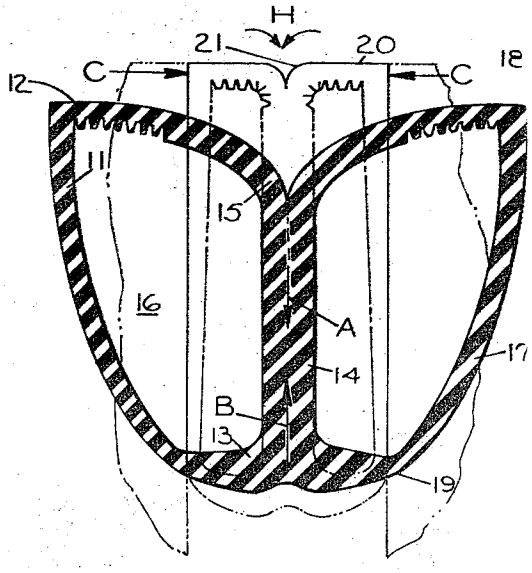


FIG. 1

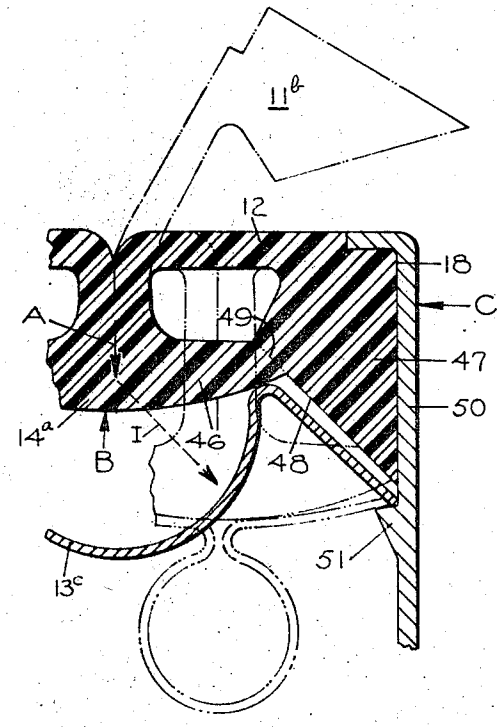


FIG. 7

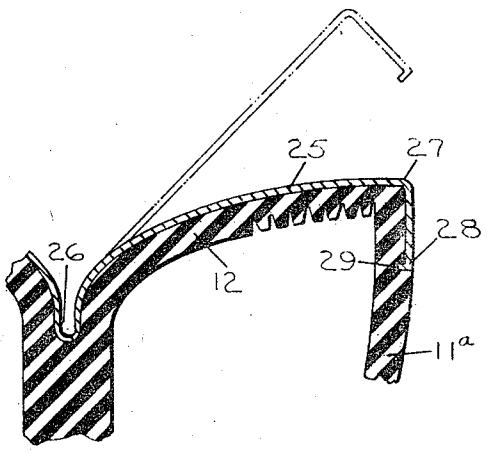


FIG. 2

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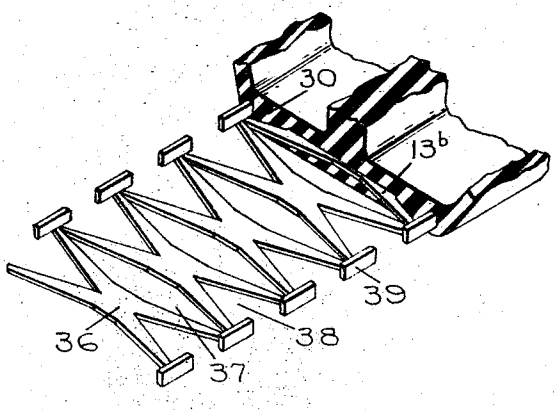


FIG. 3

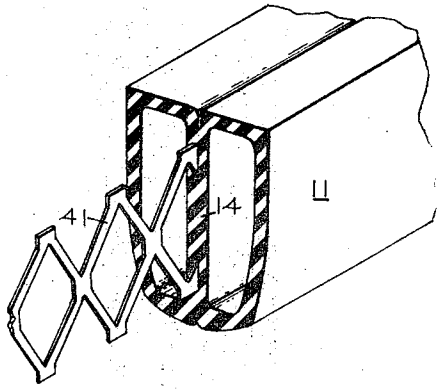


FIG. 4

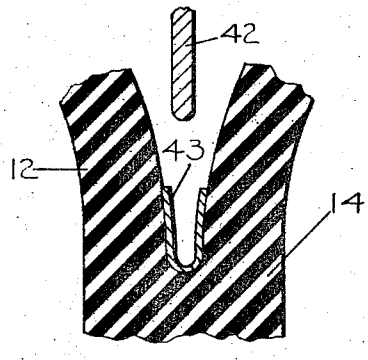


FIG. 5

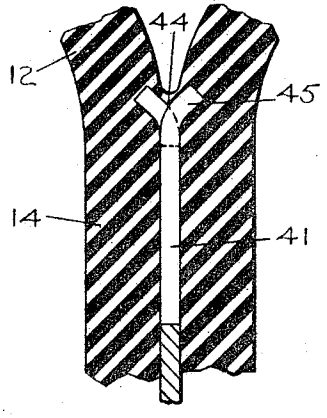


FIG. 6

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SEALING INSERTS FOR JOINTS IN CONCRETE

This invention relates to improvements in SEALING INSERTS FOR JOINTS IN CONCRETE, and this application is a division of my pending application Ser. No. 572,716, filed Aug. 16, 1966, now U.S. Pat. No. 3,394,640, which in turn discloses improvements on and includes features and concepts disclosed in my then pending application Ser. No. 319,875, filed Oct. 29, 1963 now U.S. Pat. No. 3,308,726.

This invention relates further to the sealing of variant joint spaces between sections of concrete paving, and more particularly to improvements in the functional design of sealing inserts utilizing certain of the principles disclosed in the related applications.

In brief, application Ser. No. 319,875 (herein referred to as the parent application) teaches the construction of an elastomeric insert extruded with the operative ordinates upset in such manner as to cause it to be deflected when installed in a maximumally gapped joint, in which condition a top-centered V notch is closed, the top surfaces aligned and the substructure stressed load-supportably. As the joint narrows, the inboard portions of the top surfaces roll together and downward adjacent the vertical plane of symmetry, thereby maintaining full occupancy of the upper portion of the joint and levering the excess bulk into a lower position.

The present application and application Ser. No. 572,716 (the latter referred to herein as the prior application) outline continuing development of compressible sealing inserts obedient to the primary principles originally disclosed in the parent application, but including modifications in construction and design. Certain of these derive from critical appraisal by which it became apparent that operative behavior is subject to functional division and that these definitive functions could be executed individually and thereby more effectively.

In addition to furtherance of the objectives of the original invention as previously outlined, the objects of the present invention therefore include the perfecting of functionally divisive elements in sealing inserts of the general class described, more favorable depthing of such inserts, the use of multicompositional treatments and combinations, and techniques by which increased reliability may be achieved, further exposition of which will be aided by reference to the accompanying drawings.

FIG. 1, an enlarged cross section, shows a deep dual-chambered elastomeric insert which has been extruded in butterfly contour, the ghosted FIG. illustrating the same insert installed in an operative joint.

FIG. 2, is a part section of a similar insert with a disparately compositioned sheath overlaying the upper surface.

FIG. 3, in perspective, shows a spring metal base member with a protective shroud in broken part section.

FIG. 4 is an illustration in perspective of an elastomeric insert broken away to show an X-metal stiffening member.

FIG. 5 is a greatly enlarged part section showing a stabilizing strip positioned at the base of the medial notch, which is designed to facilitate compressive installation and to prevent damage to the insert in such process.

FIG. 6 is a similar part section wherein such stabilization is accomplished by splitting the top edge segments of a medial reinforcing element such as that illustrated in FIG. 4.

FIG. 7 is a part section illustrating a positive means for motioning the central stem downward in relation to joint width.

FIG. 8, in cross section, shows a similar subspecies of sealing insert assembly as positionable in a joint space, the ghosted FIG. illustrating its changed configuration when the joint space is lessened.

Referring now to the drawings and to FIG. 1 in particular, there is shown in cross section an elastomeric extrusion 11 whose contours are deemed somewhat to resemble a butterfly, which term has been used descriptively throughout its development and should be interpreted as inclusive of this general species of sealing inserts. This group is characterized as having two flexural upper members 12 opposed in, and merging at the plane of, symmetry, a resilient lower section 13 in spaced relation thereto, a central stem 14 capable of transmitting thrust A, B between the inboard portions 15 of the upper members 12 and the base section 13, and having dual chambers 16 formed by the described elements. Although the outboard wall sections 17 as illustrated are not essential to the presently described species, both installation convenience and practicality suggest either their inclusion or that a functional equivalent thereof be provided, since thereby the outboard extremities 18 of the upper sections 12 may be held reliably in vertical spaced relation to those 19 of the section 13 and prevented from being dislodged in service.

When installed as shown schematically in the phantomed illustration the insert 11 is compressed horizontally C which causes the upper sections 12 to abut in the surface area of the joint and thereby to thrust downward as indicated at A in consequence of resistance to such flexure. The function of the base section 13 is to accept a controlled amount of downward motion but to provide an upward thrust B opposedly thereto in order that the surface portions 20 of the upper sections 12 be maintained in alignment with the merging arcs 21 thereof made relatively sharp so that maximal surface occupancy of the joint space may be achieved. As the joint opens and closes ambiently the entire medial section of the insert rises and falls, with portions of the upper sections being transposed recycling H between vertical and horizontal planes through the abutted arcuate segments 21 therebetween.

It will be apparent that the described surface sections 12 may be shorter or longer proportionately than illustrated and the height of the central stem 14 adjusted accordingly, and also that the depthing of the base section 13 is subject to considerable variation by appropriate dimensioning of the vertical sections.

FIG. 2 shows a portion of a similar insert 11*a* prepared for attachment of a sheath 25 overlaying its surface sections 12. In this instance the sheath has been separately fabricated from flat stock, formed with a medial lengthwise notch 26, square upper outboard corners 27 and anchoring edges 28 which fit into recesses 29 formed in the extrusion 11*a*. It will be apparent that by such means, which may even include metal, the surface exposed to wear and abuse may be made exceedingly durable and thereby adapted to highly specialized and demanding applications. It also will be apparent that similar sheathing means may be utilized with other forms of sealing inserts including those described in the parent application in which disparately compositioned surfacing layers were disclosed but wherein adhesional attachment to the supporting structure was suggested. By allowing slippage at the interface especially in and adjacent the area of sharp flexure, each of the arcuate segments may be stress equilibrated independently, thereby avoiding the compounding of stresses incident to bonded laminar flexure.

In the prior application of which this is a division, various types of supporting base members were described, some of which consisted essentially of spring metal or incorporated spring metal elements conjunctly with elastomeric compositions for the purpose of increasing their power potential and improving reliability with lessened dependence upon elastic recovery of rubber and rubberlike polymers. FIG. 3 is illustrative of such a spring metal base member 13*b* comprising a connected series of X-shaped spring metal segments 36. Preferably such an element is enveloped in a protective composition, which may comprise an elastomeric body 30 as illustrated. Such a body may serve simply as a protective shroud or it may be designed to supplement the spring force of the composite base. The spring metal element illustrated is of a special form which is gradingly flexural and thus comparable in spring effect to the stepped-leaf combination described in the prior application. Such an element may be made by alternately cross cleaving 37 and punching arrowhead-shaped sections 38 of a strip of spring metal, stretching the strip and bending the peripheral rectangular sections 39 alignedly at an angle thereto, followed by hardening and tempering. It will be apparent that the described procedure may be utilized to form

X-shaped segments having legs which increase in width toward the medial portion of the strip, thereby permitting such a spring metal element to be gradingly flexural with its medial portion the more rigid and its peripheral portions the more flexible. This type of construction is ideal for protective envelopment in an elastomer since thereby the problem of interfacial surface anchorage is minimized. It will be noted that inclusion of the peripheral rectangular sections **39** as described is particularly beneficial since it provides enlarged anchorage and operative bases for the narrow spring tips without loss of peripheral flexibility, whereas the fineness of unfortified tips could be injurious to the supporting elastomer.

FIG. **4** illustrates the use of a stiffening member in extrusions of the general type described in these several patent applications. In this case the central stem **14** is fortified structurally by the inclusion of a metal element **41** comprising a connected series of X-shaped segments, such an element having been prepared by patterned cross cleavage and linear extension in the traditional manner of fabricating shelf X. It will be apparent that such an element may be introduced through an extrusion die and thus embedded anchorably in the elastomer or other suitable composition, and that it may be shrouded either partially or completely therein.

The stiffening of the central stem or other vertically oriented connecting means may be occassioned by a variety of purposes including positive transmission of vertical motion to and from the resilient base element, symmetrical stabilization of the insert concomitant with prevention of bowing or buckling under adverse or imbalanced conditions including those which obtain during installation, permissive use of a lesser cross section in order to provide occupancy space for a fillant and/or to permit an increase in the operative design range of the insert, increase in the height of the central stem occasioned by greater depthing of the resilient base member of section or by proportional reduction in the length of the upper sections, and linear stabilization of the insert in order to prevent distention during installation. Additionally, it will be recognized that such stiffening elements may be so compositioned, dimensioned or structured as to modify controllably the degree of stem compressibility under varying loads, and that such elements may be used plurally, e.g., positioned in spaced relationship so as to contribute favorably to stability with minimal expenditure in space and materials. For similar stabilization purposes either the upper or lower edges may be extended into or adjacent the connecting sections of the insert.

The cointroduction of fortifying elements in extrusions of the character described is a useful tool in the hands of the designer, especially in developing larger units wherein saving in the cost of materials become increasingly significant and performance requirements tend to be more exacting. The use of expanded metal strip is of particular interest in this type of application since it adapts itself readily to such combination and permits substitution of a low cost raw material whose strength-to-weight factor makes it the more impressive. Although extrusional envelopment of such elements is preferred when using materials which are subject to deterioration under exposure, the extension technique may permit economic use of more costly materials such as stainless steel and in some cases the use of aluminum alloys. It will be further apparent that expanded metal elements may be used effectively in the levered inserts described in the parent application and suggested in the prior application as a constant rate base for butterfly inserts.

FIG. **5** and **6** are addressed to the problem of installation, which will be understood in this class of inserts to involve considerable compression since insertion must be made when the joint is not more than medianly spread. It will be recalled that one of the objects of the invention as originally disclosed refers to installation facility and that certain of the constructions described therein permit application of downward force against the medial section whereby the base of the insert is deflected and the outboard portions drawn rather than pushed into the desired sidewall placement. The same technique is patent in butterfly inserts having outer connecting sections **17** as shown in FIG. **1**, wherein the central stem **14** transmits the applied downward force directly to the medial portion of the base section **13** and draws the outer sections **17** into place. Since access to the head of the central stem is restricted by the merging upper sections **12** it is preferable that the forcing tool **42** be quite narrow in thickness, in consequence of which the unit pressure at its base could easily be capable of damaging the insert. Means for alleviating this difficulty is illustrated in FIG. **5** wherein a V-formed steel strip **43** is positioned at the base of the merging upper sections **12** against which the tool **42** may be applied forcibly with lessened likelihood of causing damage. Such an accouterment **43** may be incorporated in the extrusion or it may be inserted during installation. It will be noted that the overlaying sheath **25** shown in FIG. **2** is similarly formed **26** and usable for the purpose just described.

For similar purpose FIG. **6** suggests the forming of supporting crotches **44** at intervals along the upper edge of a central stiffening member **41** such as that illustrated in FIG. **4**, which has been modified by cleaving each of the upper segments shallowly and bending mated portions **45** thereof oppositely so as to form the described crotches.

FIG. **7** is illustrative of a subspecies of sealing inserts which by definition are includable in the butterfly class even though in appearance there may seem little resemblance since the outer wall sections **17** of the typical butterfly are disparate. That which causes this group to be subclassified separately, however, relates to the inclusion of means by which the rate of vertical motion may be made positive without reliance upon precise balancing of thrust between the upper sections **12** and the base element **13**. In the drawing are shown in half-section a typical upper section **12**, a medial inverted T-section conjoint therewith, comprising a central stem **14''** with lateral extensions **46**, and a guiding section **47** abuttable against each sidewall support, providing a diagonally inclined undersurface **48** against an opposing pair of which the contacting edges **49** of the lateral extensions, **46** are induced by upward thrust B. When subjected C to a narrowing joint, the medial section **14*a***, **46** is forced downward A by the inwardly motioned guiding sections **47** to a lowered position I as suggested by the phantoming in the main section of the illustration. The portion phantomed above completes the extruded form **11*b*** prior to stressed assembly with retainer sections **50**, each of which secures the upper extremity **18** of the insert relative to a resilient base member capable of delivering upward thrust B to the medial sections by suitable means such as hereinbefore have been described. It should be understood that the guiding facility **46**, **47** may be positioned vertically whenever convenient including a location beneath the upward thrusting mechanism and that such mechanism need not necessarily comprise the form of force providing elements specifically described herein. For example, the upward thrust required may be provided by tensionable ties chevroned from the sidewalls to the central stem or by a spring base **13*c*** having sidewall anchorages **51**.

The need for lubrication of the sliding surfaces **48**, **49** will depend largely upon the frictional characteristics of the subject materials and upon the degree of net upward thrust they must bear. It will be apparent that either or both surfaces may be faced differently from the remainder of the extrusion, e.g., with an interposed layer of metal or a disparate polymer, or by means of slip finish or specialized surface treatment. Effective lubricants when required may include graphite, molybdenum or silicone compounds, waxes or, conceivably, simple grease. A degree of porosity in the subject surfaces quite obviously would aid the retention of such lubricants.

The construction illustrated in FIG. **8** is similar to that of FIG. **7** except that the guiding means **47*a*** are formed in the retainer sections **50*a***, and the upward thrusting mechanism comprises a simple elastomeric member **13*d*** which is supported by the anchorages **51** incorporated in the retainer sections.

To those who are skilled in the art it will be apparent that the constructions illustrated in FIGS. 7 and 8 are directed to the use of higher polymers which may be categorized as being more springlike than elastomeric, which characteristics similarly are applicable broadly to the entire species of butterfly inserts. It is significant to note in appraisal thereof that severe compressive deformation occurs only in the base section and that ambient flexure otherwise is limited to short rolling segments of the upper sections. Thus such inserts could be said to have only three moving (flexing) parts. In addition it will be noted that the described improvements in resilient base design may contribute measurably to reduction in the effective severity of deformation within this element, and that further relief may be achieved in certain constructions by transference of portions of its vertical motion-absorbance function to other sections.

Due to the existence of so many variants it is difficult indeed to define a specific embodiment of the invention which is clearly to be preferred, since this species of sealing inserts is applicable broadly to a great range of specification requirements. For general highway installations in sealing contraction joints which customarily are slotted from one-fourth to one-half inch in width, and wherein cost considerations are inescapable, the preferred form would be essentially that as shown in FIG. 1 and comprised of Neoprene. For aircraft ramp applications especially in engine startup areas where flame, fuel and heat problems are encountered, a silicone rubber extrusion could be utilized if adequately protected from the fuel, e.g., with an overlaying sheath sealed effectively against the abutting concrete sections. In such an application the use of metal sheath is intriguing especially if its conductive capacity could be utilized effectively for the transmission of heat into a sink and away from the body of the insert. Otherwise a Teflon sheath could be preferred. For heavy duty applications such as in bridge construction wherein the seals often are generously dimensioned (on the order of 3 to 6 inches or larger) Neoprene extrusions of relatively high durometer may be used effectively. Due to their size it is preferred that the central stem be fortified, e.g., with strips of expanded metal enveloped in the elastomer in spaced relation and that the motor element be made strongly reliant upon similarly enveloped spring steel, the construction of which would be dictated by the work to be performed.

In applications wherein medial supports are feasible it will be noted that inserts of the type described may be used plurally, whereby increased spans may be achieved at lessened material cost. Additionally it will be understood that fortifying elements may be incorporated advantageously in portions of the insert other than those hereinbefore expressly described, among which could be included the outer wall sections **17**, the inboard portions **15** of the upper members which in essence serve as extensions of the central stem **14** and therefore are subject to similar requirements, and as reinforcement in the upper corners of the extrusion.

I claim:

1. A compressible insert for sealing a variant joint space such as that which occurs between sections of concrete paving said insert comprising, and in combination:

a. two flexural upper sections opposed in symmetry, having a central junction and extending upward and outward from said junction to define corner extremities;

b. a central stem conjoint with and extending downward from said junction, said stem having lateral extensions upon opposite sides to form a T-section;

c. opposed guiding means to engage the respective edges of said extensions, said guiding means having undersurfaces which incline downward and outward symmetrically to provide diagonally slanted guide faces for said edges when the insert is installed in the joint space, thereby to position the relative depth of said stem ambiently as a function of deviation in width of the variant joint space;

d. resilient means to exert an upward force against said stem to maintain operative engagement of said edges with said guide faces; and

e. supporting means upon either side to maintain a fixed relationship between said corner extremities and said guiding means respectively, and to secure the combination when installed in the joint space.

2. The combination as claimed in claim **1**, wherein said supporting means are of rigid composition and contoured to provide said opposed guiding means.

3. The sealing insert as claimed in claim **1**, wherein said stem comprises a strip of metal consisting of a connected series of X-shaped segments.

4. The sealing insert as claimed in claim **1** including, and in combination, a reinforcing strip positioned proximate said central junction.

5. In a compressible insert for sealing a variant joint space having opposed vertical faces such as occur between sections of concrete paving, wherein said insert is of the type adapted to be subjected to deformation comprising a resilient extrusion having a patterned cross-sectional structure including upper and lower pairs of lateral sections opposed in symmetry and extended outward to engage said faces, and connecting means oriented vertically conjoint with intermediate portions of said pairs, the improvement wherein said connecting means comprises an embedded strip of expanded metal forming a conjoint series of X-shaped segments adapted to stabilize said structure when the compressible insert is in said joint space.

6. In a compressible insert for sealing a variant joint space having opposed vertical spaces such as occur between sections of concrete paving, wherein said insert is of the type which comprises an elastomeric extrusion having a patterned cross-sectional structure including upper and lower pairs of lateral sections opposed in symmetry and extended outward to engage said faces, and means to conjoin said pairs in spaced relationship, the improvement wherein said lower pair of lateral sections comprises an embedded metal element cleaved and expanded to form a connected series of X-shaped segments.

7. A compressible insert as claimed in claim **6**, wherein said element consists of spring metal and the legs of each said X-shaped segments increase in width toward the medial portion thereof to provide a gradingly flexural lower pair of lateral sections with its medial portion the more rigid and its peripheral portions the more flexible.

8. In a compressible insert for sealing a variant joint space having opposed vertical faces such as occur between sections of concrete paving, wherein said insert is of the type comprising a resilient extrusion having a patterned cross-sectional structure including upper and lower pairs of lateral sections opposed in symmetry and extended outward to engage said faces, connecting means oriented vertically conjoint with said pairs, said upper pair of lateral sections having an exposed central junction, and in which such an extrusion is adapted to be inserted forcibly into a prepared joint space by a relatively narrow edged installation tool, the improvement wherein said insert includes, and in combination, a reinforcing member positioned proximate said central junction and having a composition disparate from that of said upper sections to prevent damage to the extrusion by said tool during installation.

9. The combination as claimed in claim **8**, wherein said reinforcing member extends downward from said central junction and comprises a connected series of X-shaped segments, the upper edge of said member which is proximate said central junction having formed crotches at intervals to transmit the force of said tool distributively into said insert.

10. The combination as claimed in claim **8**, wherein said member overlays all of the exposable surface of said upper sections and includes means for securing the edges of said member to said extrusion, whereby, when said combination is installed in the joint space, the overlaid member will comprise a protective sheath conforming essentially to the surface contours of the upper portion of the extrusion.