March 14, 1967 D. F. DREHER 3,308,726

SEALS FOR CONTRACTION AND EXPANSION JOINTS IN CONCRETE PAVEMENTS

Filed Oct. 29, 1963 4 Sheets-Sheet 1

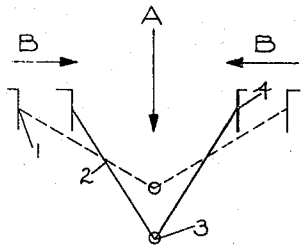


FIG. 1

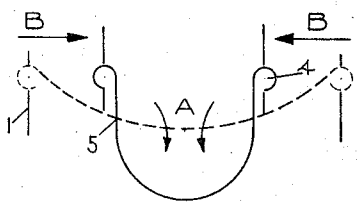


FIG. 2

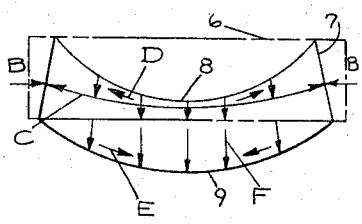


FIG. 3

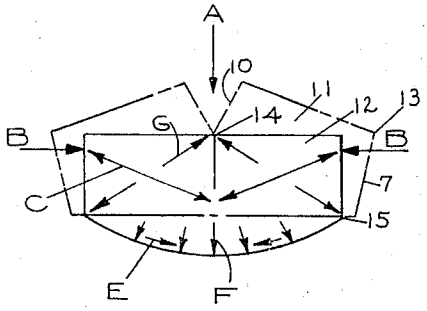


FIG. 4

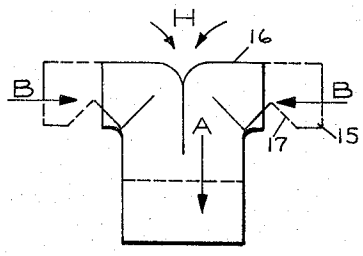


FIG. 5

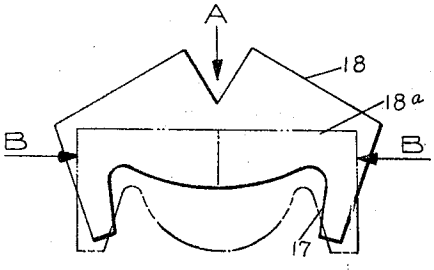


FIG. 6

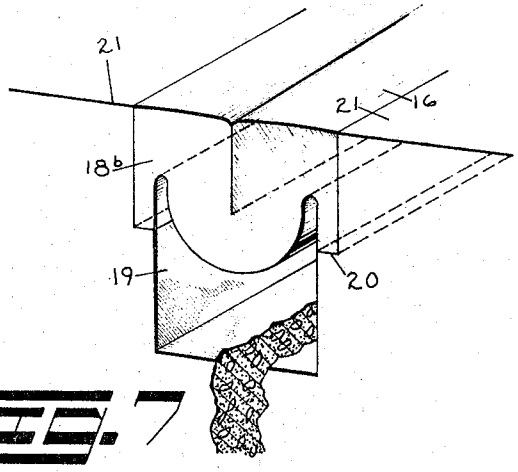


FIG. 7

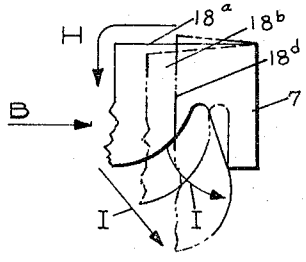


FIG. 8

INVENTOR.
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March 14, 1967 D. F. DREHER 3,308,726

SEALS FOR CONTRACTION AND EXPANSION JOINTS IN CONCRETE PAVEMENTS

Filed Oct. 29, 1963 4 Sheets-Sheet 2

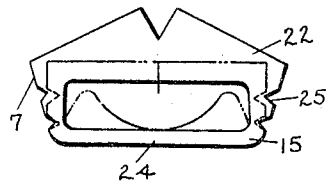


FIG. 9

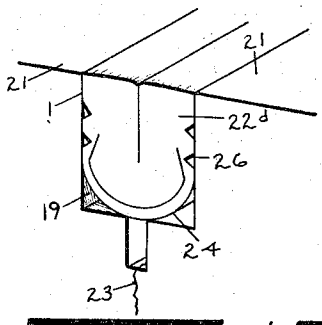


FIG. 10

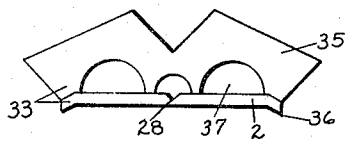


FIG. 13

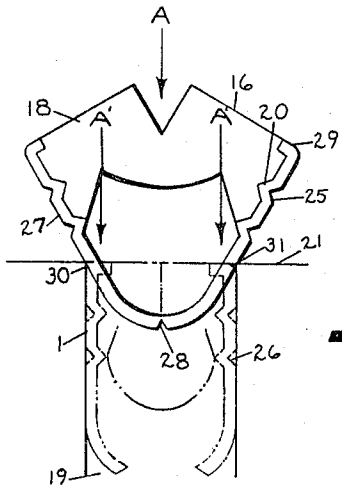


FIG. 11

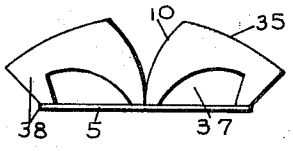


FIG. 17

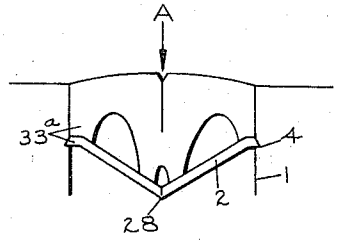


FIG. 14

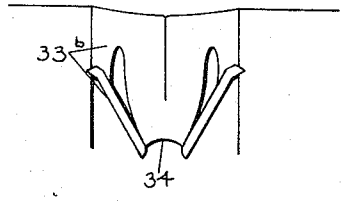


FIG. 15

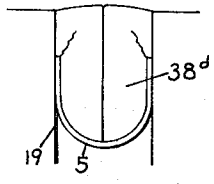


FIG. 18

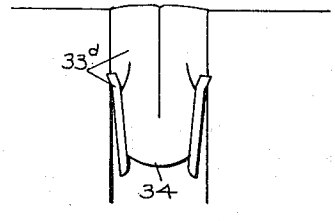


FIG. 16

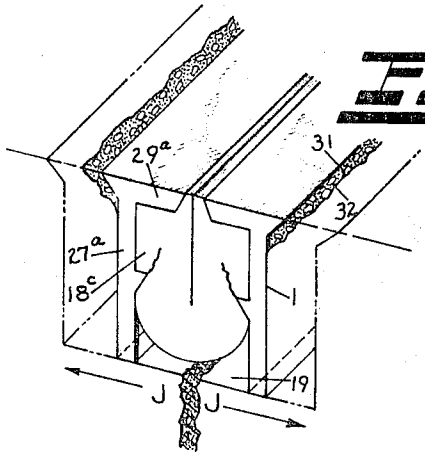


FIG. 12

INVENTOR.
DONALD F. DREHER

March 14, 1967 D. F. DREHER 3,308,726

SEALS FOR CONTRACTION AND EXPANSION JOINTS IN CONCRETE PAVEMENTS

Filed Oct. 29, 1963 4 Sheets-Sheet 3

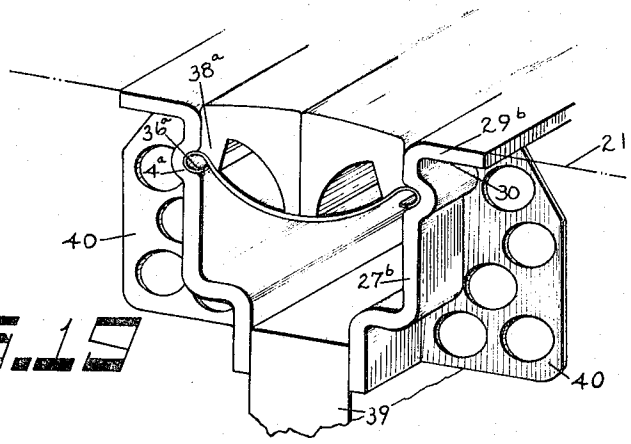


FIG. 19

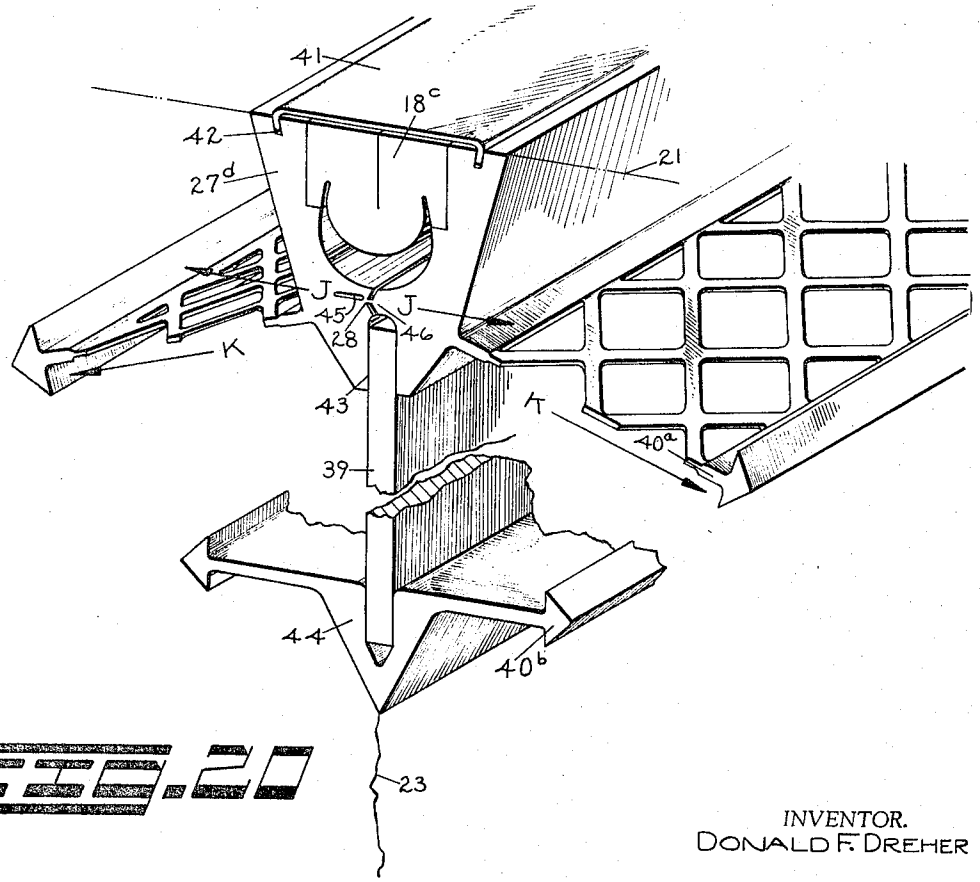


FIG. 20

INVENTOR.
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March 14, 1967 D. F. DREHER 3,308,726

SEALS FOR CONTRACTION AND EXPANSION JOINTS IN CONCRETE PAVEMENTS

Filed Oct. 29, 1963 4 Sheets-Sheet 4

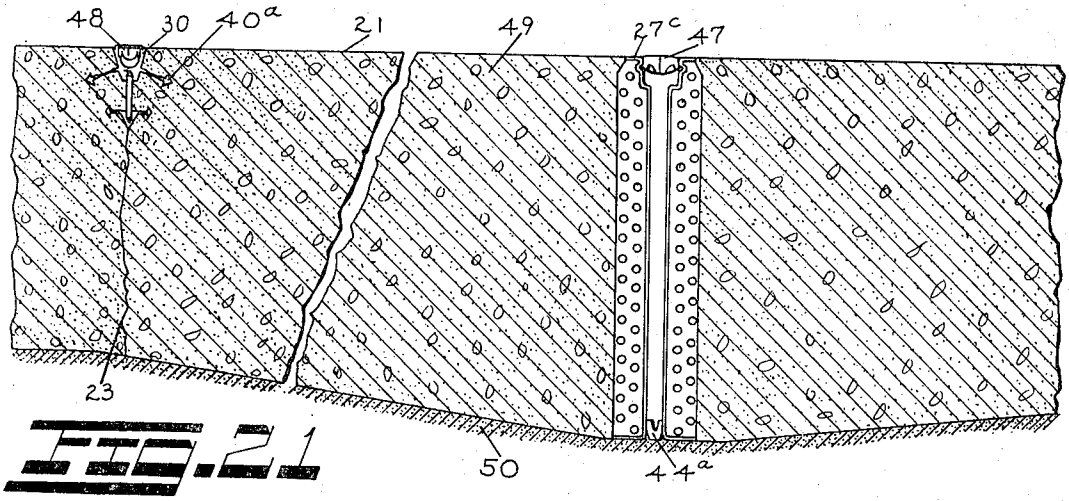


FIG. 21

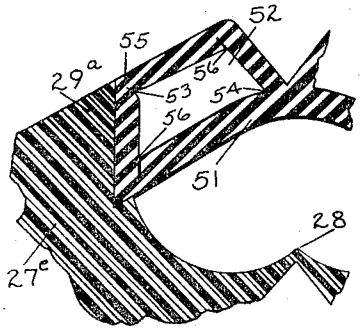


FIG. 22

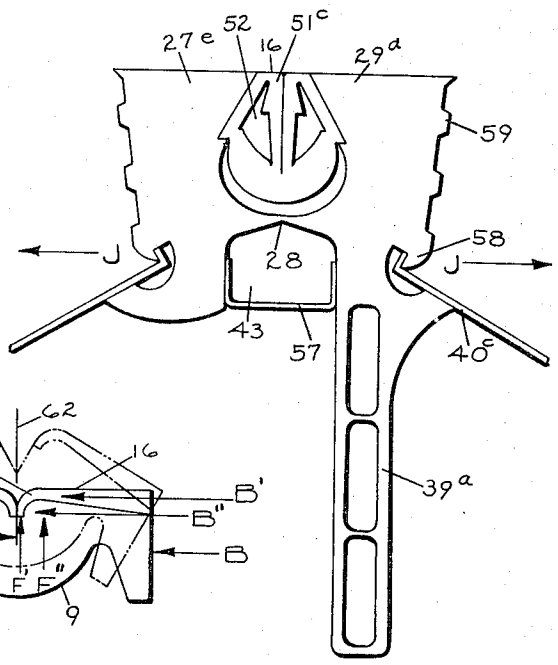


FIG. 23

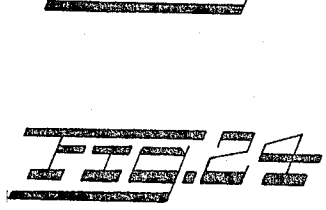


FIG. 24

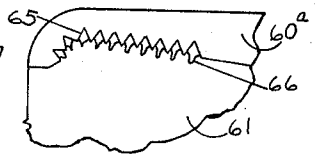


FIG. 25

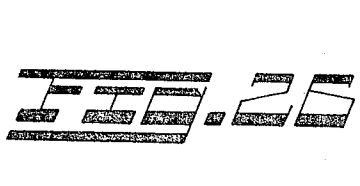


FIG. 26

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United States Patent Office 3,308,726 Patented Mar. 14, 1967

3,308,726

SEALS FOR CONTRACTION AND EXPANSION JOINTS IN CONCRETE PAVEMENTS

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East Brookfield, Mass. 01515

Filed Oct. 29, 1963, Ser. No. 319,875
19 Claims. (Cl. 94—18)

This invention relates to the sealing of expansion and contraction joints in concrete. More particularly it concerns the use of preformed inserts for such purpose in the construction and maintenance of concrete paving laid down as highways, airport ramps and runways, industrial flooring, corridors and the like.

Joints are required in concrete pavements to reduce compressive, tensile and flexural stresses in the slabs, caused by changes in volume resulting from variations in temperature and moisture content of the concrete. Reduction of these stresses is accomplished by dividing the pavement into a series of sections of predetermined dimension by means of joints. These jointed separations are variously categoried, purposed, designed and positioned. Although applicable to certain other forms, those with which the instant invention is principally concerned are transverse expansion and contraction joints. Sealing is required in such joints in order to exclude water and thus to discourage its infiltration into the subgrade, and to prevent dirt and other foreign material from lodging in the joint and so interfering with its expansion-absorbing function, the restriction of which can cause spalling of the adjacent concrete surface or "blow-up" of the pavement.

The joint sealants customarily used are bituminous materials or rubber compounds, or combinations thereof, poured or pressurably flowed into formed or saw-slotted grooves and therein firmed to solid consistency. It is manifest that an ambiently variable space cannot be continuously and fully occupied by a solid filling which, although deformable, is demanding of volumetric displacement; thus, compensative vertical displacement is inevitable with every change in horizontal spacing. Coincidentally it will be observed that fullness of occupancy of the joint space by the sealant is diametrically inverse to the need for such filling. This aberration is aggravated at both temperature extremes. In heat, when the joint is minimally gapped and maximally occupied, such sealants offer their lowest physical resistance to deformation and mobility, and often may be extruded from the joint and tracked along the surface of the pavement. At the opposite temperature extreme when it would be highly advantageous for the broadened joint to be bridged securely, the top surface of the sealant will have wettedly meniscused parabolically inward, developing a yawning gap in the surface of the pavement.

More importantly, since the sealant was originally poured and set in or above the median temperature range, contraction of the adjacent concrete sections at lesser temperatures subjects the sealant to horizontal tension. Being thus increasingly subject to tensile stressing as temperatures fall and slab contraction proceeds, such a sealant quite naturally will tend to crack and gap either within its own mass or from its adhesional attachment to the concrete, such phenomena apexing at extremes of cold when the sealant is least capable of yielding to such stresses. Although fluidly-installed sealants of this character tend to be adherent to concrete and may be made somewhat elastic, the requirements are often difficult of attainment and highly demanding in formulation, compounding and installation, the latter involving meticulous cleaning of the prepared slot in order to insure adhesional anchorage.

In order to alleviate these two major problems of fluidly-installed sealants, viz: compensative vertical displacement and crevising within the joint, the manufacturers of sealants recommend wider joints in order proportionately to reduce the relative variants. The use of broader slotted openings however is objectionable for a number of reasons among which may be included the increased cost of slotting and filling, impact damage to the vulnerable surface corners of the slot, and the nerve-racking discomfort and potential accident hazard of the sonic beat set up by the pounding of tire treads meeting joint after joint in hypnotic rhythm. Specification airport paving has contributed partial solution to this problem by increasing the frequency of narrow top-surface groove-type contraction joints and all but eliminating the customary expansion joint, the latter requirably occurring only at 1,500-foot intervals on runways and at certain types of intersections.

The invention herein described, although utilizing both intelligence and product derived by chemistry, proposes mechanical solutions to the aforestated problems. Briefly, the seal is a preformed elastomeric insert, so designed and structured as to be vertically depressed when compressed horizontally, while maintaining its top exposed surface essentially level and unchanged in height and thus capable of bridging the joint fully and securely over its design width range. Although demandingly elastic, it is capable of sizable variation in stiffness, load-bearing capacity, design and chemical composition. These factors are especially pertient in such highly specialized and demanding applications as that of airport ramps and runways designed for use with jet aircraft, requiring great resistance to heat, flame and fuel. Being minimally consumptive of material and differentially surfaceable, the techniques herein described may be utilized both effectually and economically, making feasible in extreme applications the use of high cost materials whenever such may be required to achieve the necessary resistibility together with desirable durability and longevity.

Having been so-purposed and finally achieved, the sealing insert's ability to maintain constant level may permit the installation of concrete paving with the necessary joints imperceptible. Leading toward such desirable end, it should be noted that being under elastomeric compression over its entire width range, the sealing insert force-opposes the slabs, and thus provides physical support for the concrete at its spallably-vulnerable corner-termini, which may permit the elimination of round-edged corners with consequent narrowing of the exposed gap and the setting of all joint-sealing inserts flush with the slab's surface. More certain means for such reinforcement and reliable level-surface continuity are additionally described herein, some being integral with the sealing inserts and/or contemporaneously installed therewith.

The primary objects of the instant invention as thus far revealed include development of the compression-depressing principle and its adaptation to the sealing of joints in concrete, full occupancy of the upper portion of the ambiently gapped joint by the sealing insert, maintenance of essentially unchanging top level of the sealing element, means whereby level surface continuity may be achieved in concrete pavements including stabilization of points of inherent structural weakness, and satisfaction of the demands of exceedingly critical installations. Additional objects include improvement in installation techniques with concomitant cost savings, increase in reliability of joint sealing with resultant lessening in the incidence of required maintenance, simplification of such maintenance as may be required in consequence of accident or excessive wear or abuse, and adaptation to the repair of old structures. Means by which these and other worth-

while objectives may be accomplished will best be understood by reference to the accompanying drawings, in which—

FIGURES 1 to 5 inclusive are schematic elevations illustrative of principles upon which the instant invention is based.

FIGURE 6 is an end elevation of an extruded preformed elastomeric insert showing both its original form and its prestressed shape when compressively positioned at maximal width.

FIGURE 7 is a perspective view showing the same sealing insert installed in a concrete joint, medianly-widthed.

FIGURE 8 is a partial end elevation showing the progressive downward motion of the central portion of the sealing insert as the sealed gap width reduces.

FIGURE 9 is a dual end view like that of FIGURE 6, showing a similarly patterned insert with a bottom connecting membrane, thereby forming a tubular element.

FIGURE 10 is a perspective view of the same insert showing it installed and maximally compressed in its retaining groove.

FIGURE 11 is a dual end elevation of an insertable assembly showing its original form and its highly compressed positioning between opposing concrete walls.

FIGURE 12 is a perspective view showing a sealing assembly installed in a surface-spalled concrete slot.

FIGURES 13 to 16 inclusive show the fabricated form and progressive compression of a rigidly levered insert partially principled in accordance with the schematic illustration shown in FIGURE 1.

FIGURE 17 is an end elevation showing the non-stressed form of a sealing insert whose support is principled in accordance with the schematic illustration shown in FIGURE 2.

FIGURE 18 is an end elevation showing the same insert installed in maximally compressed position.

FIGURE 19 is a perspective view of a spring supported insert modified slightly from that shown in FIGURES 17 and 18, maximally widthed and mounted in a rigid retainer designed for use in an expansion joint, the formed retainer providing reinforcement of the concrete in which it is mounted.

FIGURE 20 is a perspective view of a sealing insert of the type shown in FIGURE 6, prefabricatively installed in an anchorable retainer, including a removable compression clip and provision for insertion of a variably-depthed slab separator and an anchorable bottom sealing element.

FIGURE 21 is a cross-sectional elevation of a segment of concrete pavement showing exemplary installation of sealing insert assemblies in contraction and expansion joints.

FIGURE 22 is a partial cross-sectional end elevation showing the manufactured form of a co-extruded combinational element designed for pre-pour installation, and showing a modified form of elastomeric sealing element.

FIGURE 23 is an end elevation showing the same combinational element ready for pre-pour installation as a contraction joint assembly, in which the sealing element is internally compressed almost maximally as befits its intended function.

FIGURE 24 is a dual end elevation showing the design of a bi-compositioned sealing insert with an exceptionally durable and impregnable top surface.

FIGURE 25 is a segmental end section of the same type of insert including stress relief for the top surfacing element.

FIGURE 26 is a partial end elevation showing another form of flexurable stress relief applicable to bi-compositioned inserts.

Referring now to the drawings, FIGURE 1 illustrates the dominating principle which causes the central portion of the sealing inserts herein described to be downwardly motioned A as a consequence of horizontal inward movement B of the opposing walls **1** of the concrete slabs, against which two symmetrically positioned levers **2**, centrally hinged **3**, thrust pivotally **4**, the behavior as thus described occurring transitionally between the respective positions indicated by dotted and continuous lines **2**. Such transitional positioning will be indicated in identical manner in FIGURES 2 to 5 inclusive.

FIGURE 2 illustrates a similar phenomenon A, wherein a spring element **5** replaces the hinged lever arrangement **2, 3**, shown in FIGURE 1, also thrustable pivotally **4** against supporting walls **1**.

FIGURE 3 illustrates application of the spring support principle (FIGURE 2) executed in an elastomeric substance **6**. Indicated in the drawing are the primary lines of force resulting from horizontal inward movement B against the ends **7** of the elastomeric block **6**, and thereby resistibly opposed C, the vertical equilibrium initially having been upset in a downward direction. Its indicated equilibrated position is maintained by compression D of the upper or concave portion **8** of the block **6**, opposed by the tensioned E lower or convex portion **9**. In consequence of such deformation, quasi-radial-vertical lines of secondary stress develop within the deflected section **6**. These lines of force F exhibit graded stress reversal between upper and lower termini, any given point being stressed oppositely and proportionately to the primary stress (C, D, E) and at right angles to it except as influenced by angular deformation and shear. Such a force complex increases the inherent rigidity of the elastomer, as does the stressing of any elastomeric material, and thus renders it capable of supporting a load vertically applied at its central section.

In FIGURE 4, which is similarly part numbered, a V-grooved **10** upper section **11** has been added to the rectangular block **6** shown in FIGURE 3, and the ends **7** of its body section **12** sloped outward as indicated in the ghosted portion of the drawing. Horizontal force B first applied to the upper or outboard corners **13** cause downward movement A of its central section and when compressed to the point indicated, lines of force, C, E, F similar to those shown in FIGURE 3 are extant. At this point it is interesting to note that the dominating horizontal compressive force C behaves not unlike the lever action **2, 3** as principled in FIGURE 1. When horizontally stressed B to the position shown, with the V-groove **10** closed and its top corners **14** abutting, diagonally-oriented or secondary lines of compressive force G begin to develop at their respective termini in opposite corners **14, 15**, although being centrally tensioned by deformation caused by the dominant or primary compression C, the displacedly outward deformation per se contributing to the terminal compressive force G. As the elastomeric block **12** is progressively and further compressed inwardly and its central portion lowered in shear, the designated secondary force G increases and the line of primary force C moves parallelly downward, its original outboard position **13** tending to be drawn inward as a terminus of the lengthening diagonal, such phenomenon being clearly demonstrated by the inwardly sloping ends **7** of the stressed elastomeric block **6** as shown in FIGURE 3.

FIGURE 5 is illustrative of the rolling gland principle H which harmoniously combines with the inward B and vertical A movements of the top surfaces **16** of elastomeric sealing inserts as herein described. Also shown is one means of alleviating the phenomenon immediately hereinbefore mentioned, wherein the upper outboard corners of the insert tend to be drawn inward **7** (FIGURE 3) as the moments A, B progress. By notching **17** the lower section of the insert adjacent its lower supporting corners **15**, compression relief is provided its downwardly bending moment, thus relieving its pivot-supported elongating deformation. It will be noted that such arc segmental relief interferes little with the indicated lines of force C, E, F, G shown in FIGURE 4, and thus affects only minimally the insert's load-bearing capability.

Both in the preceding figures and in all that follow, reference characters are identically meaningful. Differentiation between things material and forces or movements is aided by the use of numbers to identify the former, and capital letters to signify the latter. Alphabetical suffixes attached to part numbers indicate deformative changes in shape of elastomeric elements, each suffix being meaningful as to the degree of such deformation, e.g., a part number per se represents an extruded form of insert, the suffix *a* indicates its shape when minimally compressed and maximally widthed, *b* when medianly stressed, *c* approximating a further reduction in width, and *d* signifying maximal design deformability. Applied to certain rigid elements, such suffixes may be used to identify alterations in an element whereby dissimilar or additional objectives may be achieved, the referencing procedure thus utilized making description of the instant invention more intelligible.

FIGURE 6 shows the developed form of an elastomeric compression-depressing insert utilizing certain of the principles illustrated in the schematic illustrations. It will be noted that it resembles the showing of FIGURE 4, from which it has been modified to include the teaching **17** of FIGURE 5, although dotted and continuous lines are reversed from the previous principling illustrations. Its shape as originally formed **18** is shown by the solid-lined main figure, while the ghosted figure **18***a* indicates its stressed shape when compressively B positioned at its maximal load-bearing design width.

FIGURE 7 shows the same insert **18***b* installed in a concrete joint **19** which is gapped medianly within the insert's range. As shown, the sealing insert **18***b* is ledge-supported **20** and its top surface **16** mounted flush with that of the adjoining concrete slabs **21**.

FIGURE 8 shows a half section **18***a* of the same insert identically maximum-widthed as in FIGURE 6, and indicating its changing form as it progressively is compressed to its median **18***b*, and then to its minimum **18***d* design width. The several directional arrows B, H, I indicate the motion of some of its elements in relation to its slab-contacting edge **7**. Insertion of such an insert **18** into a prepared slot **19** requires the use of compressive force B which is most easily applied by a pattern of rollers, the leading pair compressing its width followed by downward force A which seats the insert **18** in its desired vertical position **18***b*. Ledge support **20** for this type of insert as indicated is highly desirable, although support may be by adhesive means or by being self-compressionably keyed to the concrete.

FIGURE 9 shows a similarly patterned insert formed in a broad, relatively shallow tubular section **22**, which becomes inversely proportioned when maximally compressed **22***d* as shown in FIGURE 10 where it is installed in a saw-slotted groove **19**, beneath which the contractionally-broken sections **23** of the concrete keyingly abut each other. By connecting **24** the lower outboard corners **15** of the sealing insert **22** and thereby making it tubular in section, its compressible installation **22***d* is greatly simplified over that of the original form **18** shown in FIGURE 6, the tubular insert **22** being positionable by forcibly rolling or depressing it directly into place.

Lubrication facilitates this method of insertion and minimizes abrasion of wall-contacting surfaces, both that of the concrete **1** and that of the insert **7**. Such lubrication may comprise a fugitive substance, or a bonding element which may pocket in the grooves **25** formed in the sidewalls **7** of the insert, thus keying the interface by providing bead-formed support ledges **26**. Another means by which mechanical keying may be developed in this type of installation is by use of an evaporable solvent and/or a fugitive plasticizer temporarily and shallowly incorporable into the outer surface **7** of the elastomer, thus permitting its stress-relaxed imaging of the opposing concrete surface **1** and ultimate restoration of its original physical properties. Combinational means including both bonding and keying, either or both involving partial attack upon the polymeric composition, whether it be highly elastomeric or extremely rigid, may be advantageously employed.

The assembly shown in FIGURE 11 also is designed for simple depressible insertion, achieved by containment of the sealing insert **18** within metallic or rigid plastic sidewalls **27**, which may be fracturably connected **28**, the rigid elements **27** extending convergingly downward so that they are easily insertable into the prepared slot **19** in the concrete. By downward force A, first applied to the top surface **16** of the sealing insert **18**, the rigid sidewalls **27** are drawn inward, causing fracture of their separable linkage **28**. By further depression, the downward force A' being increasingly borne by the rigid elements **27** which approach parallel alignment with the supporting walls **1** of the prepared slot **19**, the assembly **18**, **27** slides unobstructively into place, the top edges **29** of its retaining sidewalls **27** reliably positioning flush with the surface **21** of the pavement, thus providing an additional measure of physical support for the concrete's exposed corners **30** which reinforcement may be further enhanced if desired by filling **31** such radiused or spalled gapping as may occur along this junction. The retaining elements **27** as shown in the illustration may be designed for keyable anchorage by providing external recesses **25**, which coincidentally may form support ledges **20** for the elastomeric insert **18**, and in which the adhesional composition may form keying beads **26**, similarly as in the like-purposed and -numbered elements in FIGURES 9 and 10.

The rigid-walled sealing assembly **18**, **27**, however, differs from all of the sealing elements previously shown by its interposition of another kind of element **27** between the elastomeric surface **7** and the supporting concrete **1**. Whereas the compressed elastomeric surface **7** ably seals the interface against water intrusion, even high pressured contact between rigid surfaces of the character here involved could not prevent seepage of water along such plane of contact. Thus this type of interface must be sealed against water, the doing of which is concomitant with adhesional anchorage of the retainer **27**.

FIGURE 12 shows a further extension of the use of a concrete-reinforcing retainer **27***a* for the insert **18**. The illustration shows its installation in a slot **19** prepared in spalled concrete **32**, which may be filled in **31** with grout or other suitable filling and/or sealant. The top section **29***a* of the retainer **27***a* overhangs a considerable portion of the insert **18***c* per se, almost abutting its mating section **29***a* when the joint **19** is minimally spread, from which gapping the assembly may open as indicated by the phantomed exterior and the directional arrows J.

Each of the elastomeric sealing inserts thus far described has utilized the basic form **18** illustrated in FIGURE 6. That which is presently illustrated **33** in FIGURES 13 to 16 inclusive resembles the first-principled form originally suggested by FIGURE 1, from which it differs with respect to the hinged connection **3**, the modification of which **28** provides additional space **34** into which the central portion of the insert may depress. This insert **33** comprises an elastomeric superstructure **35** bonded to a rigid base **2**, preferably metallic, which is weakened at its centerline **28** so as to bend along that line when inserted as in FIGURE 14 and variably separable **34** when further depressed as shown in FIGURES 15 and 16. This type of insert also may be installed by simple roll-in means A, the sidewall lubrication of which is not necessarily meaningful. The sharp corners **36** of the metallic base **2**, whether they be square-cut or formed in the manner indicated, anchorably pivot **4** in the supporting concrete sidewalls **1** in each of which a groove **4** develops as the joint ambiently varies in width. The over-center lever-like action of the base plates **2** in this design of insert makes it virtually impossible for it to be lifted out from its placement by overhead or surface suction. Additionally it will be noted that the elastomeric super-

structure **35** contains voids **37** capable of occupancy by the elastomer, thus permitting increased compressive collapsibility in to a volume of space less than that which it originally occupied, giving it a wider range of operational width than otherwise would be practicable. Equivalent collapsibility could be achieved by the use of a composition having a relatively low bulk modulus of elasticity such as foam latex, but in the instant application such an elastomer would tend to be insufficiently capacitied in structure to serve the intended purpose durably, although assured certain combinational arrangements may utilize such materials effectively as hereinafter will be described, and some inherently high-strengthened elastomers might well be made adaptable by foam treatment.

FIGURE 17 examples another form of elastomeric insert which may be metal-based **5**. This insert **38** utilizes directly the principle originally illustrated in FIGURE 2.

Its elastomeric superstructure **35** is more deeply center-grooved **10** and each of its symmetrical sections collapsibly voided **37** in a manner similarly executed in the levered insert **33** of FIGURE 13.

FIGURE 18 shows the same insert maximally compressed **38***d* in its retaining concrete groove **19**. The base **5** of this insert must have spring capability. It need not necessarily be metallic, however, since a number of tough semi-rigid plastics may be substituted effectively.

FIGURE 19 shows the same type of insert **38***a*, modified with respect to its pivotal terminals **36***a* which seat into recesses **4***a* formed in a matching retainer **27***b*, intended for wet insertion as an expansion joint contemporaneously with the pouring of the pavement. It upper section **29***b* preferably flush-mounts level with the top surface **21** of the pavement and provides positive reinforcement for the corner terminals **30** of the concrete. The lower section of the retainer **27***b* spans the top edge of a premolded compressible separator **39** of the type customarily used in such joints. Since this is an expansion joint, the insert **38***a* has been installed near the upper end of its design width range, or close to its maximum effective spreadability.

To those who are skilled in the art it will be apparent that each of the opposing sections of the retainer **27***b* may be installed individually and at different times, and if desired either or both wall sections may extend full-depthed to the subgrade (**27***c* in FIGURE 21). Separate installation thus permits their use in other types of joints, e.g., transverse construction joints, which normally are required wherever pavements intersect or when the pouring of a continuous strip may be interrupted for any one of a number of reasons. Additionally, perpendicularly oriented anchoring elements **40** may be included or affixed, positioned either in essentially horizontal plane, which may be continuous or segmented, or in vertical plane at spaced intervals, as suggested in FIGURE 19, or combinations of the two.

Also it will be apparent that an elastomeric element may be installed or inserted at the bottom of the expansion joint adjacent the subgrade, thus sealing it effectively against the intrusion of water and/or solid matter and protecting the joint space against the ill effects of such pumping as may originate from pressures beneath the pavement as well as from movement of the adjacent slab sections. In order that this type of bottom seal remain effective in periods of slab contraction, it is desirable that it be under compression at all times, which basic teaching applies to each and all of the sealing inserts hereinbefore described and comprises one of the fundamental principles upon which the instant invention is based. A simple and effective form of such a bottoming insert may comprise a tubular section which is flattenably stressed. Although it may be structured in sufficiently weak form to permit facile insertion by being flattened with internal vacuum, it is preferable that it be more substantially compositioned and structured, and thus more capable of adequately performing its intended function. Even simpler than the compressibly flattened tubular form is a plain rectangular section not unlike that which is principled in FIGURE 3, or a shaped section in the form of a V or a U preferably broad-bottomed, any of which may be either installed prior to the final pour or inserted later simply by being pushed into position from above. Such insertion may be aided by utilizing any of several techniques described previously, including that of adhesional anchorage if desirable or seemingly prudent. The last described bottoming insert **44***a* is included in the composite showing of an expansion joint in FIGURE 21.

FIGURE 20 illustrates further expansion of the use of sealing insert retainers designed for installation contemporaneously with the pouring of the pavement and preferably in planar alignment with its top surface **21**. This particular showing is that of a contraction joint assembly, which may depth ⅛ to ¼ the thickness of the slab and thus cause contractional breakage **23** to the subgrade from the position of the pavement-weakening assembly. The retainer **27***d* is extruded in semi-rigid plastic and its lower sidewall appurtenances **40***a* interruptibly slit and stretched K in a manner somewhat resembling that of expanded metal which is sometimes referred to as "Shelf-X." This type of separation and expansion K differs, however, in that the longitudinal dimensions undiminished. Following its fabrication is so described, a sealing insert **18** of the type shown in FIGURE 6 may be placed in the retainer **27***d* by flexing the extrusion pivotally at its centrally positioned connecting segment **28** and thereafter forcibly returning the retaining structure **27***d* to its original position, thus clamping the sealing insert **18** and compressing it to the position indicated **18***c*. A restraining clip **41** is inserted into the slots **42** formed in the top surface of the extrusion **27***d*, which together with the pivotal tie **28** locks the sealing insert **18***c* compressively in place. The expanded or grilled appurtenances **40***a* are designed for stable anchorage within the poured concrete, the contraction of which when it cools from its high point of heat of hydration will seize J the opposing sidewalls of the retainer **27***d* causing their separation at the relatively weak connecting segment **28**, the top restraining clip **41** having been removed prior to this occurrence, preferably as soon as the concrete was sufficiently set. The tensioned clip **41** serves additionally as a protective covering for the seal-insert **18***c* during the pouring of the pavement, and may indeed eliminate the need for clean-up at the joint.

Since the upper portion of the concrete slab must be freely separable to a specified depth, an inexpensive divider **39** may be inserted into the recess **43** provided for it in the lower section of the retainer **27***d*, thus continuing slot formation to the depth required. Additionally it may be desirable to seal the bottom of the slot formed by the dividing assembly, which may be accomplished by a suitably compositioned elastomeric element **44** such as that illustrated, it also being anchorable **40***b* in the concrete and sufficiently flexible to come and go as the sectionalized pavement expands and contracts.

Since contraction joints may be required to absorb a small amount of expansion greater than that at which the original set occurred, which usually applies only to the upper section since it is exposed to greater temperature variations than the lower section of the pavement, the slot-deepening separator **39** should be somewhat compressible, and additional means may be provided within the retainer **27***d* to absorb such overtravel. This may comprise an internally weakened area **45** which is subject to fracture by the opposing protrusion **46**.

FIGURE 21 shows the placement of sealing assemblies **47**, **48** wet-installed and flush mounted in concrete pavement **49**. That appearing on the right is an expansion joint assembly **47** which is similar to that shown in FIGURE 19, but modified in the manner further described in

connection therewith, at which point the slab **49** is thickened in accordance with specifications currently applicable to rigid airport runways. That shown on the left, where the slab's depth is restored to its basic design dimension, is a contraction joint wherein the dividing assembly **48** is like that illustrated in FIGURE 20. The fracture **23** which occurs beneath the contraction joint assembly **48** generates from the lower end of the bottom seal (**44** in FIGURE 20) and breaks randomly and keyingly **23** to the subgrade **50**. Since an accurately scaled showing of the contraction joint would tend to be unintelligible, the exceedingly narrow breadth of the sealing insert **18***c* and its retainer **27***d* is not revealed by the composite illustration shown in FIGURE 21. Although the total assembly may depth several inches, the design width of the insert **18***c* in this instance is 5/16 inch, while the retainer **27***d* measures only 9/16 inch across its top face and depths an equal dimension. Thus it becomes a tiny surface-imbedded element, compressively supporting the adjacent corners **30** of the pavement surface **21** and bringing tensiled reinforcement **40***a* to within close proximity of the vulnerable surface corner **30**.

FIGURE 22 is a partial showing of a sealing insert **51** modified in construction from that **18** originally illustrated in FIGURE 6. This illustration also contemplates co-extrusion of the elastomeric sealing element **51** with the semi-rigid plastic retainer **27***e*, the immediately adjacent portion of which shows in the drawing. Although of relatively little significance in this specific design of retainer, where its inwardly sloping sidewalls overhang **29***a* and thus lock the insert **51** securely when installed, co-extrusion of assemblies of this general character may permit integral bonding or keying between the differently compositioned elements.

Modification of the insert **51** includes opposing half sections which are hollow and internally contoured **52** in such manner as to facilitate successive reshaping by providing internal relief where the most disruptive stresses occur, thus minimizing the severity of the elastic deformation to which the insert is subject. An immediate consequence of such stress relief is to permit the use of elastomers which are less amenable to deformation than those required in the solid form **18** exampled in FIGURE 6. Observing the internal structure more critically, it will be noted that opposing corners are similar and adjacent corners dissimilar. Upper outboard **53** and lower inboard **54** corners being requirably collapsible are relieved, thus minimizing pivotal compression as the opposing inner faces come together. Additionally, the upper outboard corner **53** which is forced to pivot sharply when the sealed gap approaches its narrowest spacing, is minimally thicknessed **55** thus facilitating its flexure. The upper inboard and lower outboard corners **56** which must open as the insert compresses, are internally tensioned-relieved in the manner indicated, without sacrifice of their capacity to carry compressive loads when the insert is maximally spread.

FIGURE 23 shows the co-extrusion partially illustrated in FIGURE 22, completely assembled and ready for installation as a contraction joint in the formwork. Whereas the retainer **27***d* shown in FIGURE 20 was separately formed essentially in the upright shape illustrated and flexurally opened to receive the sealing insert **18**, the retainer **27***e* shown in FIGURE 23 has been formed in the open position as segmentally indicated in FIGURE 22. Similarly as with the retainer **27***d* of FIGURE 20 following placement of the insert **18**, the assembly has been brought forcibly to its upright essentially parallel position, the compression of the insert **51***c* being opposed by a separate brace **57** placed in the recess **43** below the pivotal connecting segment **28**. Although identical in primary purpose to the restraining clip **41** in FIGURE 20, opposite positioning of the brace **57** makes it quite different in other respects: it is compressioned instead of tensioned, internally positioned as against external and thus non-accessible as contrasted with being demandingly removable. Since it can interfere in no way with the opening of the assembly as the pavement contracts J, fracturing both the lower concrete section **23** and the connecting segment **28** within the retainer **27***e*, the compression brace **57** needs neither to be accessible nor to be removed. Having served its one purpose and being minimally structured, its ultimate fate wherever it may lodge within the joint is inconsequential.

Anchoring of the sidewalls of the retainer **27***e* is accomplished by attachment **58** of separate rigid elements **40***c* to the retainer walls. Such anchoring elements **40***c* are preferably metallic and may be expanded, punched, contoured or disheveled in such manner as to be sufficiently seizable by the concrete to effect separation of the connecting segment **28** of the retainer **27***e* and to provide such additional reinforcement as may be desired further to strengthen the structurally weak corner terminus **30** of the pavement adjacent the retainer **27***e*. In this example the lower slab-dividing element **39***a* is incorporated in the structure of the retainer **27***e*, being an extension of one of its outer walls. This depthing element **39***a* may be made collapsible in the manner indicated in the illustration. The exterior wall surfaces of the body section of the retainer **27***e* may be fluted **59** or otherwise shaped, if desired, to supplement their keying into the concrete. The lower slot-forming element **39***a* similarly may be contoured and/or positively anchored to the concrete along one appropriate face. Additionally it will be noted that the top face **29***a* of the retainer **27***e* overextends a portion of the elastomeric insert **51***c*, thus rigidly bridging part of the exposable gap in a manner not unlike that shown in FIGURE 12.

Thus far in development of the instant invention, stress relief within the structure of the sealing inserts has been accomplished by means of voids either positioned internally or developed in external contour. In addition to perfecting behavior, e.g., the top centered V groove **10** and the lower pivotal notching **17**, and broadening the design width range by use of collapsible voids **37** which coincidentally obviates the need for volume reduction within the elastomeric mass per se, the combination **52** of designed stress relief and unoccupied internal space as executed in the last described construction **51** and collapsibly illustrated **51***c* in FIGURE 23 permits the use of tougher elastomeric compositions than those required in the prior examples. Since the use of even more durable or impregnable compositions is presently indicated in order to meet transcending requirements, further investigation and innovation is demanded. One of the more likely avenues seems to be further development of the stress relief concept, to which I now respectfully direct your attention.

Bearing in mind the rolling-together movement H of the top exposed surfaces **16** of the sealing insert as graphically principled in FIGURE 5, it will be apparent that this outer surface **16** is minimally demanding of elastic deformation, its distortion being exclusively that of flexure or elasticity in shear where its vertical and horizontal planes rollably H intersect. A metal surfacing layer, for example, could be flexibly structured so as to function in the prescribed manner. Conversely, the physical demands upon the underlying supporting structure, which intimately contacts the aforesaid interplanar-motioned top surfaces, could not conceivably be satisfied by a chunk of metal. The very absurdity of such suggestion perhaps best reveals the discomparable requirements of the top surfacing element and its substructure, even though elasticity is demanded of both elements. In brief, the surfacing element **16** requires flexure such as may be provided adequately and advantageously by a composition having a high modulus of elasticity, while the supporting body section demands great deformability which is synonymous with a low modulus. Thus, being oppositely demanding in modulus of elasticity, these two discom-

parably functioning elements may be compositioned distinctively, permitting each to be maximally capacitied so as best to serve its respective purpose.

Such a differentially compositioned construction is shown in FIGURE 24 wherein symmetrically patterned top surface layers **60** cover each half of the supporting substructure **61**, the insert being formed in the manner previously taught as suggested in this drawing by phantoming its formed shape, so that when flexed into level top surface position as shown in the main illustration its elements are prestressed and load supportable. In such position the top surface elements **60** meet at the vertical center plane **62**, into which plane their external surfaces **16** merge tangentially in arced flexure **63** from the horizontal. Although arced transition from horizontal to vertical plane is endemic in such rolling gland movement H, its sharpness in the lesser modulsed compositions rendered its then discussion irrelevant. But when greater resistance to such abrupt flexure is encountered, as contemplated in the differentially compositioned construction herein shown, it must be considered.

Observing critically this area which immediately surrounds the aforementioned planar intersection wherein such flexure occurs, it will be noted that the sharpness of the bi-tangentially generating curvature **63** and its actual shaping is a combinational function of four basic influences: (a) the rigidity of the top surface layer **60** at its section of abrupt flexure **63**, (b) the force applied linearly to it B', F' through its own tangential extension, (c) the internal pressure configuration B'', F'' of the supporting substructure **61**, and (d) the external force or pressure B''' applied horizontally to it at the centerline vertical plane **62** by the opposing half section of the sealing insert.

The first named factor (a) is the simple product of the composition's modulus of elasticity in shear and its thickness at the point of flexure **63**. The tangential force (b) is compressively activated B' by the dominant external force B applied increasingly by the abutting concrete wall, and vertically opposed F' in shear by the elastomeric substructure **61** of the insert. The internal pressure configuration (c), which in a classic fluid example would simply push outward radially and be restrained by circumferential tension, is not so chaste in establishing equilibrium. In the theoretical example it would be that which hereinbefore has been designated the secondary line of compressive force G, being the oversimplified geometric summation of horizontal B'' and vertical F'' forces. The horizontal force B'' again dominates, such force by design having been first established in the initial prestressing flexure and compression of the insert. Vertical shear F'' is equilibrated in deformation with designed control of the top surface **16** supporting structure **61** and an ever-depressing and tensioning bottom contour **9** as the sealing insert is irresistibly narrowed in width. The horizontal force B''' which must be considered external (d) to the subject flexural arc **63** of the top surface layer **60**, merely images and faithfully opposes all horizontal forces (a), B', B'' which develop at the vertical center plane **62**. Its principal contribution to the shaping of the intermating arcs **63** is to cause their abrupt curvature where they merge tangentially into the common vertical plane **62**, such sharply flattening phenomenon occurring even if the internal supporting pressure (c) were fluid.

In summary, the effects of these several basic influences on the sharpness of the arc where the top surface layer flexes in transition from horizontal to vertical plane is as follows: (a) The natural radius of the top surface layer **60** will be enlarged with increase either in its coefficient of rigidity or in its thickness. (b) The flexural arc will be sharpened proportionately as its tangential extensions are additionally compressed B', F'. (c) Insofar as the internal pressure configuration may be represented as the secondary line of compressive force G, an increase in such internal pressure would tend to shallow the arc, or cause it to be greater radiused. However, since its horizontal component B'' is dominant increasingly as the joint narrows and its vertical forces equilibrated, the horizontal component B'' within the arc of flexure **63** combines with that of its opposing section which becomes oppositely applied externally B''' to the subject arc **63**, thus causing great horizontal compression against the vertical center plane **62** and flattening the arc **63** abruptly as it merges with such vertical plane **62**. From this summary it will be noted that as the gapped joint narrows and the horizontal compressive forces B', B'' become increasingly dominant, the latter three identified factors (b), (c), (d) will in fact combinedly tend to sharpen the flexural arc **63** of such a top surface layer **60**. Thus, when the sealing insert is differentially compositioned in the above described manner, the opposing deformation-resistant top surfacing elements **60** may be tapered **64** so that their inboard first-contacting sections are lesser-depthed and thus more flexible, the tapering being such as to permit the interflexing arcs **63** to be relatively constant in dimension over the entire design width range of the insert. It also may be noted that when the insert is maximally widthed the temperature will be the coldest, with consequent increase in coefficient of rigidity as a function of temperature, thereby providing another reason for lessening the thickness of the top surface layer at its inboard junction in such manner. Additionally it should be noted, in giving consideration to the factor of durability and surface abrasion, that the outboard portions of the top surfacing layer **60**, being at all times exposed and subject to such abrasion, are in fact needful of greater depth than the inboard portions which are less exposed in point of usage and thus subject to less abrasive wear.

To those who are knowledgeable in the behavior of high or complex polymers it will be apparent that the dually-compositioned construction just described permits utilization of a wide range of impregnated materials in the top surface layer **60** which heretofore have not been applicable to the sealing of concrete joints. Additionally it should be noted that such composition, due to its interfacial attachment to the supporting substructure and to its relatively minimal thickness, is not as needful of perfect elastic recovery as the elastomeric composition which supports it. Thus a certain amount of plastic deformation in the top surfacing layer may be tolerated to the extent that its substructure is capable of controlling and reshaping it, provided of course that its repeated plastic deformation not result in fatigue and fracture.

FIGURE 25 suggests a modification **60***a* of the top surfacing element **60** as shown in FIGURE 24, wherein its inwardly flexing surface has been grooved **65** and thus compression-relieved in the manner previously exampled at the designated opposite corners **53**, **54** of the internally contoured insert **51** shown in FIGURE 22. The grooving **65** may be filled with the more deformable composition of the substructure **61**, particularly if it be desirable or needful to key and thus to improve the interfacial attachment of the dissimilar compositions, or matching voids **66** may be developed in the substructure **61** in the manner illustrated in the drawing.

FIGURE 26 shows another modification **60***b* of the top surfacing element, similarly contributing to stress relief in flexure but differently executed, wherein the exposed surface has been tension-relieved by being segmented **67** following in principle the example of internal tension relief shown previously in corners **56** of the insert **51** in FIGURE 22. By such means it will be apparent that the surface element **60** may be deepened in total thickness without having increased its mean design rigidity, thus providing additional wearing depth which may abrade without change in flexurability. Or by identical means, equivalent mean flexure may be achieved safely and durably in an even more rigidly compositioned material as a consequence of

reduction in its thickness at intervaled points of flexure. In certain applications fatigue and ultimate fracture 68, concerning which caution hereinbefore has been counseled, could be tolerated and/or intended, or such severance could be included in the original fabrication, thereby eliminating completely the need for flexure in the top surfacing element itself. For such applications a continuous layer of suitable composition may be interpositioned between the outer surfacing segments and the substructure, this being a further specialization in the functionalizing of elements in the ideal sealing insert.

It will be apparent that shielding the elastomeric main body or substructure of the insert from surface exposure permits choice of its composition with less regard for the deleterious effects of such exposure. This factor may be especially apropos when giving consideration to ultraviolet emission of sunlight, absorption of fuels and solvents, and exposure to short-intervaled applications of heat or flame to the extent that such heat may be dissipatable with minimal transfer to the substructure. It will also be apparent that in other respects incident to surface exposure it need have no durable resistance, e.g., abrasion, wear and external damage in general. Thus its composition may be less restrictively formulated and its internal physical structure more varied in order that its now specialized function may be maximally achieved.

One of the problems inherent in joint sealing of concrete pavements concerns the incorporation of foreign matter such as dirt, sand and gravel, which often tends to imbed into the sealants irretrievably. By way of contrast with the several types of compression-depressing sealing inserts herein described, neither the highly deformable compositions used in the simpler forms nor certainly the tougher materials with which the later described seals are surfaced, are capable of accepting such particles. Although the top surfaces join and roll inward as the seal compresses, their centerline mating is so abrupt that none but exceedingly small particles could wedge and be carried inward. Such entrapment would tend to be temporary since any particles so seized will be rolled out and freed when the joint reopens.

Another serious problem with which joints in concrete, and consequently their sealing, must contend is that of sub-freezing temperatures. Indeed one of the purposes of joint sealants is to prevent the formation of ice in such spaces, the accumulation of which can be destructive when slab expansion occurs below the melt point. An ordinary sealant which has been deeply depressed by subzero conditions can permit the formation of ice in the upper portion of the joint from which it was withdrawn, which accumulation inevitably can lead to spalling of the adjoining surface of the concrete where its resisting strength is the lowest. Thus the significance of continuous top-level surfacing is obvious. Additionally it is interesting to note that the types of elastomeric materials in general which satisfy the physical requirements of compression-depressing inserts as hereinbefore described, tend to be low in their inherent affinity for ice. Added to this fact, to the extent that the inserts are subject to flexure under traffic, such interfacial bond as does exist will tend to be broken, not unlike the action which occurs upon a flexing de-icing element mounted on the leading edge of an airplane wing. Under conditions of load flexure, although probably of lesser significance, it is interesting to note that the temperature of the insert per se will tend to be higher than that of the adjacent structure as a consequence of, and in direct proportion to, the amount of flexing to which it may be subject.

And finally there is the probem of maintenance, which is necessitous if longevity is to be achieved in any structure however seemingly secure. Even though this problem is complex and with many ramifications, the instant invention may contribute importantly to its simplification and to reduction in its cost. The foremost contribution derives from an increase in the over-all reliability of the sealing element including its capacity for level surface continuity and reinforcing support at the sealed joints, and the certainty with which it may be correctly and uniformly installed. During the period in which development of the herein-described concepts have been in progress I have inspected innumerable expansion joints in concrete highways, some of which have been in service less than one year. Even in these recent installations and after one winter's exposure, careful inspection reveals frighteningly apalling conditions including discontinuity of the sealing element, gapping from the concrete, inadequacy of fill, the pocketing of sand and gravel, transverse cracks in the pavement in close proximity to the joint and/or stemming from it, and in some cases actual spalling of the adjacent surface. Such revelation, in addition to providing encouraging incentive, assuredly exposes the inadequacy of joint sealing techniques as presently practiced and executed in concrete paving. Additionally it demonstrates the extent to which experienced judgment is demanded in effective preventive maintenance, involving anticipatory appraisal as to which imperfections are more likely to cause damage. In practical terms this often means little more than the filling of obvious cracks or badly cavitied joints with a hot-poured or pressurably injected filler. Of necessity, such maintenance is done seasonably and in favorable weather and seldom if ever at extremes of cold when hidden weaknesses would become apparent and when some cracks might be opened sufficiently to accept a sealant.

Except for those sealing inserts which are locked in place by inwardly overhanging portions of well-anchored retainer sections, the removal and replacement of compression-depressing inserts can be an exceedingly simple and foolproof operation. This feature may be of considerable significance in paving areas which are subject to destructive abuse, e.g., where jet aircraft engines are started or run prior to takeoff, or in areas where excessive abrasion may occur repetitively.

To those who are skilled in the art of designing elastomeric elements and knowledgeable of the sizeable array of compositions from which intelligent selection may be made, the principles and teachings herein disclosed will permit the design and execution of sealing inserts capable of meeting a wide range of demands and effectively performing their intended functions.

It is to be understood that the disclosures herein presented are designedly mechanical in concept, and that therefore no attempt has been made to specify the exact materials or compositions which may be used in their execution, the inclusion of which would have been superfluous and is not needful to those who are skilled in the art and more knowledgeable of the behavior of such materials than am I. Elastomeric compositions however may be characterized as rubber or rubber-like materials which are capable of the necessary deformation and sufficient elastic recovery to permit repetitive cycles and to maintain the amount of compressive resistance necessary for satisfactory performance over the design width range of operation. Designatedly rigid, semi-rigid or spring-like elements may be either metal or plastic, whichever more suitably or economically serves the intended purpose. It will further be understood that design contours, indicated shapes and proportions, and certain dimensions have been given solely for the purpose of explaining the principles herein described, thereby to make them more understandable and to assist others to practice informatively the teachings of the instant invention.

Having thus described my invention, what I claim and desire to secure by Letter Patent of the United States is:

1. Insertable deformative means for sealing motionable joints between sections of concrete paving, comprising a symmetrical elastomeric extrusion having a V-notched recess formed longitudinally in its upper medial section, its top surfaces sloped outward and downward therefrom, and its sides inclined inward approximately perpendicular

to said surfaces, whereby when the extrusion is positioned between two opposed faces and subjected to compression therebetween the medial portion will be deflected downward, the V-notch closed, the top surfaces substantially aligned and the sides conformed to said faces.

2. In combination, the sealing insert in accordance with claim 1 and a retainer therefor comprising a formed clip having V-inclined rigid sidewall members supportably engaging the sides of the extrusion, extending downward therefrom and joining separably at the base, whereby the combination can be wedge-inserted into a prepared slot in the paving, the sidewall members thence separated and aligned compressively against the vertical walls of the slot.

3. In combination, the sealing insert in accordance with claim 1 and a retainer therefor comprising contraposed rigid sidewall members supportably engaging the sides of the extrusion and extending downward therefrom convergingly, each sidewall member having an upper section inwardly overlaying a portion of said top surface, whereby the combination can be wedge-inserted into a prepared slot in the paving and the sidewall members thence aligned compressively against the vertical walls of the slot, and when installed in the joint said upper sections will provide cantilevered load-bearing support across portions thereof.

4. The sealing insert in accordance with claim 1 wherein a recess is formed in the underportion of the extrusion adjacent each of the sides, whereby when the medial portion is maximally depressed compression relief will be provided and the upper outboard corners of the extrusion permitted to remain impactively engaged with said faces.

5. The sealing insert in accordance with claim 4 wherein an underposed elastomeric section connects the lower extremities of the sides, whereby the extrusion is made tubular.

6. The sealing insert in accordance with claim 1 wherein the extrusion comprises symmetrical half-sections each of which is provided with a collapsible void, whereby when the extrusion is maximally impacted the severity of deformation will be lessened and the mergeable portions of the top surfaces made more readily transitionable from horizontal to vertical planes.

7. The sealing insert in accordance with claim 6 wherein a rigid strip is secured to the lower surface of the extrusion and weakened at its longitudinal centerline, whereby when flexed in installation the strip will be fractured at its weakened section and thereafter provide levered supports pivotable against said faces.

8. The sealing insert in accordance with claim 1 wherein each top surface consists of a layer of composition having greater durability than that of the supporting body.

9. The sealing insert in accordance with claim 8 wherein the effective thickness of said layer is diminished as it approaches the V-notched recess, whereby when subjected to rolling transition between horizontal and vertical planes the merging arcs will be allowed to radius more sharply and to be maintained relatively constant over the operational design width range.

10. The sealing insert in accordance with claim 8 wherein a disparate compositional layer is interposed between each top surface layer and the supporting body.

11. The sealing insert in accordance with claim 1 wherein a spring strip is secured to the lower surface of the extrusion, whereby when positioned compressively between two opposed faces the spring strip will be deflected arcuately downward and its edges pivoted against said faces.

12. In combination, the sealing insert in accordance with claim 11 and a retainer therefor, wherein the insert is compressed between contraposed rigid members which together comprise the retainer, each said member having an upper extension bent outward horizontally from the insert and adapted to being secured in the paving with said extension aligned with the surface thereof, and having a longitudinal recess formed in its vertical face in which one edge of the spring base is pivotable.

13. The sealing insert in accordance with claim 11 wherein the extrusion comprises symmetrical half-sections each of which is provided with a collapsible void, whereby when the insert is maximally impacted the severity of deformation will be lessened and the mergeable portions of the top surfaces made more readily transitionable from horizontal to vertical planes.

14. Insertable deformative means for sealing motionable joints between sections of concrete paving, comprising a symmetrical elastomeric extrusion having a V-notched recess formed longitudinally in its upper medial section, its top surfaces sloped outward and downward therefrom, and wherein its sides form obtuse-angled corners with said top surfaces and are adapted to being positioned against contraposed supporting faces which slant obliquely thereover when the extrusion is compressed horizontally between said faces, whereby when the extrusion is so positioned it will be locked keyably therebetween and prevented from being lifted easily therefrom.

15. A assembly for installation in wet concrete, comprising a retainer, an elastomeric sealing insert positioned compressively therein, and restraining means for holding the insert transiently in compression, wherein the retainer comprises an extrusion having contraposed sidewall members forming therebetween a longitudinal chamber for the insert and extending downward therefrom to a connecting link proximate the plane of symmetry, and wherein means are provided for severing the connecting link, whereby the insert can be positioned between the sidewall members, the assembly then compressed and installed, and thereafter the connecting link severed.

16. The assembly described in claim 15 wherein means are provided for extending its depth, whereby when contraction of the concrete occurs the pavement will be fractured communicatively with the depthing means.

17. The assembly described in claim 15 wherein the means for severing the connecting link comprise lateral appurtenances extending outward from each sidewall member opposite the severable link, whereby when the concrete contracts and fractures beneath the assembly the sidewall members will be seized and the link severed tensionally thereby.

18. The assembly described in claim 17 wherein said extrusion comprises a semirigid plastic and the appurtenances are integral therewith.

19. The assembly described in claim 18 wherein the appurtenances are provided with laterally expanded openings and adapted thereby to being anchored securely in the concrete.

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