United States Patent [19]

Brown

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[54] **EXPANSION JOINT AND SEAL**

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[52] **U.S. Cl.** **404/48**; 14/16; 52/396; 404/68

[51] **Int. Cl.** **E01c 11/12**

[58] **Field of Search** 404/48, 64, 65, 66, 67, 404/68, 69, 74; 14/16; 52/396

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Assistant Examiner—Thomas J. Holko
Attorney, Agent, or Firm—Johnston, Keil, Thompson & Shurtleff

[57] **ABSTRACT**

A combination expansion joint-seal having longitudinal frames made from aluminum extrusions extending longitudinally of an expansion joint for pavements and bridge decks. The expansion joint and seal are designed for joints of relatively small width and movement, e.g., between one-half inch minimum opening and 3½ to 4 inches maximum opening. The longitudinal frames are mounted in new concrete or on previously laid pavement or bridge decks to be resurfaced with asphalt or other resurfacing material. The tread-seal is fixedly held in the longitudinal frames by elongated tongue and groove means and the joint space is spanned by at least one shallow, V-shaped, elastomer wall which deforms downwardly as the joint width becomes narrower.

8 Claims, 8 Drawing Figures

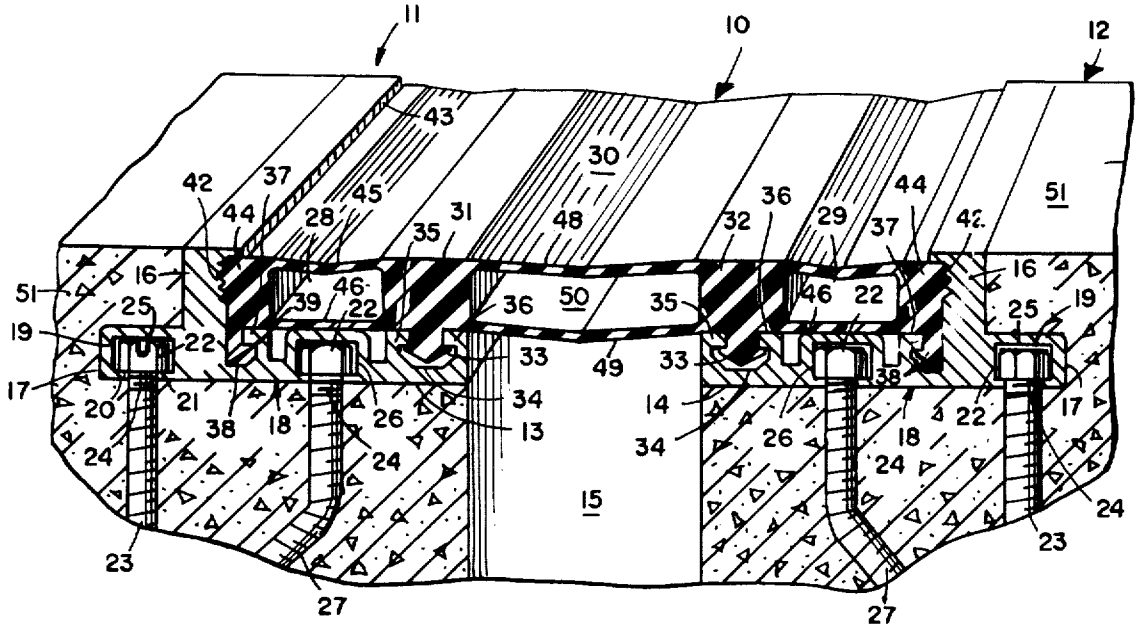


FIG. 1

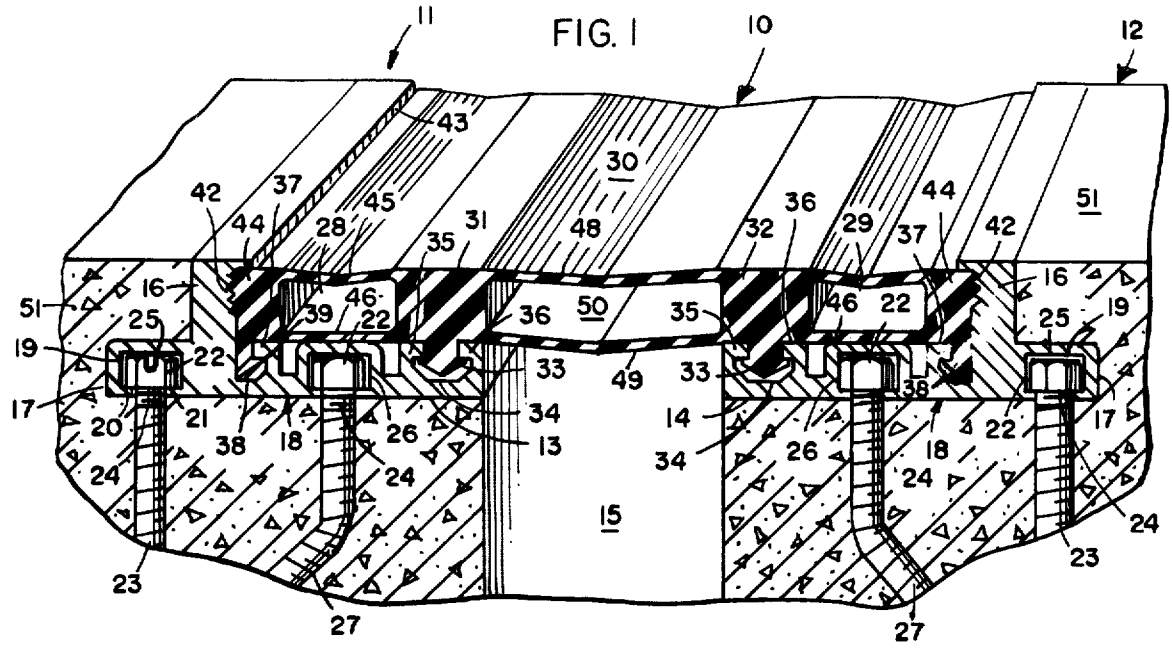

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FIG. 2

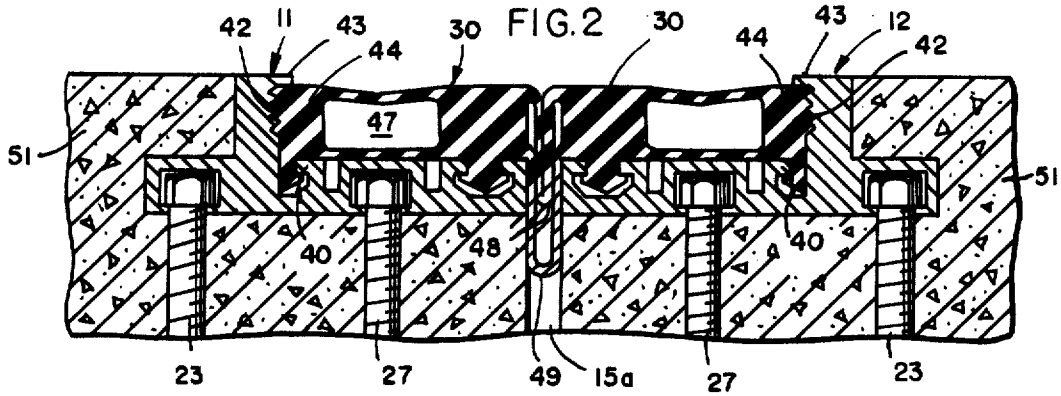

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11
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15a
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FIG. 3

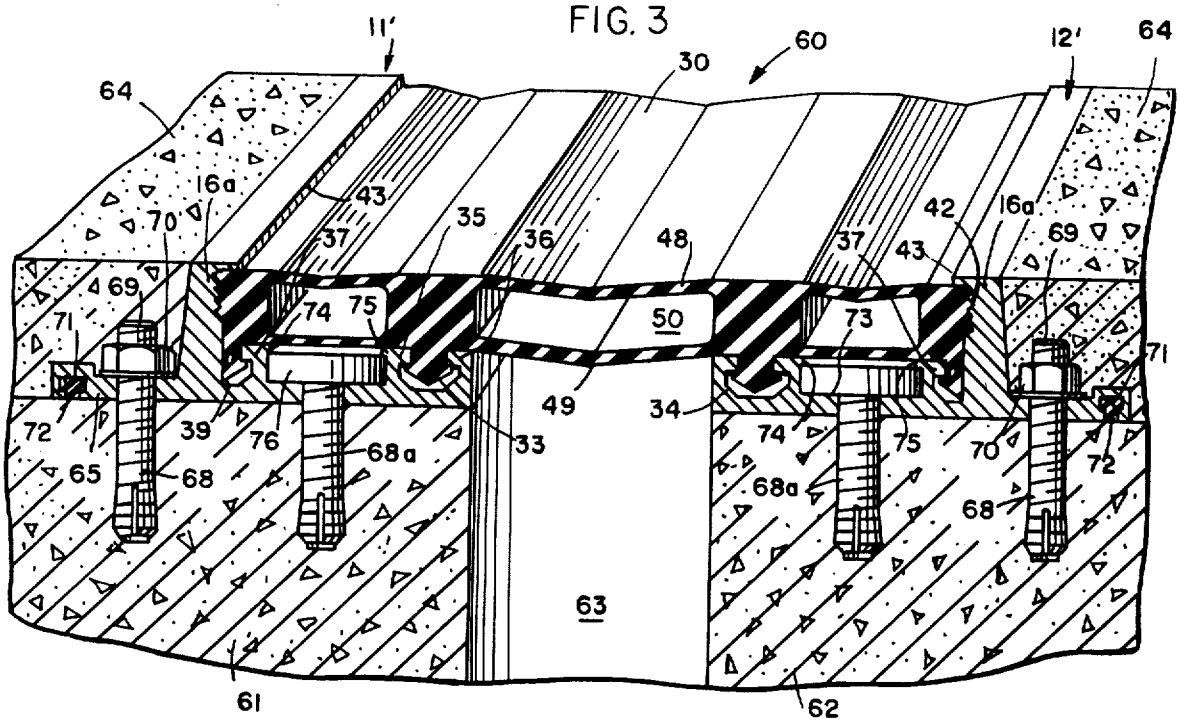

11'
12'
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16a
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68a
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FIG. 4

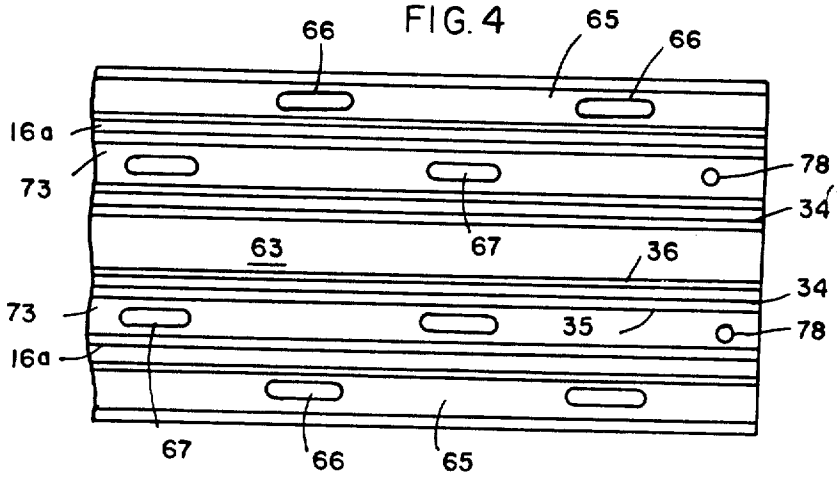

66
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16a
73
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67
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16a
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FIG. 5

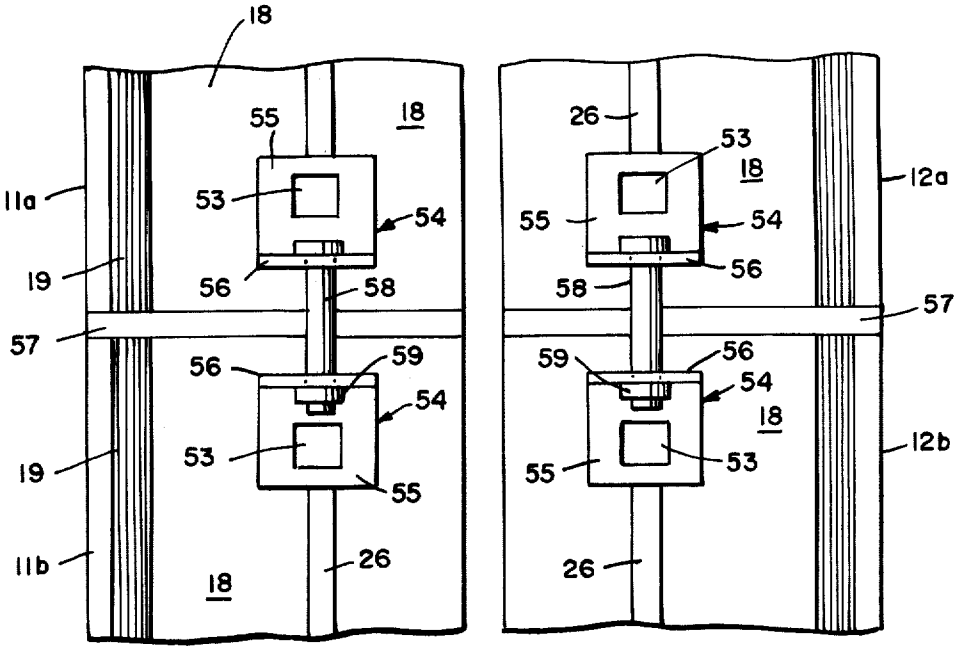

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11a
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11b
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12a
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12b
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FIG. 6

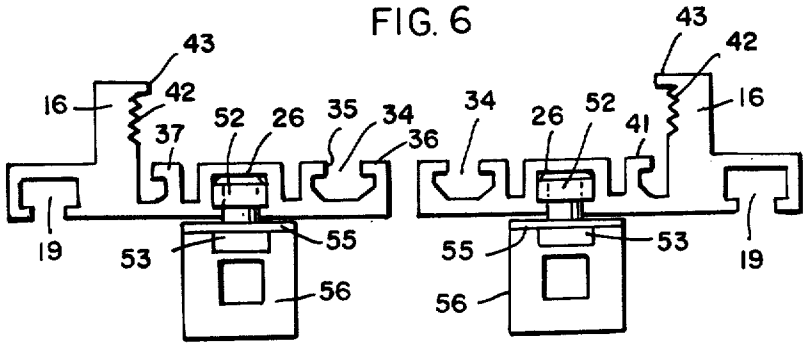

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FIG. 7

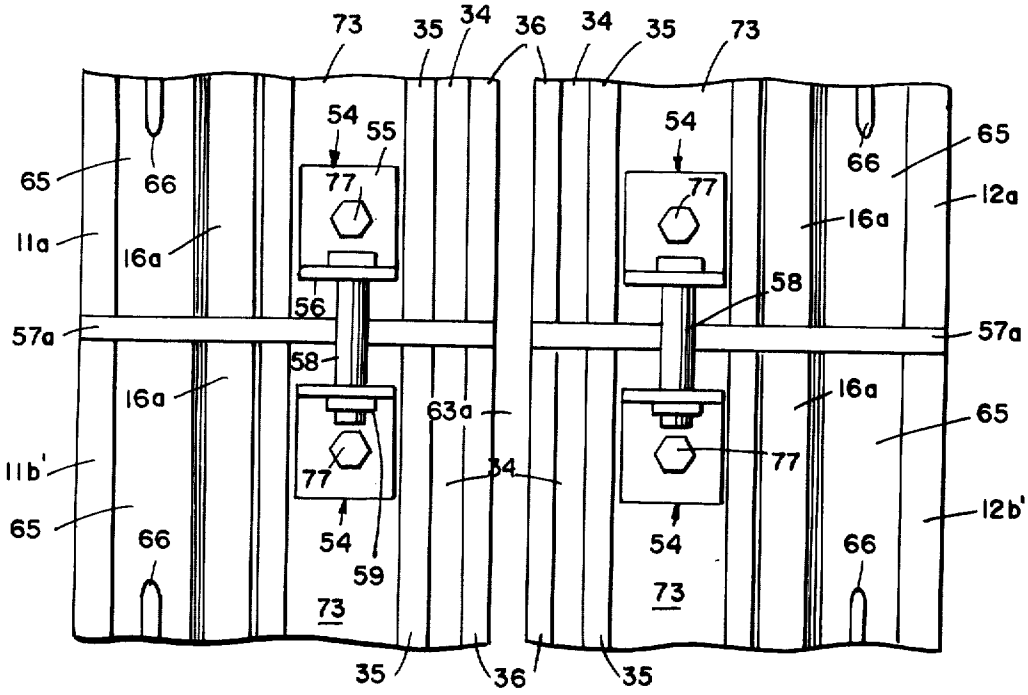
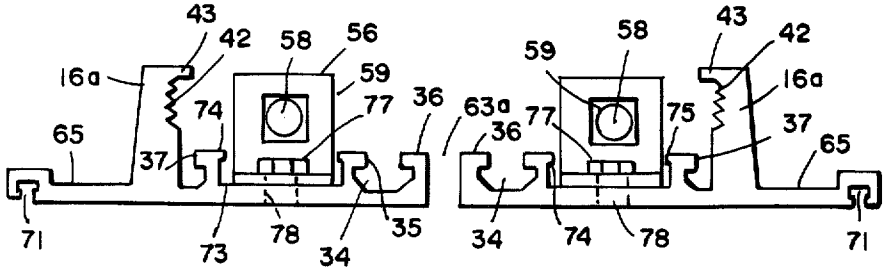

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12a
11a
16a
16a
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57a
57a
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16a
16a
63a
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11b'
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12b'
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FIG. 8


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EXPANSION JOINT AND SEAL

INTRODUCTION

The subject invention concerns improvements in expansion joint structures useful in the spanning of relatively narrow joints in pavement surfaces, particularly joints in pavement decks of bridges. The latter joints have a relatively narrow range of movement, i.e., opening and closing, during expansion and contraction of sections of a bridge deck as the environmental temperature changes.

Expansion joints for bridges heretofore have involved heavy assemblies or subassemblies brought to the bridge site and mounted in the bridge joints by cranes or the like. One well known type of bridge expansion joint comprises a pair of heavy duty plates fixedly attached to opposite sides of the joint. The plates have projecting, interfitting fingers which span the joint and can move relative to each other if the joint opens or closes. Joints of this type cannot be effectively sealed against leakage of water from rain or melted ice or snow. The latter two in particular carry with them corrosive salts which, over a period of time, damage the superstructure of the bridge, its piers, and/or abutments.

Bridge designers and engineers have been giving more attention in recent years to use of bridge joints which are sealed against leakage of water and/or solids through the joint onto the underlying structure of the bridge. A relatively recent design for a sealed bridge joint embodies longitudinal, spaced rails resting on joint-spanning beams. Laterally compressible elastomer seals are compressed between the rails slightly below the upper surface thereof. The upper surfaces of the rails lie substantially in the plane of the bridge deck. The tires of automobiles crossing the joint run across these upper surfaces of the rails while the elastomer seals are recessed enough to avoid contact with the automobile tires.

These known expansion joints are manufactured and preassembled at an off-site facility, compressed to a width allowing them to be inserted in the joint, hauled to the bridge site and laid in the joint with heavy duty cranes. Once installed, they are difficult to repair. Repair or replacement of a component usually involves closing the entire bridge or several lanes thereof to traffic in order that heavy duty equipment may be brought to the joint site to raise the expansion joint, repair it, and replace it back in the joint.

THE INVENTION HEREIN

This invention provides improvements in expansion joint structures useful as bridge deck and pavement joints. The joint structure comprises a pair of opposed, elongated, side frames, preferably formed as aluminum extrusions. The side frames respectively have a side wall and a bottom wall with an upwardly facing, longitudinal, first groove in the bottom wall. This groove has opposed horizontal legs.

A second longitudinal groove, also opening upwardly, is formed at the juncture of the side and bottom walls and has a horizontal lip spaced from but extending toward the side wall. These grooves receive and hold deformable, longitudinal, tongues or beads projecting downwardly from the respective sides of an elastomer seal and tread extending completely across

the joint between the respective side walls of the side frames.

The joint opening itself is spanned by at least one, preferably two, shallow, V-shaped, elastomer walls attached to the respective side portions of the tread and seal. The V-shaped wall or walls bend progressively into deeper V-shape configuration as the joint contracts.

The respective side frames are rigidly mounted along the longitudinal edge portion of the joint formed in the pavement or bridge deck, e.g., concrete sections with a spacing therebetween to accommodate contraction and expansion of the respective sections and/or their underlying support structure. The side frames have a rear, longitudinal flange projecting rearwardly from the bottom of the vertical wall. This flange is provided with slot means to bolt the respective frames to the pavement or the bridge deck. The bottom wall of each side frame also preferably contains slot means to provide additional means for bolting the frames to the pavement or the bridge deck.

In one embodiment of the invention, the slot means in both the flange and the bottom wall are elongated, continuous longitudinal slots in the undersides of the flange and bottom wall. These slots receive nuts positionable at any desired place along the length of the slots. The nuts in turn received treaded ends of cast-in anchors, which are treaded in the nuts until the bolt and nut in each instance is firmly anchored in the slot. This embodiment utilizes concrete poured around the joint side frames after their placement on the bridge or pavement supporting structure. After curing, the concrete holds the frames in place.

In another embodiment of the invention, the slot means comprises short, longitudinally spaced slots stamped or otherwise cut out of the rear flange and bottom wall. These slots accommodate the shanks of bolt or stud anchors placed in vertical holes drilled in the cured concrete. The frames are held by nuts threaded on the anchors. The latter type of slot-bolt structure is principally useful in the placement of the side frames along the longitudinal edges of the joint where the pavement or bridge deck is to be resurfaced, or where the base structure is in place and does not lend itself to the placement of concrete, e.g., in replacement of an existing joint. In this embodiment there is also a longitudinal groove or slot in the bottom wall to accommodate a compressible seal or piece of rubber which prevents water from working down and under the frame from the joint between the pavement and the metal vertical wall.

The side frames preferably are fabricated as aluminum alloy extrusions. Each extrusion is relatively light in weight so that the joint may be assembled easily at the joint site without using heavy duty equipment. The frames are of relatively short lengths, e.g., 12 feet, or other length corresponding approximately to the width for one lane of traffic of the road or bridge. This feature allows the joint to be constructed or repaired on a one lane at a time basis, while keeping other lanes open to traffic flow during maintenance. The side frame sections preferably have a gasket between abutting ends to seal the abutting ends against seepage of water at these points.

The abutting ends with the gasket therebetween utilize bracket and bolt means for drawing the frame sections together and compressing the gasket therebe-

tween. In one embodiment of the invention the bolt and bracket means are mounted on the underside of the bottom wall of each frame section and remain in place when the concrete is poured. In the embodiment which is used in resurfacing of the pavement or bridge deck or replacing existing joints, the bolt and bracket means are attached to the upper side of the bottom wall. After the abutting frame sections have been drawn together, the bolts which attach the frame sections to the bolt anchors in the drilled concrete holes are tightened to hold the frame sections in place, after which the aforesaid bolt and bracket means are removed so that the seal and tread can be mounted in the frame sections.

The elastomer seal and tread is a continuous piece without joints subject to leakage and extends the full width and length of the joint. The longitudinal tongues or beads on the underside of the seal and tread snap into the upwardly facing channels or grooves in the manner aforedescribed.

As additional features for guarding against seepage of moisture or incompressible particles between the side walls of the respective frames and the abutting faces of the seal and tread, the side wall of each frame and the respective side portion of the tread are provided with interlocking, longitudinal, sawtoothed serrations. Also, the side frames preferably have a small, longitudinal lip overlying the upper corner of each side portion of the tread and seal. A positive seal against moisture penetrating the joint is provided by positive compression of the tongue or bead neck portions at the entry of the upwardly facing channels or grooves.

THE DRAWINGS

Preferred embodiments of the invention are illustrated in the drawings, wherein:

FIG. **1** is a fragmentary, isometric, transverse cross section of an expansion joint in concrete pavement or a concrete bridge deck with a first embodiment of the joint side frames and elastomer tread and seal mounted thereon, the joint being open to its approximate maximum width;

FIG. **2** is a transverse, fragmentary cross section of the embodiment of FIG. **1** with the joint closed to its approximate minimum width;

FIG. **3** is a fragmentary, isometric, transverse cross section of a joint in pavement or in a bridge deck with a second embodiment of the side frames positioned at the joint of pavement or a bridge deck which has been resurfaced;

FIG. **4** is a fragmentary, top plan view of the opposed, side frame sections of the embodiment of FIG. **3**;

FIGS. **5** and **6**, respectively, are a fragmentary, bottom plan view and a side elevation of abutting frame sections of the embodiment of FIG. **1** with bolt and bracket means drawing the abutting sections together and compressing therebetween a gasket; and

FIGS. **7** and **8**, respectively, are a fragmentary, top plan view and a side elevation of the frame sections of FIG. **3** drawn together by bolt and bracket means to compress therebetween a gasket.

Referring to the drawings, FIGS. **1** and **2** illustrate a joint and seal **10** which is set in place prior to the pouring of the concrete pavement of the bridge deck. It comprises an elongated side frame **11** and an opposed, elongated side frame **12**. The respective side frames are supported on recessed steps **13** and **14** which are formed when the concrete is poured at the joint. The respective concrete sections have therebetween a space **15** forming an expansion joint accomodating expansion of the concrete sections and/or the underlying support structure therefor.

Each side frame **11** and **12** is composed of a vertical wall **16** having a rear flange **17** and a forwardly extending bottom wall **18**. The rear flange **17** is provided with an elongated, longitudinal, downwardly facing groove **19** having at its bottom, entrant side opposed lips **20** and **21**. Nuts **22** for anchor rods **23** may be positioned at any desired points in the longitudinal groove **19**. This free selection of positioning is advantageous in that the anchor rods **23** can be located or adjusted to any desired spacing and can also be moved in the event of interference between the anchor rod **23** and other components of the joint or the concrete, e.g., reinforcing mesh or rods.

The anchor rods **23** have a treaded end **24**, which is treaded into the nuts **22** until the end of the anchor rod abuts the top wall **25** of the downwardly facing groove **19**. This creates a binding action to hold the anchor rod **23** at its desired location in the longitudinal groove **19**.

The side frames may have mounted thereon a second series of anchor rods **27**. The latter are seated in nuts **22** positioned in the longitudinal groove **26** which faces downwardly and has the same cross section as the groove **19**. The longitudinal groove **26** is located in and extends longitudinally of the bottom wall **18**.

The side frames are spanned both transversely and longitudinally by the seal and tread **10**, which preferably is an elastomer extrusion of a low crystallization type neoprene formulation. It is optionally provided with longitudinally hollow sections **28** and **29** positioned in the seal and tread above the respective bottom walls **18** of the side frames. The seal and tread has solid elastomer sections **31** and **32** contiguous to the joint space **15**. These solid sections each have a downwardly depending, deformable, elastomer, longitudinal, dovetailed tongue or bead **33** which can be pressed into and interlocked in a longitudinal slot **34** in the upper surface of the bottom wall **18** of each side frame. The longitudinal slot **34** has inwardly facing, opposed lips **35** and **36** which interlock and hold the tongue or bead in the respective slots **34** after the tongue or bead has been pressed into the slots **34**.

Near the juncture of the vertical wall **16** and the bottom wall **18**, each side frame has an inverted L-leg **37** forming a longitudinal slot **38** which opens upwardly. The seal and tread **30** is provided along each side edge thereof with a downwardly depending, dovetailed tongue **39** corresponding in cross section to one-half of the tongues or beads **33**. The inverted L-leg **37** in each side frame forms a horizontal lip **40** (FIG. **2**) extending toward but spaced from the side walls **16**. The lips **40** interlock with the tongue **39** after the latter has been pressed into the longitudinal slot **38**.

Preferably both the upper portion of the inner face of the side wall **16** and the upper portion of the sides of the seal and tread **30** have longitudinal, sawtoothed-like serrations **42** which serve a sealing function to prevent seepage of water and incompressibles between the vertical wall **16** and the ends of the tread and seal **30**. Also, each side frame **11** and **12** preferably has a small longitudinal lip **43** overlying the upper corners of the seal and tread **30** to hold the latter in position as traffic passes over the joint. Such lips further serve an incompressible and water-sealing function, particularly in

concert with the serrations **42**. The neck portions of the longitudinal tongues or beads **33** and **39** are wider than the entrant portions of their respective slots (between lips **35** and **36** and between the edge of the lip **40** of L-leg **37** and side wall **16**) so that water-tight seals are formed.

The side portions of the tread and seal **30** preferably include solid, elastomer segments **44** which are respectively joined with the solid, elastomer segments **32** by a thin upper wall **45** and a thin lower wall **46** thereby defining the longitudinal cavities or hollow spaces **28** and **29**.

In the joints of the subject invention, the joint width is spanned in its entirety with at least an upper, connecting web or wall **48** having a shallow V-configuration which can become progressively deeper as the joint narrows in width. Preferably the solid sections **31** and **32** are connected not only by the upper wall or web **48** but also by a lower wall or web **49** with a longitudinal cavity or space **50** formed between these walls. The cavity or space **50** is provided to accommodate the downwardly deflecting center segment of the upper wall **48** as the joint narrows to its narrowest width shown in FIG. **2**.

The side sections **11** and **12** are placed at the joint prior to pouring the concrete sections **51**. The elastomer seal and tread **30** is mounted in the side frames after the concrete has set. Referring to FIGS. **5** and **6**, the side frames **11** and **12** are composed of relatively short sections, e.g., **12** feet, to provide at the end of each section an aligned side frame component **11***a* and **11***b* and **12***a* and **12***b* (FIG. **5**). Adjacent the abutting ends of these frame sections, a nut **52** is placed in the downwardly opening channel **26** in the bottom wall. A bolt **53**, which extends through and holds the leg **55** of an L-bracket **54**, is treaded into each of the four nuts **52** to hold the L-brackets firmly in position. Each L-bracket **55** has a vertical leg **56**. A gasket **57** conforming in cross section to the side frames **11** and **12** is placed between the abutting ends of the sections **11***a*, **11***b* and **12***a*, **12***b*. The vertical legs **56** have a bolt **58** extending therethrough. When the nut **59** is tightened on each bolt **58**, the frame sections are drawn together to compress therebetween the gasket **57**.

Another embodiment of the invention is illustrated in FIGS. **3**, **4**, **7** and **8**. This embodiment constitutes a maintenance joint **60** useful when pavement or a bridge deck is resurfaced. The expansion joint between the previously laid concrete deck sections or pavement slabs **61** and **62** have therebetween the space **63** defining the joint between the concrete sections or slabs **61** and **62**. The latter are covered with a resurfacing layer of asphalt or other resurfacing material **64**. Prior to such resurfacing, however, side frames **11'** and **12'** are laid longitudinally along the edges defining the expansion joint. These side frames **11'** and **12'** preferably are aluminum extrusions of generally similar transverse cross section to the side frames **11** and **12**, as can be seen by comparing FIGS. **1** and **3**. The elastomer seal and tread **30** is the same in both embodiments.

The side frames **11'** and **12'** have a rear flange extending longitudinally along the lower edge of each vertical wall **16***a*. This rear flange is provided with longitudinal slots **66** at spaced intervals (FIG. **4**). Additional longitudinal slots **67** may also be provided at longitudinally spaced intervals in the bottom wall of each side frame, e.g., in the bottom wall of an upwardly facing, relatively wide longitudinal groove **73**.

The slots **66** and **67** accommodate therein varying positions of anchor bolts or expansion sleeve bolts **68** and **68***a*, which are set in the concrete sections **61** and **62** after drilling vertical holes to accommodate such bolts. Such holes must be drilled in places which avoid reinforcing steel (not shown) within the cured concrete. The jam bolts or expansion sleeve bolts **68** have an upper treaded end **69**, upon each of which is treaded and tightened a nut **70** to fix the side frames **11'** and **12'** firmly in place. In FIG. **3**, the anchor bolts or expansion sleeve bolts **68***a* are illustrated only in fragment in that such bolts are optional.

The rear flange **65** preferably has along its outer longitudinal edge a downwardly facing, T-shaped, longitudinal groove **71** in which is placed a neoprene seal **72**. The latter seal functions to prevent migration of water and/or resurfacing material between the concrete sections or slabs **61** and **62** and the bottom wall of the side frames **11** and **12**.

The longitudinal groove **73** in the upper face of the bottom wall has at its mouth, opposed, small lips **74** and **75**. This groove may be used at abutting ends of sections of the side frames **11'** and **12'** to hold therein a splice bar **76** extending between abutting sections.

The abutting sections **11***a'*, **11***b'* and **12***a'*, **12***b'* (FIG. **7**) have therebetween gaskets **57***a* of the same cross section as the side frames **11'** and **12'**. These sections are drawn together to compress therebetween the gaskets **57***a* by L-bracket and bolt structures like those heretofore described with reference to FIGS. **5** and **6**. In this instance, however, the L-brackets cannot be mounted on the underside of the side frame sections. Accordingly, the L-brackets **54** are secured in place by bolts **77** which will thread into tapped holes **78** provided in the bottom wall of the side groove **73** near the respective ends of each of the frame sections. The frame sections are drawn together by the tightening of the nuts **59** on their respective bolts **58** with the nuts **70** being loose or non-binding on the rear flange **65**. The side frames **11'** and **12'** can move longitudinally due to the positioning of bolts **68** and **68***a* in the respective slots **66** and **67**.

After the frame sections have been drawn together to provide the desired amount of compression of the gaskets **57***a*, the nuts **70** are tightened to hold the frame sections in the adjusted position. Thereafter the bolts **77** are treaded out of the tapped holes **28** to remove the bolt and bracket means from the respective sections. Thereafter the tread and seal **30** may be mounted in the side frames **11'** and **12'** as aforedescribed with regard to FIGS. **1** and **2**.

It is thought that the invention and its numerous attendant advantages will be fully understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention, or sacrificing any of its attendant advantages, the forms herein disclosed being preferred embodiments for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. An expansion joint structure useful as bridge deck and pavement joints comprising a pair of opposed, elongated, side frames respectively having a vertical wall and a bottom wall with an upwardly-facing, longi-

tudinal, first groove in said bottom wall, said groove having opposed, horizontal lips, a second longitudinal groove formed at the juncture of said vertical and bottom walls and having a horizontal lip, means for rigidly mounting said frames along the respective edges of a pavement or bridge deck joint, an elastomer tread extending across said joint between said frames with longitudinal side portions of said tread overlying the bottom wall of each of said frames, elastomer, longitudinal beads on the bottom of said tread releasably interlocked in said grooves in said side frames, said side portions of said tread being connected by elastomer wall means which spans the joint and which deforms as the joint contracts, said frames each having a longitudinal flange projecting horizontally away from said bottom wall at the bottom of said vertical wall, slot means in both said bottom wall and said flange for accomodating bolt means for securing said frames to pavement or a bridge deck, and said frames comprising abutting, end-to-end sections with a gasket therebetween, a bracket attached to each end-to-end section by bolts mounted in said slot means, and additional bolt means extending through respective brackets for drawing said sections together and compressing the gasket therebetween.

2. A joint structure as claimed in claim **1**, said elastomer wall means of said tread having an upper, shallow V-shaped wall and a lower, shallow V-shaped wall respectively spanning said joint, and a hollow space between said upper and lower walls into which said upper V-shaped wall can project as it assumes a deeper V-shape.

3. A joint structure as claimed in claim **1**, said slot means being a pair of downwardly facing, elongated, continuous longitudinal slots in the undersides of said flange and bottom wall.

4. A joint structure as claimed in claim **1**, said slot means being a plurality of slots cut through said flange and bottom wall.

5. A joint structure as claimed in claim **1**, the vertical wall of each frame and the respective side portion of said tread having interlocking, longitudinal serrations.

6. A joint structure as claimed in claim **1**, said elastomer tread being a continuous piece extending the full width and length of the joint.

7. A joint structure as claimed in claim **1** wherein said slot means comprises a pair of downwardly facing, elongated, continuous, longitudinal slots in the undersides of said flange and said bottom wall of each side frame, and anchor bolt means for securing said frames to pavement or a bridge deck longitudinally adjustably positioned in and projecting downwardly from said downwardly facing slots.

8. A joint structure as claimed in claim **7** wherein said anchor bolt means constitute nuts longitudinally slidably laid in said downwardly facing slots and anchor bolts threaded into said respective nuts until the respective nuts and bolts bind in respective slots for locking respective nuts and bolts at the desired, longitudinal position in the respective slots.

* * * * *