Sept. 20, 1966 R. L. PARE 3,273,473

ROAD EXPANSION JOINT

Filed Dec. 5, 1963 2 Sheets-Sheet 1

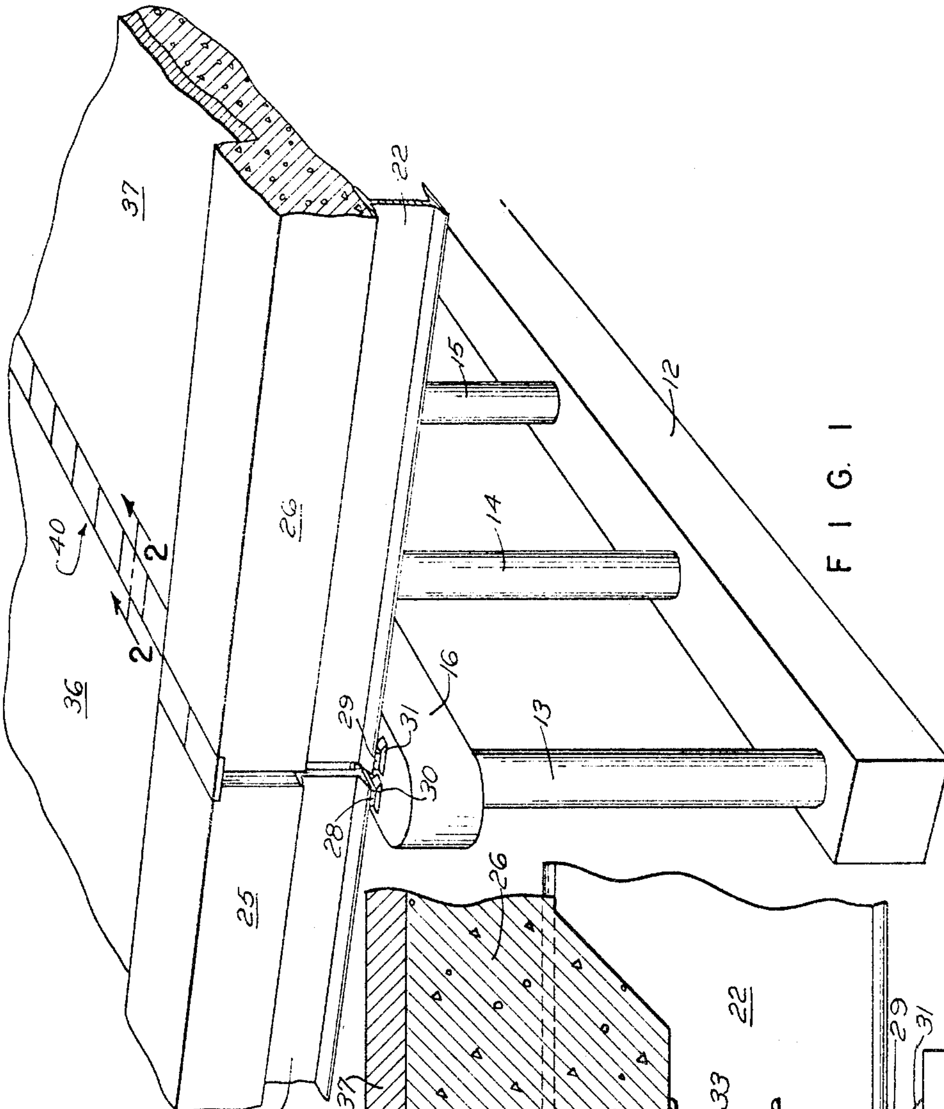


FIG. 1

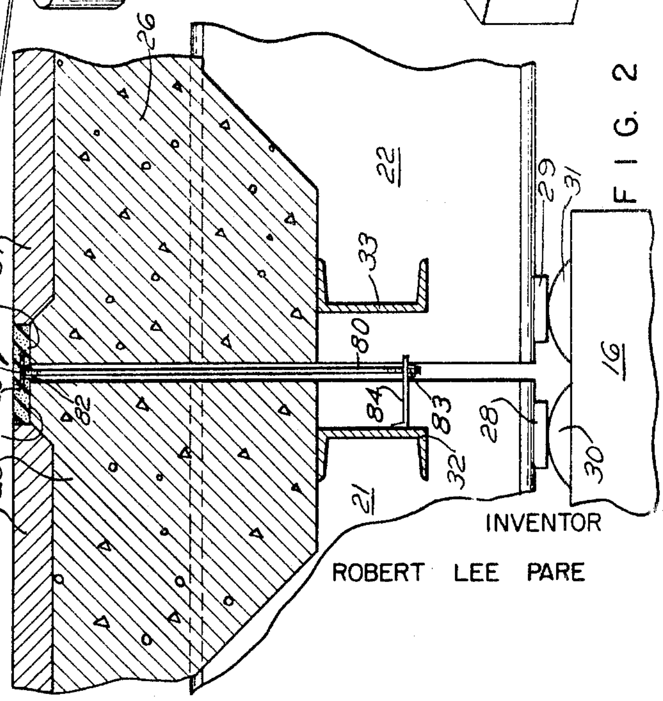


FIG. 2

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ROAD EXPANSION JOINT

Filed Dec. 5, 1963 2 Sheets-Sheet 2

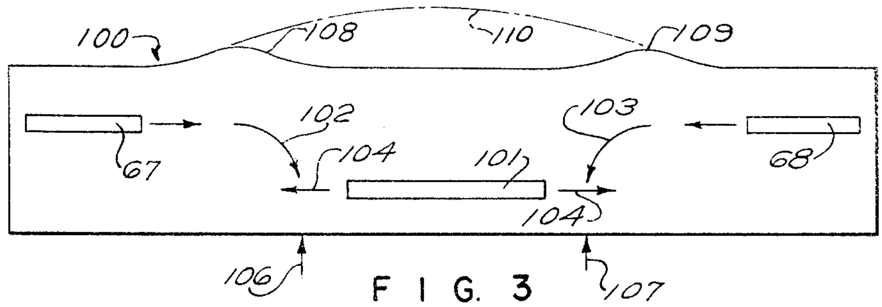


FIG. 3

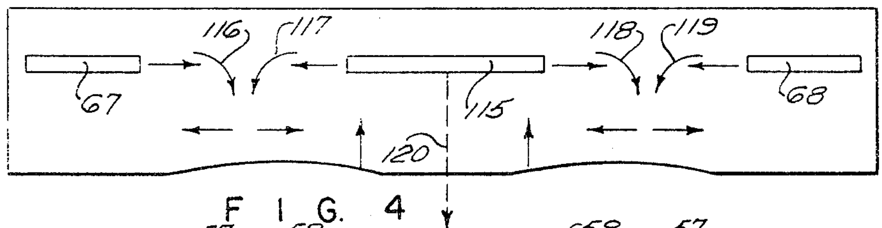


FIG. 4

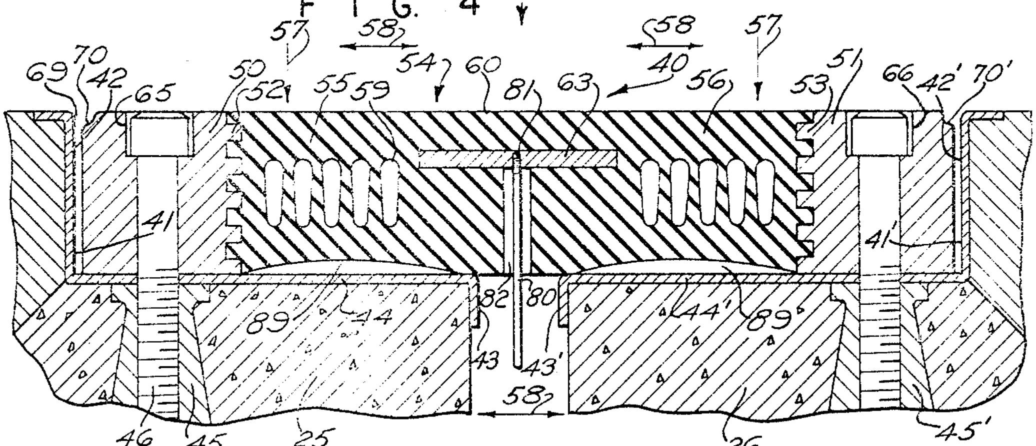


FIG. 5

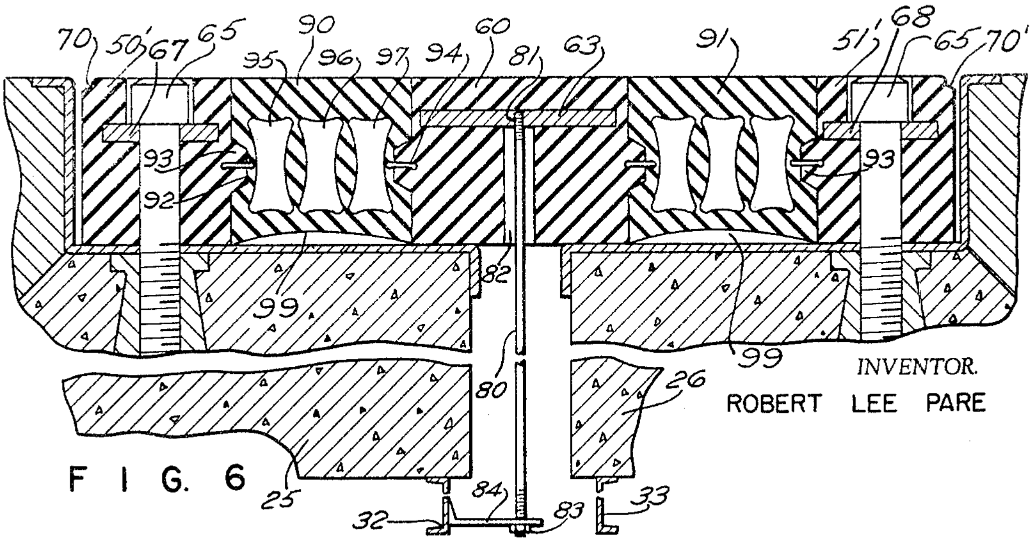


FIG. 6

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3,273,473
# ROAD EXPANSION JOINT

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4 Claims. (Cl. 94—18)

This invention relates to a highway expansion joint which is principally used in connection with joints in roadways that are supported on piers and which are generally known as bridge structures.

It is quite common in the roadbuilding industry to first lay a concrete deck slab as the foundation for the roadway and then place on top of this slab three inches of asphaltic concrete. The slabs which generally are of a length on the order of forty feet are laid in a fashion so that a space is left between adjacent slabs to accommodate the normal expansion that takes place in concrete. Normal expansion for concrete is something on the order of approximately three-quarters of an inch per hundred feet, and it is, therefore, quite common to leave a space of one inch between the abutting ends of concrete slabs. A similar practice is adhered to when concrete is used as the vehicle surface itself wherein a small area it left between adjacent slabs which in the past have been generally filled with an asphaltic compound generally of the tar family. In the following description which will be principally directed to the use of concrete slabs as the foundation piece in bridge construction, it should be understood that alternate uses are available for the expansion joint disclosed herein and that the specific example herein given and illustrated is not to be construed as limiting except within the scope of the appended claims.

In bridge construction it is quite common after the supporting piers have been erected to place beams across these supporting piers, which beams may either be steel I beams or pre-cast concrete beams. Directly on top of these supporting beams, on the upper flanges thereof, forms are erected which serve as the base for pouring a concrete slab. The concrete slabs are then poured onto these forms that have been erected and are poured to varying thicknesses and usually will be reinforced through the use of steel reinforcing rods as is quite common in the industry. It is common to form the concrete slabs in rather large single poured sections on the order of seventy feet in length and of varying widths depending upon the job, and it is therefore quite apparent that a considerable mass of concrete is poured in a single piece. Each of these slabs is spaced from each other longitudinally of the roadway a distance of an inch or so to permit expansion between adjacent slabs. In the past it has been quite common to use metallic plates such as steel plates that overlap the joint between the concrete slabs or alternately in some structures finger plates are used to bridge the gap between the slabs. In any event no matter which prior method is used, it permits a continuous road surface to be presented, and the gap successfully bridged between the slabs. The difficulty with using this form of construction is twofold. Basically this form of construction involves considerable time consuming fabrication and consequent expense. Additionally the steel plates become loose after a period of time, and since they are fastened to foundation members that are embedded in the concrete slabs, they must be removed from their foundation pieces and re-attached. This is a time consuming and costly method of replacing worn out expansion joints, and it has long been the desire of the road-building industry to have a joint which is simple in construction and which could be more easily replaced in the field. It is accordingly a main object of



this invention to provide a new form of expansion joint which may be preformed away from the job and readily installed.

Another object of the invention is to provide an elastomer expansion joint formed at least in part from material which has elastic properties and which will be resistant to surface wear by vehicle traffic.

Another object of the invention is to provide an expansion joint for a roadway which will be quiet for the travel of vehicles thereover.

Another object of the invention is to control any tendency of the body to bulge or buckle when in position.

Another object of the invention is to provide an expansion joint that will seal out moisture.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

FIG. 1 is a broken perspective view of a portion of a bridge using the invention;

FIG. 2 is a sectional view taken on line **2—2** of FIG. 1;

FIGS. 3 and 4 are diagrammatic views illustrating the forces as they act in the body member of the expansion joint; and

FIGS. 5 and 6 are enlarged sectional views taken through the expansion joint with FIG. 6 a modification of the expansion joint as shown in FIG. 5.

In proceeding with this invention, I form an elastomer expansion joint by extruding, molding or otherwise forming a bridging member which will have a mid portion to span the gap or space at the joint which is left for expansion, with means at either end of the member to fasten it in place, while at a point either side of the mid bridging portion I provide an area which may be more resilient or more compressive than the mid section and the end sections and in order to control the tendency of the member as a whole to bulge or buckle in one direction or the other as compressive forces are applied to it, I have located a plate above the horizontal centroid and in a position to span the gap between the structural elements and I have anchored this plate or mid portion of the member so it cannot bulge upwardly. Thus, the forces which are produced will tend to bulge or buckle the member at either side of the mid portion downwardly where they are well supported and prevent any upward buckling which would be undesirable. In order to enhance this tendency toward downward bulging or buckling, I have provided voids which are located below and laterally spaced from the horizontal plate and thus these also assist and tend to cause the portion between the mid portion and the end portions to buckle downwardly and provide a thrust against portions which are well supported.

Referring now to FIG. 1 of the drawings, I have illustrated therein a bridge structure in which there has been shown a typical pier having a footing **12** with a number of columns **13**, **14** and **15** supporting a top beam **16** spanning the lateral distance between the columns. Purely for illustrative purposes and in conjunction with one form in which such bridges are constructed, a number of steel I beams such as **21**, **22** suitably spaced span the distance between adjacent piers. Usually the I beams **21** and **22** are free to slide on the lateral beam **16**. The sliding movement is desired since the I beams **21** and **22** will expand and contract along their length creating a movement of something on the order of three-quarters of an inch per 100 foot of length, and it is to permit this expansion that the sliding motion on the lateral beam **16** is permitted. Additionally, the inner ends of the I beams **21** and **22** are spaced from each other on the lateral beam **16** so that during this expansion and contraction and particularly upon expansion, they will not abut each other. On top of the I beams there rests slabs of concrete **25** and **26**.

Referring now to FIG. 2 for a more detailed illustration of the joint on the lateral beam **16**, there is illustrated in enlarged cross section the portion at this joint, and here we see that the I beams **21** and **22** have welded to the bottom flanges thereof wear plates **28**, **29** which in turn rest on domed feet **30** and **31** that are secured to the lateral beam **16**. Perpendicularly secured to the webs of the beams **21** and **22** are channels **32**, **33** which serve to support the thickened end portions of the slabs **25** and **26**. At the ends of slabs **25** and **26** pockets **34** and **35** are formed, and into these pockets is fitted the expansion joint made in accordance with the invention and which is generally designated **40**. It is further noted in this figure that the pockets **34** and **35** effectively form an abutment for the depressed portions of the concrete slab that hold the asphaltic concrete which is designated **36** and **37**.

Referring now to FIG. 5 of the drawings, an enlarged and detailed cross sectional view of the expansion joint is shown. Here we find that the concrete slabs have cast therein to form the end pockets a formed sheet of metal or pan **41** which is reversely bent in S form to provide end walls **42** and **43** with a bottom wall **44**. The sheet metal piece **41** may be formed in any convenient length and has affixed at spaced locations to the wall **44** thereof concrete bolt anchors designated **45**. These bolt anchors are of standard form and are provided with a threaded bore therein to receive a threaded bolt **46**. A similar sheet metal piece **41'** is embedded in the concrete slab **26** which sheet metal bar bears like specific reference numerals with a prime. In some instances it may be possible to eliminate the sheet metal piece in which event only bolt anchors need be provided.

Traversing the space across the two slabs **25** and **26** and received on the bottom walls **44**, **44'** of the pans **41** and **41'** is the expansion joint **40**. In one form this expansion joint consists of end bars **50**, **51** which have a thickness equal to the depth of the pocket formed in the illustrated example by the sheet members **41**, **41'**. The inner end walls of these bars **50** and **51** are provided with a discontinuous surface **52** and **53** which may take a variety of forms. Illustrated is a tongue and groove form although a variety of shapes may well suffice, the main requirement being to provide as long a surface as is practicable to which there may be adhered an elastomeric section generally designated **54**. On either side of the mid portion of the section **54** there is provided areas as at **55** and **56** which are characterized as having a number of voids therein that are so arranged to exhibit resistance to deformation in the direction of the arrows **57** with considerable elasticity in the direction of the arrows **58**. In some cases it may be unnecessary to provide such voids. One particular form of voids would be a plurality of pseudo elliptical shaped voids such as **59** of such a shape that there is a greater void at the upper portion than at the lower portion. The upper portion of the void will be a little lower than the plate **63** which will be in the line of the greatest compression forces.

Adjacent to these two sections is a central section **60** which is provided immediately adjacent and between the sections **55** and **56**. Molded within this central section **60** is a reinforcing bar **63** which is of a dimension to span the open portion between the two concrete deck slabs **25** and **26** and to provide a stiffening factor and a resistance to a bending moment from a force applied in the direction of the arrows **57**. The reinforcing bar or plate **63** is permanently anchored so that it and the expansion joint **40** cannot bulge upwardly due to endwise compression. A number of means are available for anchoring the reinforcing plate **63** into vertical position. For illustrative purposes only as one of many means, a bolt **80**, threaded on both ends may be screwed into a threaded hole **81** in plate **63**, through a void **82** formed in the member **40**, and fastened by a nut **83** to a bracket **84** attached to channel **32** or alternately to channel **33**. The lower surface of the central section **60** is concave on either side of the center as at **89**. The end bars or anchorage sections **50** and **51** are provided with a bore **65** and **66** respectively which are countersunk bores, these bores being arranged on the same centers as the centers of the concrete anchors **45**, **45'**. Since the anchorage sections, as **50'** and **51'** in FIG. 6 are resilient, reinforcing bars such as **67** and **68** may be embedded therein at locations to be engaged by the head **65** of the anchoring screw **46**. In this fashion the expansion joint **40** by the use of socket head bolts may be fastened to each of the deck slabs **25** and **26** by being bolted thereto through and into the anchors and in this fashion the expansion joint may be readily placed into the structure. Preferably the expansion joint is made of a width that will accommodate any variations in the forming of the concrete slabs **25** and **26** and inaccuracies in the setting up of the sheet metal portions **41** and **41'** so that, if necessary, a sealant composition may be poured into any voids formed between the end walls **42**, **42'** and the expansion joint **40** such as at **69**, **69'**, recesses such as **70**, **70'** being provided to assist in pouring the composition, thus forming a water-tight joint.



In FIG. 6 an alternate form is illustrated which shows the more elastic areas as provided by separable elastic sections **90** and **91** which are shown as provided with grooves **92** on either edge thereof so as to receive tongues **93** on the anchorage sections **50'** and **51'** and tongues **94** on the mid section **60** so as to retain them in place. Each of these removable sections are provided with symmetrical openings **95**, **96** and **97** located midway between the top and bottom portions of the sections and with their upper edges at a point slightly below the center of the plate **63**. These sections are also concave as at **99** on their lower surfaces.

Referring to FIGS. 3 and 4, it has been found in a joint, such as shown at **100**, that the compressive forces on the joint are transmitted through a plate or bar such as **67** and **68** inwardly toward each other of the joint while a reaction force from the supporting bar **101** is located below the horizontal centroid as shown at **104**. These forces tend to move the joint downwardly such as shown by arrows **102** and **103** as a certain couple between these forces is created. As the compressive forces are increased, the resistance to further downward movement as at **106** and **107** creates first a bulge as at **108** and **109**, continued increase in compressive forces creating a bulge such as shown by dotted line **110**. This is highly undesirable, and in order to eliminate the tendency for the bulges at **108** and **109** or as at **110**, I have found that by elevating this spanning bar now designated **115** to the position shown in FIG. 4 that I do not obtain the reactive couple of forces causing the upward bulge at **108** and **109** but rather the forces are substantially in line opposition and create resultant forces as shown at **116** and **117** or **118** and **119**. With an increase in compressive force, it is apparent that the bar **115** would tend to rise. Accordingly, the bar is held against rising by the anchor designated by the line **120**. All forces then tend to move the areas about the bar **115** intermediate the mid portion and the end portions downwardly, and I do not get the couple of forces such as tend to cause the bulges **108** and **109** or bulge **110**, this coming about by the elevation of the bar **115** above the horizontal centroid and the anchoring it against moving upwardly as I have explained above.

Again referring to FIGURES 3 and 4, and also to FIGURES 5 and 6, it is seen that by locating the central plate **63** (**101** and **115** of FIGURES 3 and 4) at least in line with the resultant of the endwise compressional forces, in lieu of below them (FIGURE 3) secondary buckling will be inhibited. Thus, in FIGURE 6, the plate **63** is shown slightly above the plates **67** and **68**. In FIGURE 5, the uniform interface contact between members **50** and **51** results in a uniform transmittal of endwise compressive forces and the plate **63** is positioned above the horizontal centroid of the elastomer block.

As the joint of either FIGURE 5 or 6 shuffers endwise compression, the central portion of the elastomer block immediately below and immediately above the plate **63** undergoes fluid displacement, the elastomer being incompressible. The elastomer volume immediately above the plate **63** bulges upwardly, but because of the relatively small thickness of this volume, its magnitude is correspondingly small. The elastomer volume immediately below the plate **63** is precluded from vertical displacement by virtue of the tie bar **80** being anchored. Flow of this volume laterally is allowed by the concave portions **89** (FIGURE 5) and **99** (FIGURE 6) and by the voids within the elastomer block which are located laterally of the plate **63**.

While the foregoing specification is directed primarily to a highway structure such as bridges, it is perfectly possible that this structure might be utilized in buildings or in some similar form.

This structure has application in any instances where it is important to provide continuity across a gap whose width is subject to variation due to temperature or other changes over a period of time.

I claim:

**1.** An expansion joint between two spaced structural elements defining an expansion gap comprising an elastomer block whose midportion spans said gap, a rigid plate embedded in said elastomer block, said plate lying above and spanning said gap, said elastomer block having a substantially plane surface adapted to serve as a portion of a roadbed with said plate being substantially parallel to said plane portion, said elastomer block being positioned within upper recesses in said spaced structural elements with end portions of said elastomer block being anchored to said structural elements, said plate being positioned above the horizontal centroid of said elastomer block, means for maintaining the position of said plate fixed relative to said structural elements, said elastomer block provided with a plurality of voids located between the ends of said elastomer block and said plate in the region generally below said plate.



**2.** The expansion joint of claim **1**, wherein said means comprises an elongated rod whose upper end passes through said elastomer block and is joined to said plate, with the lower end of said rod being fixed to one of said structural elements.

**3.** An expansion joint between two spaced structural elements defining an expansion gap comprising an elastomer block whose midportion spans said gap, a rigid plate embedded in said elastomer block, said plate lying above and spanning said gap, said elastomer block having a substantially plane surface adapted to serve as a portion of a roadbed with said plate being substantially parallel to said plane portion, said elastomer block being positioned within upper recesses in said spaced structural elements with end portions of said elastomer block being anchored to said structural elements, said plate being positioned above the horizontal centroid of said elastomer block, means for maintaining the position of said plate fixed relative to said structural elements, the lower surface of said elastomer block resting on the bottom of the recessed portions of said structural elements, a portion of these said lower portions of the elastomer block being provided with concavity contiguous to said structural elements.

**4.** The expansion joint of claim **3**, wherein said means comprises an elongated rod whose upper end passes through said elastomer block and is joined to said plate, with the lower end of said rod being fixed to one of said structural elements.


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