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[54] MODULAR EXPANSION JOINT

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[52] U.S. Cl. **404/57,** 52/726, 14/16

[51] **Int. Cl.** **E01c 11/10**

[58] **Field of Search** 52/726; 94/18; 14/16

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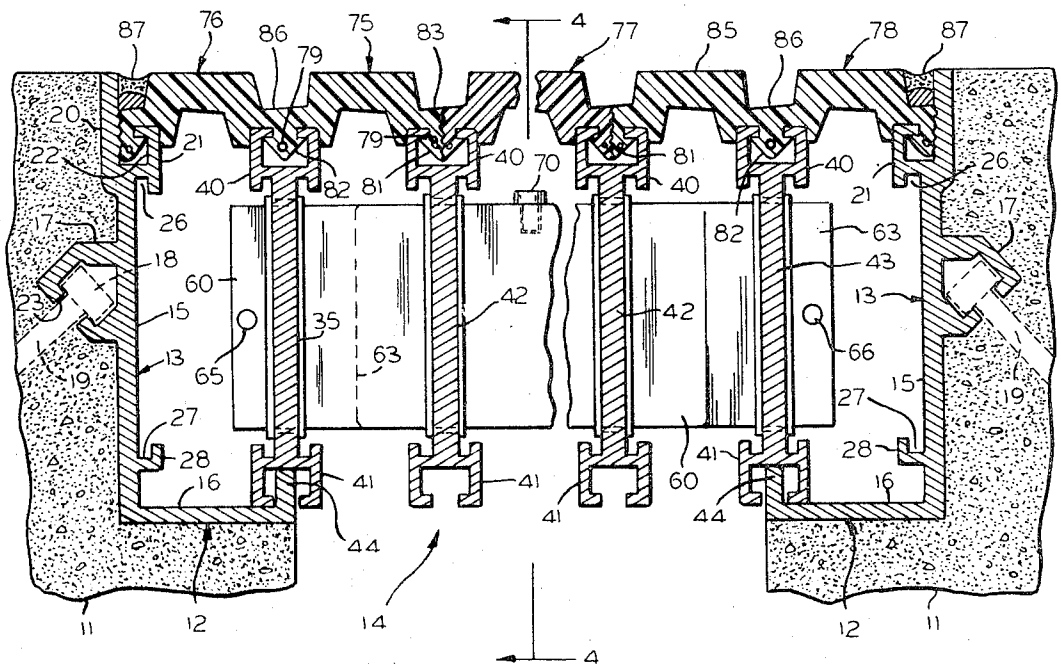
[57] **ABSTRACT**

Modular expansion joint made from aluminum extrusions providing the longitudinal frames, longitudinal rails, and load-bearing support beams. The rails have an I-beam structure with downwardly and upwardly opening channels respectively receiving a lip of the frames and receiving and interlocking therein deformable longitudinal beads on the lower surface of an elastomer tread which completely covers and spans the joint. The load-bearing, length-variable beams extend through the rails, and coil springs are interposed between contiguous rails. The rails are composed of aligned rail segments with contiguous ends slidably spliced together.

9 Claims, 7 Drawing Figures



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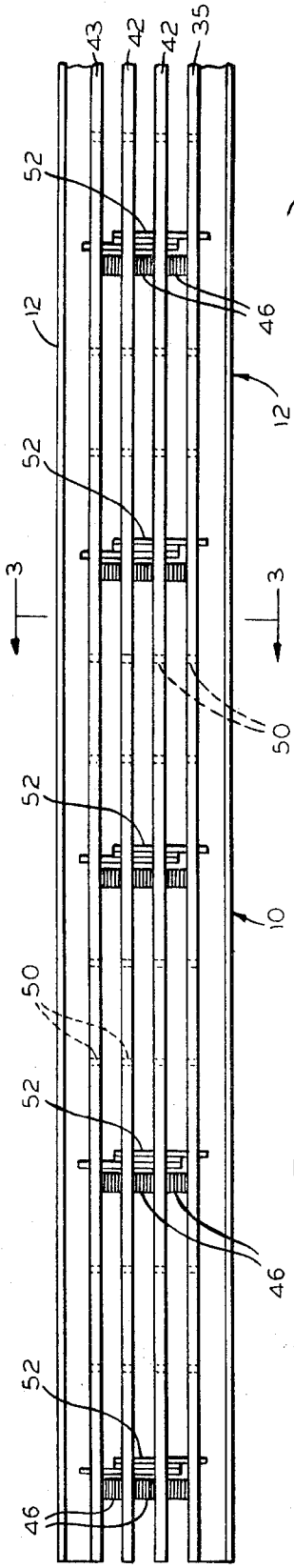
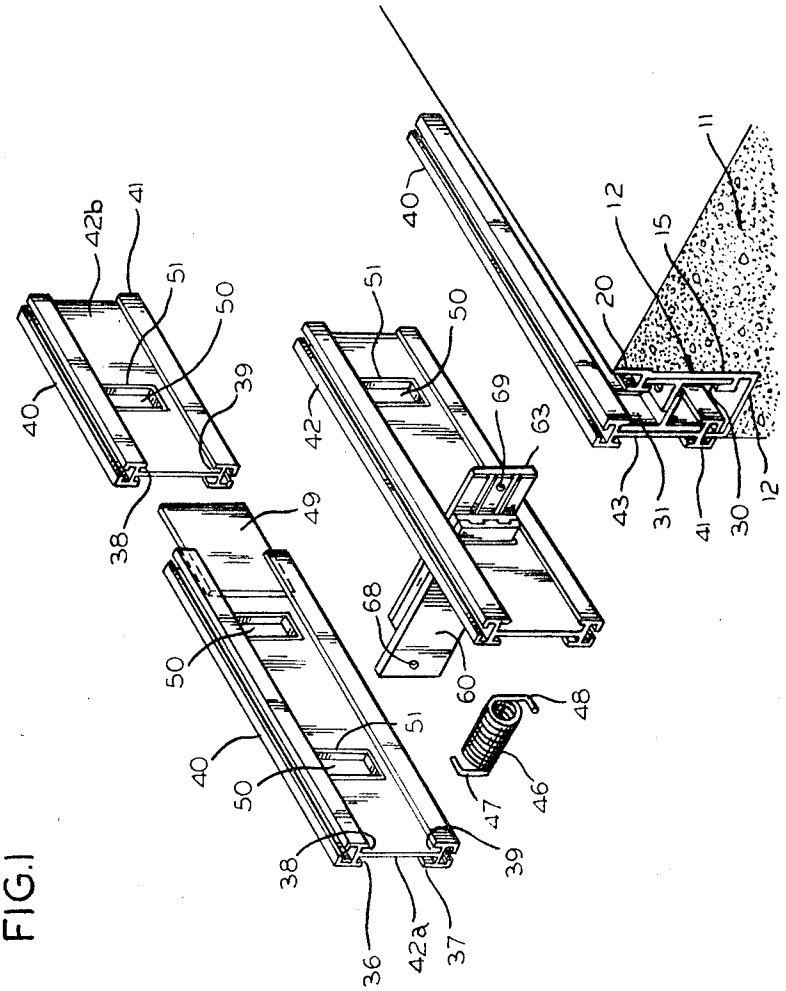


FIG.1

FIG.2



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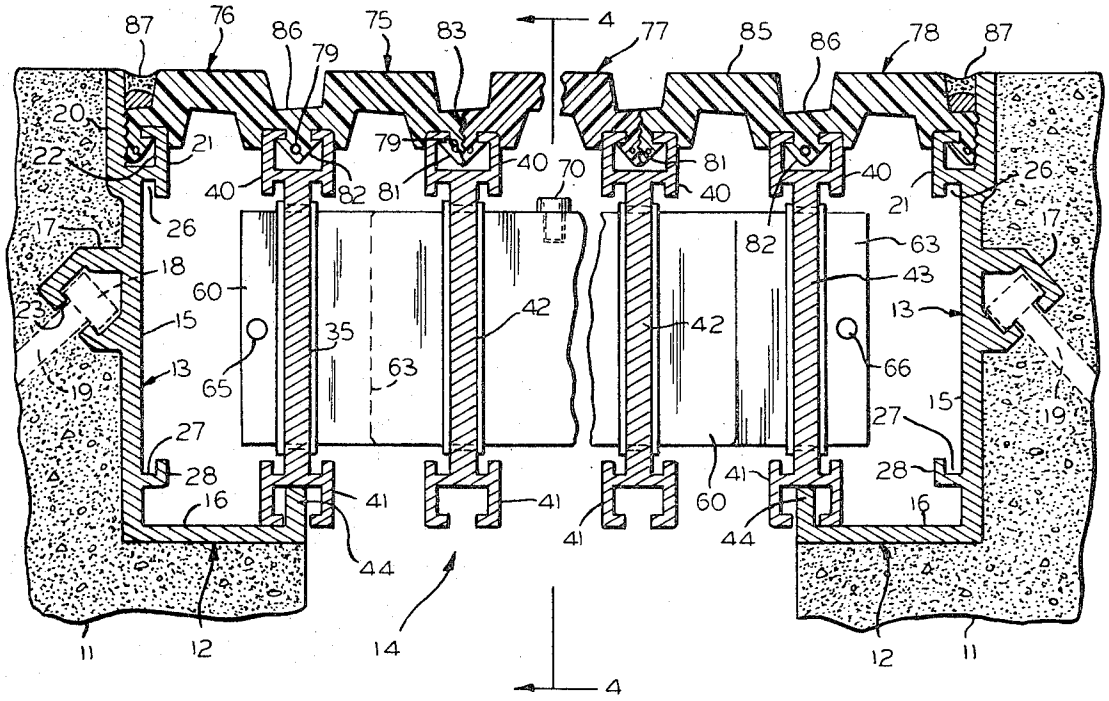

FIG.3

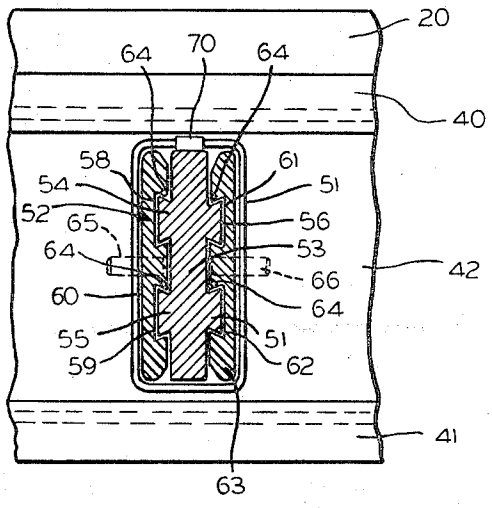

FIG.4

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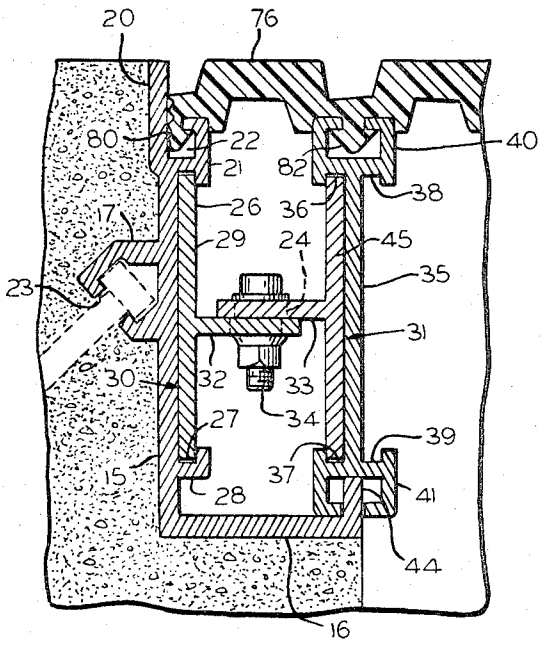

FIG.5

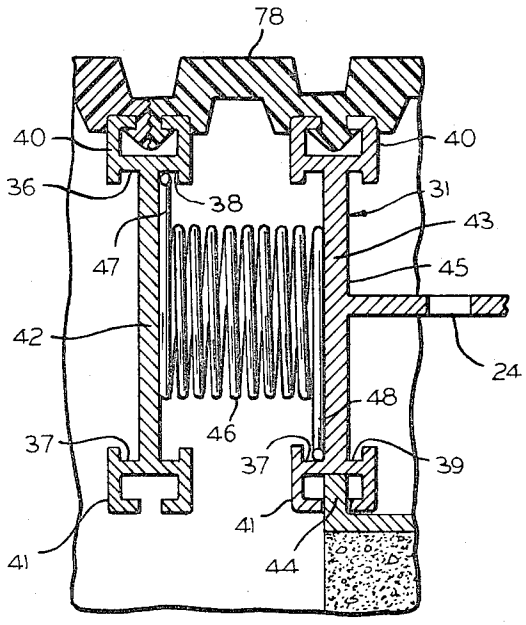

FIG.6

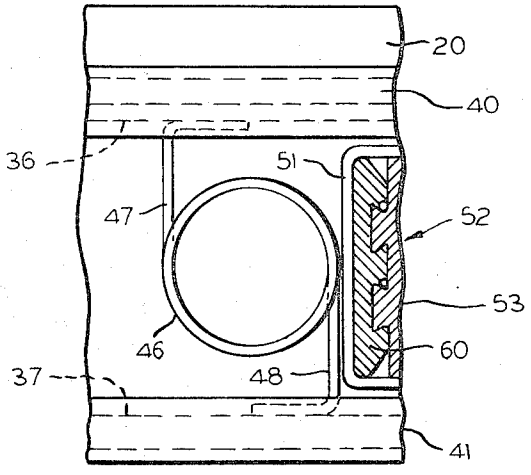

FIG.7

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MODULAR EXPANSION JOINT

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 relatively wide ranges of movement of the type used in bridge joints, i.e., joints in the pavement surface of the bridge itself or in approaches to the bridge. The joints primarily constitute metal parts with an elastomer seal and tread covering the entire joint and sealing out leakage of water, solids or the like onto the metal parts, as well as the underlying structure of the bridge.

The metal components of the joint include longitudinal frames mounted in stepped edges of the concrete pavement deck, longitudinal rails extending longitudinally in substantially equal spaced relationship along the length of the joint, the rails preferably being made in short sections and spliced in end-to-end relationship

by splicing the plates, lengthwise extendable, load-bearing beams spanning the joint and extending through beam-receiving openings in the rails, and coil springs interposed between contiguous rails, preferably adjacent each load-bearing beam.

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 joints of the invention are constructed from standard units regardless of joints width, e.g., joints ranging from twelve inches to forty-two inches. No welding, brazing or the like is required. The coil springs between the rails maintain substantially equal spacing therebetween regardless of the joint width. The openings in the rails receive the load-bearing support beams which preferably are lined with an elastomer cushioning strip, which eliminates the generation of noise in the joint as traffic crosses 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 J-bolts embedded in the concrete, thus eliminating any need to locate reinforcing steel in the deck pavement and/or tying of the frame to the reinforcing steel.

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 top plan view of an expansion joint with the elastomer seal removed therefrom;

FIG. 2 is an exploded, fragmentary, perspective view of a portion of said joint;

FIG. 3 is a cross-sectional view of the joint of FIG. 1 taken on section plane 3—3 of FIG. 1;

FIG. 4 is a sectional view taken on section plane 4—4 of FIG. 3; and

FIGS. 5, 6 and 7 respectively are sectional, detailed views of the frame and means for mounting the outermost rail thereon and the mounting of a coil spring between the rails.

THE ILLUSTRATED EMBODIMENT

Referring to the drawings, the illustrated embodiment is a modular expansion joint 10 spanning the space 14 between adjacent sections 11 of a concrete bridge deck. The edges of the sections 11 each have a step 12 in which a frame 13 is seated.

The frame 13 is an L-shaped aluminum extrusion having a rear wall 15 and a bottom wall 16. The rear face of the rear wall has a longitudinal channel 17 integrally formed as a part of the extrusion. The channel 17 projects rearwardly from the rear wall 15 and has a slot 23 facing downwardly and rearwardly. The channel 17 is slidable over the heads 18 of J-bolts 19, which are fixedly embedded in the concrete sections 11. The frame 13 and the J-bolts 19 may be positioned in the forms used for pouring the concrete bridge deck sections 11 prior to the pouring of the concrete deck, thereby eliminating need for a secondary or supplemental paving around the frame.

The frames 13 have a rearwardly offset, upper segment 20 at the top edge of the rear wall 13. This offset segment together with a U-lip 21 forms an elongated socket 22 adapted to receive and interlock with the deformable bead of the elastomer seal and tread as hereinafter described.

The frame extrusions 13 further have a longitudinal, downwardly facing slot 26 beneath the U-lip 21. Opposing this slot is the upwardly facing, longitudinal slot 27 formed by the longitudinal L-leg 28.

The opposed slots 26 and 27 receive and hold opposite edges of the leg 29 of a T-bar 30. The T-bar 30 is used in association with a similar T-bar 31 for mounting the outermost rails 35 and 43 on respective frames 13. The T-bars are relatively short in length and a plurality of T-bars are used at spaced intervals along the length of the frames and outermost rails.

The legs 32 and 33 of the respective T-bars overlap. They are bolted together by bolts 34 extending through slots 24 in the overlapped legs. The slots enable sliding adjustment of the two T-bars to enable vertical alignment of the outer rails 35 and 43. The leg 33 of the outer rail-holding T-bar 31 lays over the leg 32 of the frame-mounted T-bar 30. In this arrangement tightening of the bolts 34 draw the T-bars 31 downwardly and press the outer rails 35 and 43 tightly against the upper surface of the upstanding lip 44.

The rails 35, 42 and 43 are identical. They are I-bars having at each end elongated U-channels 40 and 41 forming elongated sockets used for purposes later described. Beneath and above respective U-channels 40 and 41 are downwardly facing grooves 36,38 and upwardly facing grooves 37,39. Opposed pairs of these grooves receive the longitudinal edges of the leg 45 of respective T-bars 31.

The outermost rails 35 and 43 thus are respectively rigidly connected to the frames 13 by the T-bars 30 and 31. An upwardly projecting longitudinal lip 44 on the bottom wall of the frame 13 extends into the lower U-channel 41 to further stabilize the mounting of outer rails 35 and 43 on the frames.

As shown in FIGS, 1, 2, 6 and 7, a plurality of coil springs is interposed at longitudinally spaced intervals in columns between the respective outer rails 35 and 43 and all intermediate rails 42, the exact number of which vary according to the width of the expansion joint. The coil springs 46 and the respective ends thereof have L-legs 47 and 48, which project in opposite directions. These L-legs are received in the grooves 36–39 and thus hold the springs in position between the rails.

As can be seen in FIG. 2, the rails 35, 42 and 43 are made up of a series of aligned sections. This is illustrated by the sections 42*a* and 42*b* for one of the intermediate rails in FIG. 2. Abutting ends of these sections are spliced together by splice plates 49, which are slidably inserted into opposed pairs of grooves 38 and 39 or 36 and 37. This splicing arrangement allows for thermal, longitudinal expansion or contraction of the rail sections 42*a* and 42*b* and in fact provides expansion joints along each rail.

The rails 35, 42 and 43 are provided with vertical slots 50 at regular spaced intervals along their length. These slots preferably are lined with elastomer cushioning strips 51, which may line all or part of the slots. The elastomeric cushioning strips eliminate joint noise caused by rubbing or hitting together of metal parts as traffic passes over the expansion joint. These elastomeric strips also prevent galling of metal parts which would otherwise rub against each other as the joint widens and narrows.

The transverse, load-supporting members of the joint are length extendable bars or beams 52. The length extendable function is provided by making the bars or beams 52 as a plurality of bar segments slidable relative to each other. In the illustrated embodiment, the load-supporting bars or beams 52 comprise a center bar 53 having a length sufficient to span at least half of the intermediate rails 42. The sides of the center bars each have two parallel, longitudinal, dovetailed tongues 54,55 and 56,57. The dovetailed tongues 54 and 55 slidably receive longitudinal dovetailed grooves 58 and 59 of a first outer bar 60. The dovetailed tongues 56 and 57 slidably receive longitudinal dovetailed grooves 61 and 62 of a second outer bar 63.

In order to facilitate ease of sliding motion of outer bars 60 and 63 relative to the center bar 53, the tongue and groove surfaces may be provided with bearings 64. The bearings 64 may be lubricated or self-lubricating rod bearings, roller bearings, or ball bearings confined by suitable means on one of the bearing-containing faces of the dovetailed tongues or dovetailed grooves. Additional bearings may be provided on the undersides of the dovetailed tongues, if desired.

The ends of the outer bars 60 and 63 extend through slots 50 in the outer rails 35 and 43. The ends of these bars respectively have split dowels or pins 65 and 66 driven into holes 68 and 69 in the ends of the outer bars 60 and 63 (FIGS. 2, 3 and 4). The dowels or pins preclude movement of the ends of the outer bars 60 and 63 completely out of the slots 50 in the outer rails 35 and 43. The outer bars 60 and 63 are free to slide a restricted distance determined by contact of the ends of the outer bars with the rear walls of the channel 13 and by contact by the pins or dowels with the outer rails.

The center bar 43 is kept approximately centered during opening and closing of the joint by providing in the upper surface a bolt 70, the end of which may strike either of the contiguous rails 42 and thereby preclude further longitudinal movement of the center bar 53. Other stop means such as an upwardly projecting pin, stud or shoulder may be used in lieu of bolt 70.

The expansion joint is completely covered and sealed by an elastomer seal and tread 75 made of neoprene or other wear-resistant and weather-resistant elastomer.

In the illustrated joint the seal and tread 75 is composed of three side-by-side sections 76, 77 and 78 respectively extending longitudinally along the entire length of the joint, e.g., curb to curb. Each of the sections has along its lower longitudinal edges a one-lip bead 80 and 81. A two-lip head 82 extends along the longitudinal midportion of the lower surface of each tread section. These beads are deformable enough, due to holes 79, to allow them to be pressed into the channels 40 and the sockets 22 as shown in FIG. 3. Their lips lock the beads in the respective channels and sockets.

The longitudinal edges of the sections 76-78 may have longitudinal corrugations 83 which intermesh when the edges are laid side-by-side in the channels 40. Together the one-lip beads 81 on such edges form a two-lip bead of a configuration similar to the beads 82.

The upper surface of the seal and tread 75 has longitudinal channels 86 directly above each rail (as shown) or between rails. These channels aid in flexing of the segments of the seal and tread between the channels as the joint opens and closes. They further serve as drain channels for rain water or melted snow or ice. If desired, the channel segments in the upper surface of the seal and tread adjacent the longitudinal frames 13 may be filled with a caulking material 87.

The invention thus provides a modular joint structure capable of spanning and sealing joints having relatively large amounts of movement. The important features of the invention include a plurality of joint-spanning, load-bearing beams extending through at least some of the rows of openings in the rails of the joint structure, said openings being aligned in a plurality of transverse rows; resilient means, preferably coil springs, mounted between respective contiguous rails to balance the spacing between the rails as the joint structure widens or narrows and to provide positive movement of the rails as the joint opens; lining of the openings in the rails with elastomer cushioning strips to lessen noise originating in the joints as traffic passes thereover and prevent galling of the metal parts which would otherwise be in sliding contact; joint-spanning, load-bearing beams which are made in interengaged segments longitudinally slidable relative to each other to permit the beams to lengthen or shorten as the joint structure widens or narrows; longitudinal rails for the joint structure respectively in the form of a plurality of aligned rail segments with splicing means joining contiguous ends of the rail segments in slidable relationship thereto to facilitate ease of manual installation of the rails and also to allow the respective segments to expand and contract longitudinally and independently of each other; and channel forming means on the upper sides of the rails with an elastomer tread supported on the rails and releasably interlocked in the channel forming means by elongated, deformable beads extending longitudinally along the lower side of the tread.

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

The invention is hereby claimed as follows:

1. A 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, a plurality of joint-spanning, load-bearing beams extending through at least some of said rows of openings with said rails resting individually and independently slidably thereon, and compression spring members individually mounted between respective contiguous rails in a plurality of longitudinally spaced, transverse rows spaced from but adjacent to respective beams to balance spacings between said rails as the joint structure widens or narrows, said spring members each having legs at opposite ends thereof mounted in leg-receiving groove means in respective rails.

2. A joint structure as claimed in claim 1, said resilient members being a plurality of coil springs arranged in said plurality of longitudinally spaced, transverse rows.

3. A joint structure as claimed in claim 1, said openings being lined with elastomer cushioning strips.

4. A 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, and a plurality of joint-spanning, load-bearing beams extending through at least some of said rows of openings with said rails resting slidably thereon, said load-bearing beams comprising interengaged segments longitudinally slidable relative to each other to allow said beams to lengthen or shorten as the joint structure respectively widens or narrows.

5. A 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, and a plurality of joint-spanning, load-bearing beams extending through at least some of said rows of openings with said rails resting slidably thereon, said rails respectively comprising a plurality of aligned rail segments, and means joining contiguous ends of said rail segments in slidable relationship thereto to allow said segments to expand and contract longitudinally and independently of each other.

6. A joint structure as claimed in claim 1, and means rigidly mounting the outermost rails on respective frames.

7. A 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, a plurality of joint-spanning, load-bearing beams extending through at least some of said rows of openings with said rails resting slidably thereon, channel-forming means on the upper side of said rails, an elastomer tread supported on said rails, and means on said tread interlocking the tread in respective channel-forming means.

8. A joint structure as claimed in claim 7, wherein said last-mentioned means are elongated, deformable beads extending longitudinally along the lower side of said tread.

9. A 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, a plurality of joint-spanning, load-bearing beams extending through at least some of said rows of openings with said rails resting slidably thereon, said load-bearing beams comprising interengaged segments longitudinally slidable relative to each other to allow said beams to lengthen or shorten as the joint structure respectively widens or narrows, means rigidly mounting the outermost rails on respective frames, the respective ends of said beams being positioned between one of said frames and its respective outermost rail, and means confining sliding movement of respective ends of said beams between said frame and its respective outermost rail.

* * * * *