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Rizza et al.

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[54] **MODULAR EXPANSION JOINT**

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Related U.S. Application Data

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[52] **U.S. Cl.** **404/69**

[51] **Int. Cl.** **E01c 11/02**

[58] **Field of Search** 404/47, 48, 60, 68, 69, 404/50, 51, 47; 14/16; 52/396, 403

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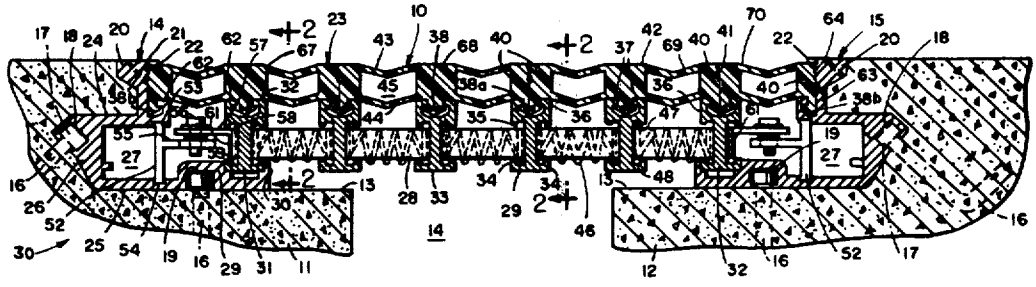
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[57] **ABSTRACT**

Modular expansion joints made from aluminum extrusions providing longitudinal frames and longitudinal rails. The rails have an I-beam-like structure with upwardly opening channels respectively receiving and interlocking therein deformable beads on the lower surface of an elastomer tread with hollow, V-sections deforming downwardly as the joint width becomes narrow. The elastomer tread completely covers and spans the joint. The longitudinal rails are supported by solid load-bearing beams having a greater width than depth, and coil springs are interposed between contiguous rails.

12 Claims, 4 Drawing Figures



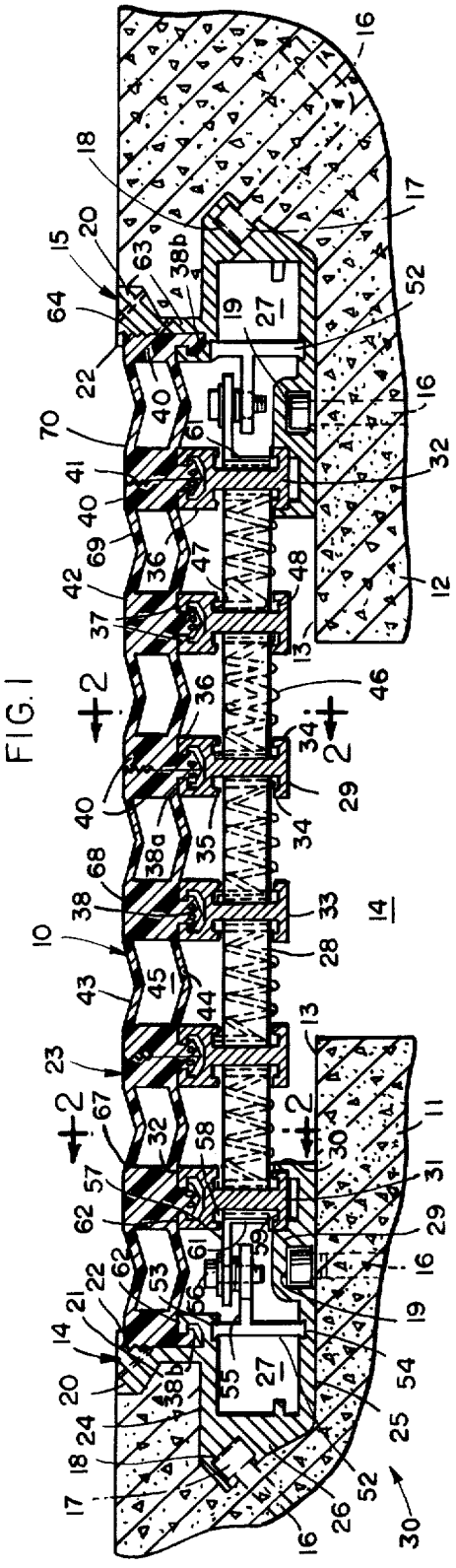


FIG. 1

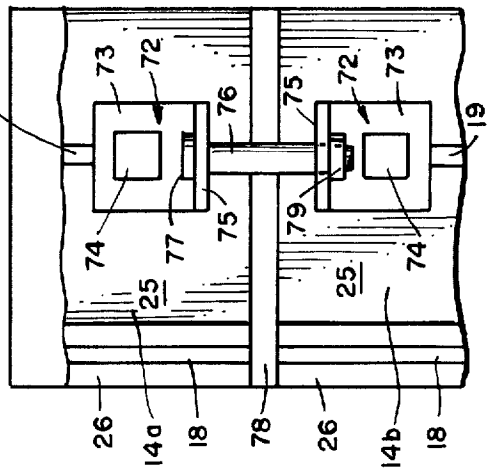


FIG. 3

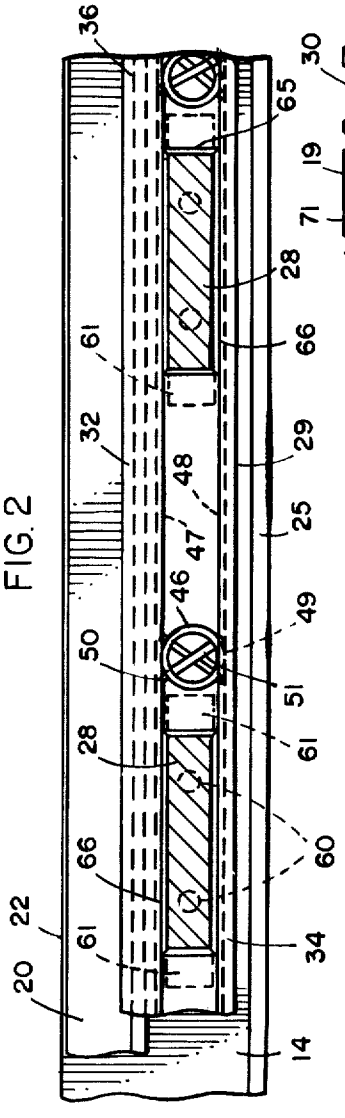


FIG. 2

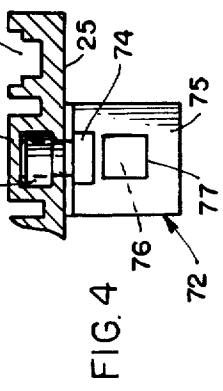


FIG. 4

MODULAR EXPANSION JOINT

RELATED APPLICATION

This application is a continuation-in-part of our application Ser. No. 121,957, filed Mar. 8, 1971 now U.S. Pat. No. 3,732,021.

INTRODUCTION

The subject invention concerns improvements in expansion joint structures useful in the spanning of relatively wide joints in pavement surfaces, particularly joints in pavement decks of bridges. The latter joints have a relatively wide 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 joints having ranges of movement which are lesser than those attainable in the modular bridge joint of the aforesaid copending application, the latter having load-bearing beams which are segmentally interconnected to allow the beams to lengthen or shorten the movement of the joint. The improvements of the subject invention reside in modular expansion joints having a shallower overall depth attained through, inter alia, the use of load-bearing beams of solid material, e.g., aluminum or steel, laid in the joint in a manner where the width exceeds the depth of the respective beams. Further improvements of the invention reside in the configuration of the seal and tread which spans and covers the entire joint, particularly in the provision of upper and lower V-shaped walls with a hollow space therebetween in the sections of the tread extending between respective longitudinal rails. Other improvements reside in the manner of mounting the outermost rails in the longitudinal frames on opposite sides of the joints.

The metal components of the joint include longitudinal frames mounted in stepped edges of a concrete pavement deck, such as the concrete pavement deck of a bridge, or in other concrete structures such as pavement sections adjoining or contiguous to bridges. The longitudinal rails extend longitudinally of the joint in substantially equally spaced relationship. These rails may be made in short sections and spliced together in end-to-end relationship in the manner shown in the aforesaid application.

The frames, rails and load-bearing beams preferably are fabricated as aluminum alloy extrusions. Each extrusion is relatively light in weight so that the joint can be assembled manually at the joint site without using heavy duty equipment. The rails are of relatively short lengths, e.g., 12 feet. 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 frame sections provided at each side of the joint also preferably are made in short sections and may have a gasket between abutting ends to seal the abutting ends against seepage of water at these points.

The joints of the invention are constructed in standard unit lengths and will span joints of medium width, e.g., joints having a maximum opening of 8–12 inches. The coil springs between the rails maintain substantially equal spacing therebetween regardless of joint width. The ends of the coil springs respectively are composed of horizontal legs which seat in a groove provided in the lower portion of the I-beamlike rails and a diagonal leg, the tip of which seats in an opposite groove of said rails.

The load-bearing beams or bars extend through aligned openings provided in the respective rails and span the entire joint between respective outer rails. The longitudinal frames at each side of the joint are provided with a recess segment into which the ends of the load-bearing beams or bars can project when the joint closes and the ends of the load-bearing beams or bars begin to extend into the longitudinal frame members of the joint.

The frames at the edges of the joint are extrusions which may be placed at the time of the initial deck paving. Secure mounting of the frames in the deck pavement is accomplished by anchor bolts embedded in the concrete and tied to reinforcing steel in the deck pavement.

The elastomer seal and tread provides a continuous seal from curb to curb without joints subject to leakage. The seal has longitudinal beads which snap into channels on the upper edges of the rails thus making the seal easy to install or replace. The seal covers all of the metal structure of the joint and is the only part which could be damaged by snowplows. The interlocking of the seal with the rails assures positive sealing in that the seal must move as the joint components move during thermal expansion or contraction of the joint.

THE DRAWINGS

A preferred embodiment of the invention is illustrated in the drawings, wherein:

FIG. 1 is a vertical section of an expansion joint with the concrete segments of the joint shown in fragment;

FIG. 2 is a section view taken on section plane 2—2 of FIG. 1 without the elastomer tread;

FIG. 3 is a fragmentary, bottom plan view of abutting sections of an end frame member of the joint; and

FIG. 4 is a fragmentary detail in side elevation of the bracket and bolt connection for the abutting sections.

Referring to the drawings, the modular expansion joint **10** spans a space **14** between adjacent sections **11** and **12** of a concrete bridge deck. The sections **11** and **12** each have a step **13** on which the longitudinal end frames **14** and **15** are seated and held in place by conventional J-bolts or other type of anchor bolts **16** or like holding devices. The anchor bolts have treaded shanks which tread into nuts **17** seated in longitudinal slots **18** and **19** which extend the length of the frame sections **14** and **15.** The nuts **17** are placed in the slots **18** at any desired longitudinal spacing. The J-bolts may then be treaded into the nuts until the bolt and nut bind in the respective slots **18** and **19.** This mounting of the nuts in the slots has proven very advantageous in installation or mounting of the frame sections on the bridge structure. The nuts may be positioned anywhere in the slots and thus can be located on the job site to allow the anchor blots to interfit with or avoid interfering contact with other components of the bridge deck or its understructure.

The longitudinal end frames preferably are aluminum extrusions having an upper, rearwardly projecting lip **20** forming an undercut **21** beneath which concrete can flow. The frames **14** and **15** preferably also have a small forward lip **22** adapted to overlie the respective ends of the elastomer tread **23.** The lip **22** helps provide a seal against intrusion of sand and other incompressibles between the seal and the frame and also aids in holding the respective ends of the elastomer tread in position in the respective end frames **14** and **15.**

The lower portion of the end frames **14** and **15** includes a rearwardly directed wall **24** joined to the bottom wall **25** by a connecting wall **26** which flares in an upward direction to accommodate the longitudinal slot **18.** A chamber **27** is provided between the upper and lower walls **24** and **25,** which chambers will receive and accommodate the ends of the load-bearing beams or bars **28** when the joint **10** closes to its minimum or near minimum width.

The lower wall **25** of the end frame includes an enlarged segment to accommodate the longitudinal slot **19** and further form a seat **30** for the lower wall **31** of the respective end rails **32,** which are mounted on the respective end frames.

The intermediary rails **33** are of the same cross section as the outermost rails **32.** Their lower walls **39** with upturned ends **34** provide longitudinal rigidity for the rails and forming grooves **48,** later described. Their upper ends have wall segments **35** like the bottom wall **39** and further include U-channels **36** with inwardly directed lips **37** for receiving deformable, dovetailed tongues **38.**

The elastomer tread **23** may be made in sections which fit side-by-side across the width of the joint. Each section includes an end wall **40** having a saw-toothed or serrated upper side edge **41.** The latter interlock and form a seal against intrusion of water between abutting faces of the tread sections. The contacting faces of the end walls **40** are positively sealed against water leakage therebetween by tight-fit and compression of the portions of tongues **38** which seat between the neck formed by the opposed, inwardly directed lips **37.** The side-by-side, lower portions of the abutting edges together form as a composite dovetailed tongues **38***a.*

The remainder of the elastomer tread may include one or more solid elastomer segments **42** between the end walls **40,** each solid segment being located above a U-channel **36** with a dovetailed tongue **38** depending therefrom. The intermediary portions of the tread sections between the respective rails are composed of a shallow, V-shaped upper wall **43** and a shallow, V-shaped lower wall **44** with a hollow space **45** therebetween. As the joint closes and the elastomer tread is pushed inwardly from its respective ends, the shallow, V-shaped walls **43** and **44** assume a deeper, V-configuration. Only the upper wall **43** is essential to make the seal waterproof. However, the lower wall **44** gives symmetric stability to the tread sections and serves as a second sealing surface, should the upper wall **43** become punctured or torn.

Adjacent one side of each load-bearing beam or bar **28** there is provided a coil spring **46** between each rail. The respective rails have opposed upper and lower grooves **47** and **48** on each side thereof. The lower groove **48** on each rail receives a horizontal leg **49** at each end of the coil spring while the upper groove **47** receives the end **50** of a diagonal leg **51** extending from one end of the respective legs **49.** These diagonal legs provide a useful function in holding the coil springs **46** in place under vibrations imparted to the joint by traffic passing thereover. Springs without such diagonal legs and mounted only by the horizontal legs **49** have been found, on occasion, to work loose as a result of the vibrations imparted on the joint by traffic moving thereover.

The outer rails **31** and **32** are held in position on the longitudinal end frame members **14** and **15** by a T-bar **52,** the cross leg of which is seated in opposed grooves **53** and **54** of the frame. The other leg **55** is connected by bolt **56** to a T-bar **57** having edge portions seated in the opposed grooves **58** and **59** of the outermost rails. One or both of the parallel legs of the T-bars may have a slot allowing for adjustable positioning of the respective bars in the end frames and the outermost rails.

The load-bearing beams or bars **28** have attached at opposite ends thereof by bolts **60** or other suitable means, a plate **61** whose length is greater than the width of the load-bearing beams or bars **28.** The respective plates **62** serve as stops to prevent either end of the beams or bars **28** from passing through the outermost rails **31** and **32.**

The half tongues **38***b* of the elastomer tread are seated in end frames by providing an inverted L-leg **62** spaced from and directed toward the wall portion **63** of the end frames. The horizontal lip of the half tongues **38***b* lies beneath the horizontal leg of the inverted L-leg **62** continually along the longitudinal dimension of the joint. The vertical leg of the half tongues **38***b* are compressed between the end of the L-leg and the opposing face of wall portion **63** to make a constant, water-tight seal. This interlocking, coupled with the lips **22** overly-

ing the upper side of the outer edge of the tread section, hold the tread section firmly in place in the respective end frames. Further, the upper portion of the wall **63** may be provided with serrations **64** to match and receive the serrated side portion **41** of the outermost wall of the seal section forming the tread. This further aids in preventing seepage of moisture and incompressibles between the contacting faces of the side walls **40** of the outermost seal and the face of the wall **63** of the frame.

Preferably the rectangular opening **65** in the intermediary rails **33** and outermost rails **32** are lined with a wear-resistant bushing **66**, e.g., a gasket-like lining of Adiprene.

In preferred forms of the invention, the rails **33** and **32** and the end frames **14** and **15** are aluminum extrusions approximately 12 feet in length, which length corresponds to one lane of a dual line or multilane highway or bridge. The abutting ends of the rails **32** and **33** are spliced together by elongated plates of the type shown in our application aforesaid, which splicing plates are seated in the opposed grooves **47** and **48** on each side of the respective rails at the point or points of splicing. By using lengths corresponding substantially to lane widths of the highways or bridges, it is possible to repair or inspect or conduct periodic maintenance of the joint by closing off only one late at any given time in the performance of the aforesaid functions.

The invention thus provides a modular joint structure utilizing a pair of elongated, longitudinal frames mounted firmly in concrete or other paving material on steps at the respective edges of the joint. A plurality of elongated, longitudinal rails span the joint in parallel, spaced relationship to each other. These rails respectively have rectangular openings therein disposed at longitudinal intervals along the rails. The openings are aligned in a plurality of transverse rows through which joint-spanning, load-bearing beams of rectangular cross section extend through at least some, and usually all, of the rows of rectangular openings. The respective rails, excepting the two outermost rails, rest individually and independently slidable on the rectangular load-bearing beams.

To maintain substantially equal spacing between the respective rails, the modular joint structure utilizes a plurality of coil springs mounted between respective rails and preferably in an arrangement providing a plurality of longitudinally spaced, transverse rows close to but spaced from one side of the load-bearing beam.

The modular joint is sealed over its entire width and length by providing an upper, elastomer tread having solid elastomer segments above and supported on the upper portions of the respective rails, preferably by deformable beads or tongues interlocked in channel-forming members on the upper surface of the rails. The intermediary portions of the treads between the rails preferably comprise upper and lower, vertically spaced, shallow V-shaped walls with a hollow space therebetween. As the joint closes, these upper and lower walls deform into a deeper V-configuration.

The tread preferably is composed of a series of side-by-side elastomer segments made from low crystallization neoprene formulations. The abutting edges of the treads with the sides of the longitudinal end frames and with another side of an adjacent tread segment for a water-tight seal. In the illustrated embodiment, the tread sections comprise three side-by-side sections **67**, **68** and **69** of identical cross section and a section **70** which is one-half the width of the tread sections **67–69**. If desired, the tread sections may comprise three or more integrally formed sections, each of which corresponds in cross section to section **70** in the same manner as sections **67–69** comprise the equivalent of two sections **70**. By such dimensions and geometry of the tread sections, they can be used to span joints of varying width dimension through appropriate selection of the tread section widths needed to span the particular joint between the longitudinal end frames **14** and **15**.

The sections of the longitudinal end frames **14** and **15** preferably are also sealed at their junctures by an elastomer gasket. Referring to FIGS. **3** and **4**, the end portions of the longitudinal slots or grooves **19** of abutting frame sections **14***a* and **14***b* have placed therein a nut **71**. An L-bracket **72** is fixedly attached to the underside of the bottom wall **25** of each frame section, the horizontal leg **73** of which is held by a bolt **74**. The shank of the bolt projects through a hole or slot (not shown) in the leg **73** and is threaded into the nut **71** to hold L-bracket **72** fixedly on the bottom wall.

The vertical leg **75** of each L-bracket has a bolt-receiving hole through which the shank **76** of bolt **77** extends. An elastomer gasket **78** conforming to the cross section of the frame **14** is placed between the frame sections **14***a* and **14***b* and is compressed therebetween by drawing up tightly the bolt **77** and its nut **79**.

Similar bracket and bolt means may be mounted in the longitudinal slots or grooves **18** to draw the abutting frame sections together and give a more uniform compression of the gasket **78**.

It is through 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 form herein disclosed being a preferred embodiment for the purpose of illustrating the invention.

The invention is hereby claimed as follows:

1. A shallow modular joint structure useful for spanning joints comprising a pair of elongated longitudinal frames adapted to be mounted at the respective edges of the joint, a plurality of elongated, longitudinal rails spanning the joint in parallel, spaced relationship to each other, said rails respectively having openings therein at longitudinally spaced intervals, said openings further being aligned in a plurality of transverse rows, said openings being of rectangular cross section and having a horizontal width greater than the vertical depth, and a plurality of joint-spanning load-bearing beams of rectangular cross section with a horizontal width greater than the respective vertical depth of each beam and extending through at least some of said rows of rectangular openings with said rails resting slidably thereon.

2. A joint structure as claimed in claim **1**, said rails having mounted therebetween a plurality of coil springs arranged in a plurality of longitudinally spaced, transverse rows.

3. A joint structure useful for spanning joints comprising a pair of elongated longitudinal frames adapted to be mounted at the respective edges of the joint, a plurality of elongated, longitudinal rails spanning the joint in parallel, spaced relationship to each other, said

rails respectively having openings therein at longitudinally spaced intervals, said openings further being aligned in a plurality of transverse rows, said openings being of rectangular cross section and having a width greater than the depth, and a plurality of joint-spanning load-bearing beams of rectangular cross section with a width greater than the respective depth of each beam and extending through at least some of said rows of rectangular openings with said rails having mounted therebetween a plurality of coil springs arranged in a plurality of longitudinally spaced, transverse rows, said springs balancing the spacing between respective rails at the joint structure widens or narrows, said spring members each having horizontal legs at opposite ends thereof seated in leg-receiving groove means in respective rails and diagonal end portions extending from said legs with the tip portions of the diagonal end portions seated in opposed groove means in respective rails.

4. A joint structure as claimed in claim **1**, said longitudinal frames having formed therein longitudinally extending cavities into which the ends of the joint-spanning, load-bearing beams can extend as the joint approaches its narrowest spacing.

5. A modular joint structure useful for spanning joints comprising a pair of elongated, longitudinal frames adapted to be mounted on respective sides of the joint, a plurality of elongated, longitudinal rails spanning the joint in parallel relationship to each other, plurality of joint-spanning, load-bearing beams extending transversely across the joint and supporting the respective rails, an elastomer tread composed of one or more tread sections, means supporting said tread on the upper portion of each rail with a solid elastomer strip portion of the tread above and supported by each rail, and said solid portions being connected by at least one shallow V-shaped wall connecting respective upper corner portions of said solid portions of said tread.

6. A joint structure as claimed in claim **5**, said tread also having a lower, shallow V-shaped wall below and spaced from said first-mentioned wall and defining a hollow space between said walls and solid portions.

7. A joint structure as claimed in claim **5** wherein said tread sections have dformable members depending from said solid portions and interlocking in channel-forming means extending along the upper sides of respective rails.

8. A joint structure as claimed in claim **5**, said longitudinal frames having longitudinal groove means for receiving an interlocking member depending from the end wall of said tread mounted on said frame, and said frame further having an elongated lip overlying the upper corner of said tread.

9. A joint structure as claimed in claim **5**, said tread comprising a plurality of side-by-side sections extending longitudinally of the joint and interlocking serrations formed in the contiguous, abutting side walls of respective tread sections.

10. A modular joint structure useful for spanning joints comprising a pair of elongated, longitudinal frames adapted to be mounted on respective sides of the joint, a plurality of elongated, longitudinal rails spanning the joint in parallel relationship to each other, a plurality of joint-spanning, load-bearing beams extending transversely across the joint and supporting the respective rails, said frames having one or more downwardly facing, longitudinal slots, nuts slidably positionable at any desired point in said slot or slots, and anchor bolts having threaded ends threaded into said nuts until the nuts and bolts bind in the slot or slots, the shanks of said bolts projecting from the frame for anchoring in pavement poured adjacent and beneath said frames.

11. A modular joint structure useful for spanning joints comprising a pair of elongated, longitudinal frames adapted to be mounted on respective sides of the joint, a plurality of elongated, longitudinal rails spanning the joint in parallel relationship to each other, a plurality of joint-spanning, load-bearing beams extending transversely across the joint and supporting the rails, said frames being composed of aligned sections, a gasket between abutting ends of said section, said sections each having a downwardly facing longitudinal slot portion near respective abutting ends, a nut slidably adjustably seated in each slot portion, a bracket mounted on the inside of each section adjacent respective abutting ends by a bolt threaded into a respective nut in each slot portion and bolts connecting respective pairs of brackets of respective abutting ends for drawing said ends together and compressing therebetween said gasket.

12. A modular joint structure as claimed in claim **11**, said bolts having threaded ends threaded into said nuts until the nuts and bolts bind in said respective slots.

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