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McLean

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[54] **COMPOSITE EXPANSION JOINT ASSEMBLY**

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[52] **U.S. Cl.** **404/56**

[51] **Int. Cl.²** **E01C 11/12**

[58] **Field of Search** 52/573, 167; 248/20, 22; 404/56–69

[56] **References Cited**

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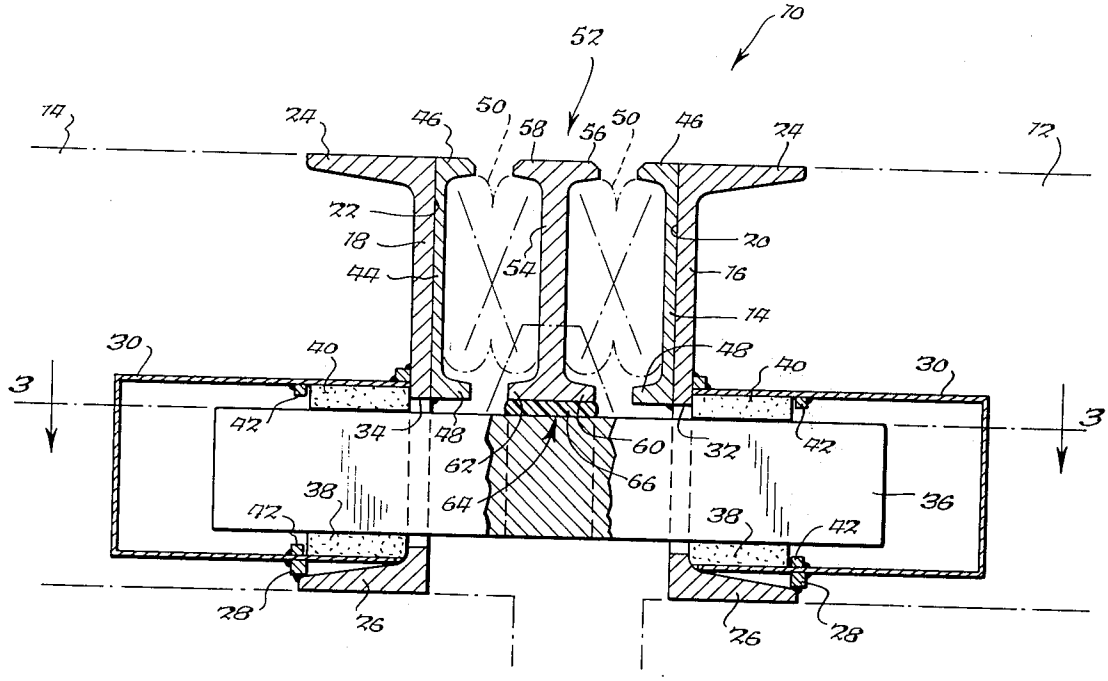
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Assistant Examiner—Henry Raduazo
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[57] **ABSTRACT**

A composite expansion joint assembly having at least one rigid structural member interposed between laterally spaced sealing elements and attached to a transversely extending support bar by an elastic connection.

4 Claims, 5 Drawing Figures



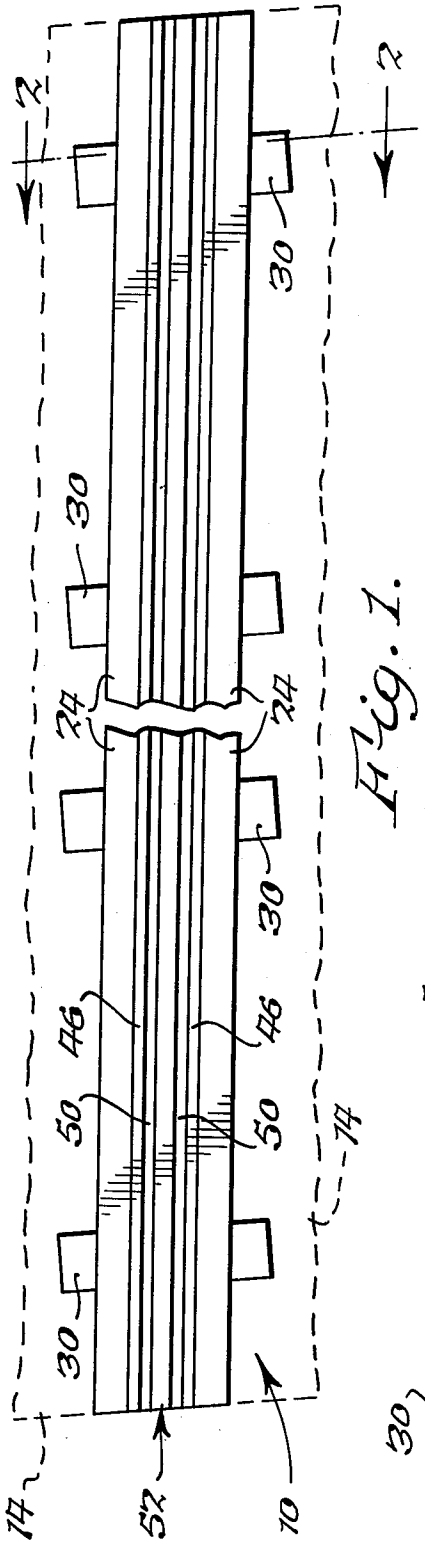

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Fig. 1.

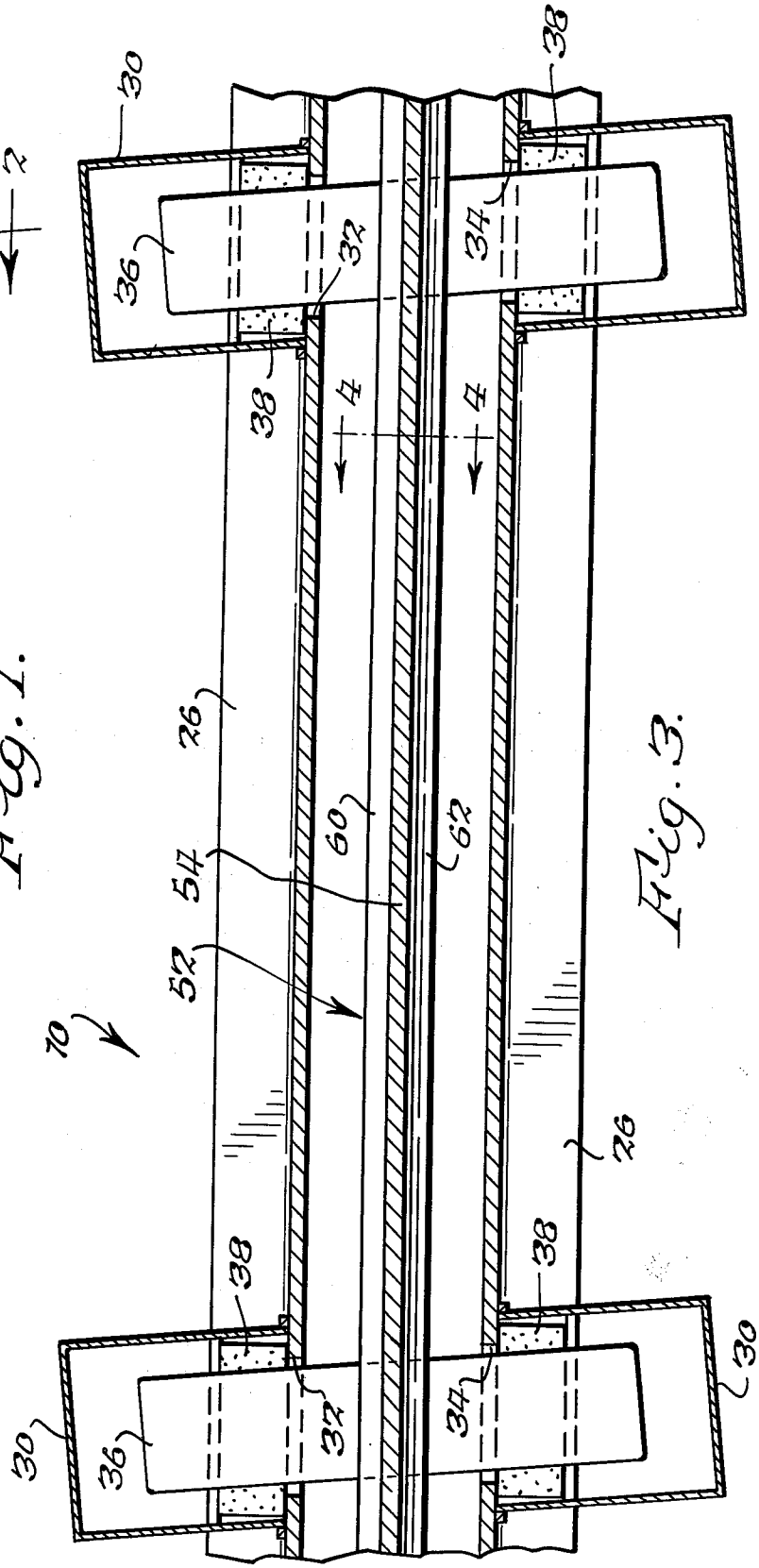
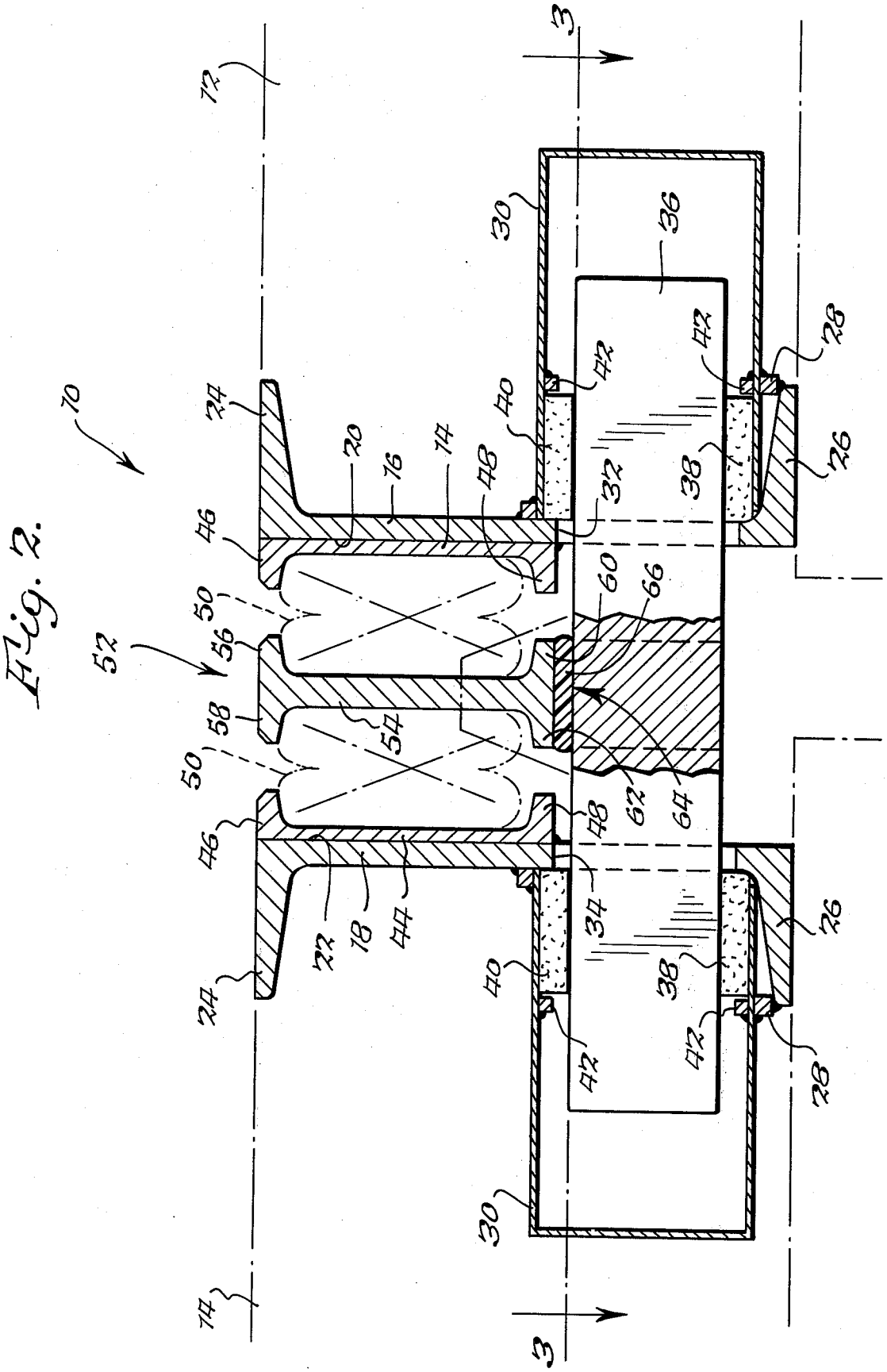

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Fig. 3.


Fig. 2.
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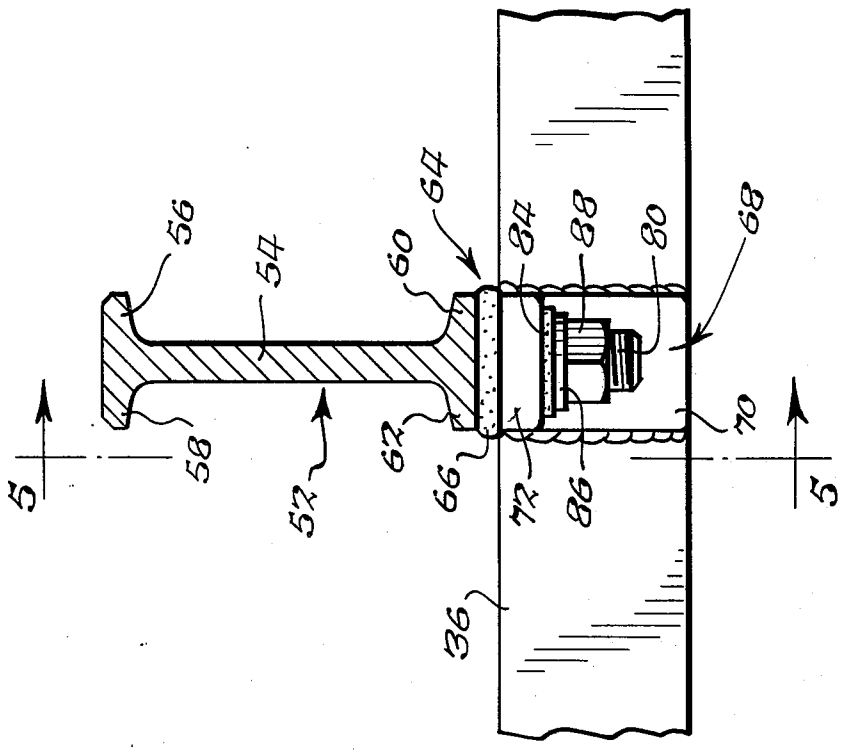

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Fig. 4.

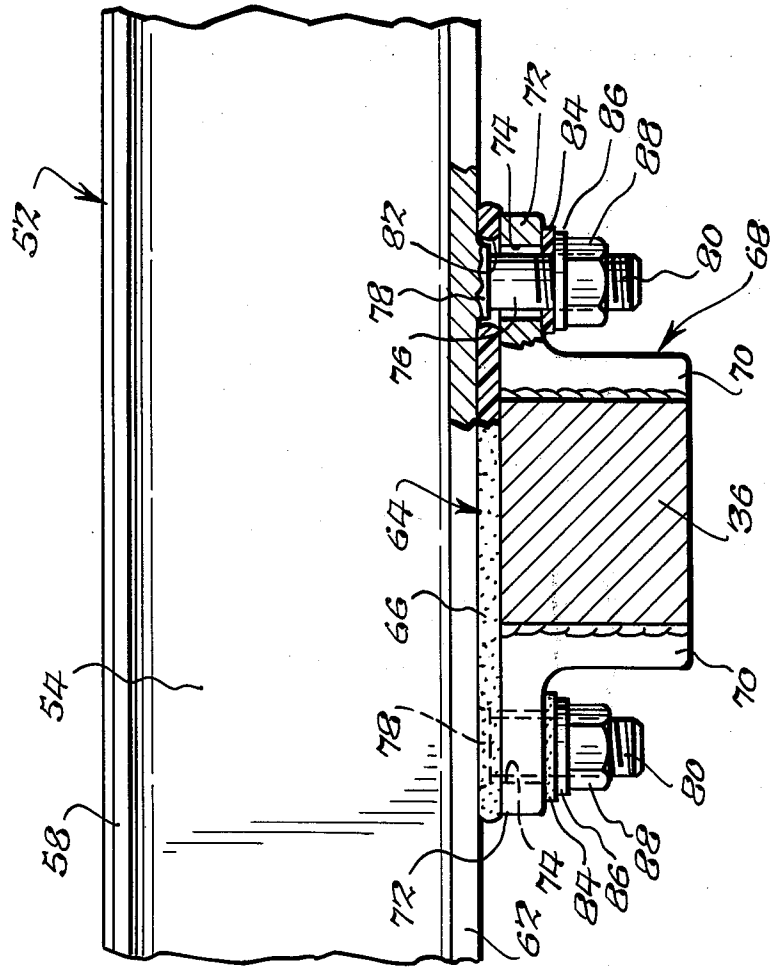

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Fig. 5.

COMPOSITE EXPANSION JOINT ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to expansion joints and, more particularly, to a composite expansion joint having elastic means for connecting the rigid structural member interposed between the elastic seals to the supporting bar.

Composite expansion joints are conventionally employed in bridge structures and the like wherein the relative movement of adjacent bridge deck slabs or sections in response to temperature changes is too great to be accommodated by a single seal unit. Such composite expansion joints normally consist of two or more laterally spaced elastic seals extending lengthwise of the expansion groove between adjacent deck sections and separated by rigid structural members or plates. Thus, the composite joint assembly consists of alternating elastic and rigid members mounted between a pair of relatively movable deck sections. Sometimes, these rigid structural members are fixedly secured, as by weldments, to transversely extending structural bars or beams on which the rigid structural members are supported. These supporting bars or beams project into the adjacent deck sections and are adapted to slide axially on bearing bars during contraction and expansion of the adjacent deck sections. While such arrangements satisfactorily accommodate horizontal movement of the adjacent deck sections, they pose problems when relative vertical displacement occurs between adjacent deck sections under loading because the consequent tilting movement of the support bar about a transverse axis effects a corresponding lateral canting or tilting of the rigidly attached structural members about their respective longitudinal axes to exert excessive stresses and strains on the adjoining elastic seals. Such action can strain the seals beyond their working limits and can open same sufficiently to allow passage of water vertically through the unit. Also, the rigid connection between the structural members and their associated support bars provides an ideal sound path creating undesirable noise. Also, the rigid connection hampers repair and replacement where indicated and results in damage to adjacent parts during disassembly.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved composite expansion joint overcoming the above noted shortcomings.

It is another object of this invention to provide the seal supporting structural components of the foregoing expansion joint with an elastic connection offering flexibility in absorbing strains and stresses imparted to such joint.

In one aspect thereof, the composite expansion joint of the present invention is characterized by the provision of an elastic connection between the rigid structural members supporting the seals and their associated supporting bars to aid in resisting stresses and strains imposed on the expansion joint components.

The foregoing and other objects, advantages and characterizing features of the present invention will become clearly apparent from the ensuing detailed description of an illustrative embodiment thereof, taken together with the accompanying drawings wherein like reference numerals denote like parts throughout the various views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a composite expansion joint assembly of the present invention, shown disposed between a pair of pavement sections;

FIG. **2** is a transverse sectional view thereof on an enlarged scale, taken about on line **2—2** of FIG. **1**;

FIG. **3** is a fragmentary horizontal sectional view thereof, on another scale, taken about on line **3—3** of FIG. **2**;

FIG. **4** is a fragmentary vertical sectional view, on an enlarged scale, taken about on line **4—4** of FIG. **3**; and

FIG. **5** is a fragmentary vertical sectional view, taken about on line **5—5** of FIG. **4**.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring now in detail to the illustrative embodiment depicted in the drawings, there is shown in FIG. **1** a composite expansion joint assembly, generally designated **10**, constructed in accordance with this invention and installed in an expansion groove between adjacent bridge deck sections **12** and **14** formed of concrete or any other suitable material. Deck sections **12** and **14** are provided with edge channels **16** and **18** permanently anchored in a conventional manner to the respective deck sections and which have opposed vertical faces **20** and **22** (FIG. **2**) defining the lateral sides of the expansion groove in which expansion joint assembly **10** is installed. Joint assembly **10** extends across the width of the groove between faces **20** and **22** and for the full length of the groove transversely to the length of deck sections **12** and **14**. It should be understood that while the composite expansion joint assembly **10** of this invention is especially adapted for use in bridge constructions, it is not restricted to such use and has general utility in various expansion joint applications.

The upper flanges **24** of edge channels **16** and **18** are substantially flush with the upper surfaces of bridge deck sections **12** and **14** and the lower flanges **26** thereof are supported either directly on the lower horizontal portions of deck sections **12** and **14**, or on structural beams (not shown) extending longitudinally along the joint and supported on the lower portions of deck sections **12** and **14**, which provide the requisite strength for carrying the load on the joint.

A plurality of tubular structural members **30**, built up from suitable structural plates, are disposed in spaced pairs in an opposing, face-to-face relation along the lower portions of edge channels **16** and **18**. These tubular members **30** project laterally outwardly in opposite directions from edge channels **16** and **18** and are welded or otherwise fixedly secured thereto. Means are provided to close the spaces between the bottom wall of tubular members **30** and the upper surfaces of edge channel flange **26**, such means taking the form of metal filler bars **28** welded to member **30** and flanges **26** to provide a fluid tight seal therebetween. The inner open ends of opposed tubular members **30** are aligned with suitable openings **32** and **34** formed in the lower portions of edge channels **16** and **18** for receiving the opposite ends of support bars **36** as will presently become apparent.

Resiliently yieldable bearing blocks **38** are adhesively secured to the bottom walls of tubular members **30** adjacent their respective inner ends for slidably supporting the opposite ends of a support bar **36** extending be-

tween each pair of opposed tubular members **30.** A plurality of such support bars **36** are provided and extend transversely across the expansion groove in laterally spaced apart relation lengthwise of the groove, as shown in FIGS. **1** and **3.** These support bars **36** support the anticipated loading on the expansion joint and are of a size and spacing dictated by the particular application. At least two such support bars **36** are required, but any number thereof can be employed, as required or desired. While support bars **36** and their associated containers or tubular members **30** are shown in the illustrative embodiment of FIGS. **1** and **2** as being oriented in a direction at a slight angle to a plane normal to the longitudinal axis of the expansion joint, it should be understood that they can be oriented normal to the expansion joint, as desired.

Bearing blocks **38** preferably are formed of a resiliently yieldable elastomeric material, such as polyurethane for example, which is relatively unaffected by tensile and compressive stresses of long term duration. Moreover, the resiliently yieldable bearing blocks **38** are effective to reduce noise to a minimum during sliding movement of support bars **36** relative thereto without interfering with such relative sliding movement. As shown in FIG. **2,** bearing blocks **38** preferably are of uniform thickness throughout and can have a square or rectangular configuration in plan, as desired.

Upper bearing blocks **40** also are provided in opposed tubular members **30** and are adhesively secured to the top walls thereof for bearing engagement against the upper surface of support bar **36.** Bearing blocks **40** also are formed of a resiliently yieldable elastomeric material, such as polyurethane for example, and serve to limit vertical displacement of the end portion of support bar **36** relative to tubular members **30.** Elongated metal bars **42** are welded or otherwise fixedly secured to the top and bottom walls of each tubular member **30** and are spaced inwardly from the open end thereof for locating bearing blocks **38** and **40** in their proper positions. Blocks **38** and **40** not only provide bearing surfaces for the relatively slidable spacer bar **36,** but also provide a cushioning effect to thereby reduce noise otherwise occurring between metal bearing blocks and the spacer bar caused by vehicle traffic on deck sections **12** and **14.**

Each support bar **36** is formed of metal and preferably is solid throughout. Support bar **36** can take any outside dimensions, as desired, and preferably has a generally square or rectangular cross section. The bottom and top surfaces of support bar **36** bear against bearing blocks **38** and **40** and are movable relative thereto during expansion and contraction of the joint upon contraction and expansion of deck sections **12** and **14.** Support bar **36** has some limited vertical or upwardly tilting movement, as determined by the reseiliency of upper bearing blocks **40.**

A pair of seal locking channels **44** extend lengthwise of the expansion groove and have upper flanges **46** disposed in substantially the same plane as the upper flanges **24** of edge channel members **16** and **18** but extending in an opposite direction therefrom. Locking channels **44** also have lower flanges **48** located adjacent the upper edges of edge channel openings **32** and **34.**

At least two resiliently yieldable sealing elements **50** are disposed between seal locking channels **44** within flanges **46** and **48** thereof. Also, an I-beam member **52** is positioned within the space defined by locking channels **44** and interposed between sealing elements **50.** While only two sealing elements **50** and one I-beam member **52** are shown in the illustrative embodiment depicted in the drawings, it should be understood that any desired number of sealing elements **50** can be provided between locking channels **44** with an I-beam member **52** interposed between each pair of adjacent sealing elements **50.**

Sealing elements **50** comprise tubular members of resiliently yieldable elastomeric material each having an internal supporting truss structure of desired cross sectional configuration for resisting compressive forces tending to buckle the sealing member side walls and for generating reaction forces for maintaining the latter in pressure sealing engagement against their adjoining supporting surfaces. These sealing elements **50** are secured to the webs of edge channels **44** and I-beam member **52** by a suitable adhesive in a manner well known in the art. I-beam member **52** is provided with a vertical web **54** and upper horizontal flanges **56** and **58** extending laterally outwardly on opposite sides of web **54** in substantially the same horizontal plane as edge channel upper flanges **46.** Lower horizontal flanges **60** and **62** extend laterally outwardly from opposite sides of web **54** at the lower end thereof and are disposed in the same plane as edge channel lower flanges **48.** Flanges **56, 58, 60** and **62,** together with edge channel flanges **46** and **48,** receive and position sealing elements **50** in place.

It is a feature of this invention that the intermediate I-beam **52,** or each of a plurality of such beams **52** employed in a multiple unit assembly, is attached to each support bar **36** intersecting the same by an elastic connection, generally designated **64.** Connection **64** comprises a detachable, generally flat, strip-like body **66** preferably formed of a resiliently yieldable elastomeric material, such as polyurethane for example, interposed between the lower flanges **60, 62** of I-beam member **52** and the upper surface of support bar **36.**

Means are provided for securing body **66** in place, such means comprising a pair of brackets in the form of structural angles **68,** each comprising a first leg **70** welded or otherwise fixedly secured to one side of support bar **36** and a right angularly related leg **72** extending laterally outwardly from support bar **36.** An opening **74** is provided in each leg **72** for receiving a stud **76** therethrough, the stud **76** having a head **78** rigidly secured to the bottom of I-beam member **52** and a threaded shank **80** depending downwardly therefrom. Suitable openings **82,** in registry with openings **74,** are formed in body **66** for accommodating the upper ends of studs **76.** A resilient or elastic washer **84,** such as a plastic one formed of polyurethane for example, or a metal one of the Belleville type, is disposed about each stud shank **80** and bears against the underside of angle leg **72.** A second washer **86** is disposed about shank **80** behind washer **84** and a suitable nut **88** is threaded on shank **80** in bearing engagement against washer **84** to complete the assembly. The resiliency of wahsers **84** enables them to yield under the influence of stresses directed to the joint, adding to the overall resiliency of elastic connection **64.** Body **66** can be readily removed for repair or replacement, if necessary, in an expedient manner and a minimum of effort without damage to adjacent parts as otherwise occurs in rigid, welded connections for example.

The resiliently yieldable flat body **66** has a generally uniform thickness throughout and is of a substantially rectangular shape in plan, having a length approximating the sum of the support bar width and the lengths of the two opposed angle legs **72** and a width approximating the width of the I-beam member flanges **60** and **62** with which it is associated.

Elastic connection **64** provides a positive sound barrier interrupting the transmission of sound between I-beam member **52** and support bar **36,** thereby reducing noises therebetween caused by vehicle traffic and loadings imposed on the bridge decks. Body **66** serves as a sound attenuator or dissipator reducing the sonic energy transmitted through the expansion joint.

More importantly, the elastic coupling provided by resiliently yieldable body **66** offers flexibility in conjunction with sealing elements **50** to absorb stresses and strains imparted to the joint caused by relative vertical and rotational movements of bridge decks **12** and **14.** In a rigid connection for example, vertical displacement of one deck section relative to the other pivots the support bar about a transverse axis to effect corresponding canting or tilting movement of the I-beam member about its longitudinal axis causing the attached seals on the opposite sides thereof to be unduly laterally compressed and expanded, respectively. Whatever reaction forces are generated in the adjoining seals have no affect on the I-beam member because the latter responds only to support bar movement through its rigid attachment thereto. This can cause wide variation in the level of lateral compression of the seals and can stress and strain the same beyond their working limits, allowing the seals to open sufificiently to cause failure of the adhesive and vertical passage of water through the unit. In contrast, the elastic connection **64** of this invention enables I-beam member **52** to respond to the reaction forces generated in sealing elements **50** to resist lateral canting of member **52** occasioned by tilting movement of support bar **36** are a result of relative vertical displacement between deck sections **12** and **14.** Thus, I-beam member **52** reacts to a combination of forces, namely, those forces resulting from tilting movement of support bar **36** to can I-beam member **52** and those reaction forces generated in sealing elements **50** resulting from the compression forces applied thereto and which tend to counteract or resist such applied forces. As a result, the elastic coupling connecting I-beam member **52** to its associated support bar **36** enables sealing elements **50** to function as intended and to have a role in determining I-beam positioning, in addition to providing a resilient connection absorbing stresses imparted to the joint.

From the foregoing it is apparent that the objects of this invention have been fully accomplished. A simple and improved composite expansion joint assembly is provided for accommodating expansion and contraction of the deck sections due to thermal expansion and relative vertical displacement between the deck sections. The I-beam member laterally separating the sealing elements from each other is tied down to the support bar by an elastic connection, offering flexibility in I-beam positioning and utilizing the reaction forces generated in the sealing elements to assist in such positioning. As a result, the sealing elements are not unduly stressed or strained, thereby prolonging the useful life thereof. The elastic connection also reduces noise resulting from overhead traffic by interrupting the transmission of sound between the I-beam member and its supporting bar. Also, the detachable mounting of the elastic body defining the connection facilitates repair or replacement without damage to adjacent structural components.

One form of this invention having been disclosed in detail, it is to be understood that this has been done by way of illustration only.

I claim:

1. A composite expansion joint assembly comprising: edge members adapted to define the opposite sides of an expansion groove between deck sections; at least two resiliently yieldable elongated sealing elements in side-by-side relation; an elongated rigid structural member interposed between said sealing elements; support bars extending transversely of said rigid structural member and being connected thereto for supporting the same; means supporting said support bar adjacent the opposite ends thereof for sliding movement relative thereto adjacent at least one end thereof; and elastic, non-metallic, means for resiliently separating said rigid structural member from said support bars for limited movement relative thereto for absorbing noise, stress and strain therebetween and mounting means for connecting said support bar to said rigid structural member comprising, fastening means secured to a surface of said elongated rigid structural member and means fixidly secured to said support bar for receiving said fastening means wherein said rigid structural member is substantially anchored to said support bar.

2. A composite expansion joint assembly according to claim **1** wherein said elastic means comprises a generally flat body of a resiliently yieldable material interposed between said rigid structural member and said support bars.

3. A composite expansion joint assembly according to claim **2** where in said mounting means detachably mounts said resiliently yieldable body between said rigid structural member and said support bars.

4. A composite expansion joint assembly according to claim **3** wherein said detachable mounting means include angle members attached to the opposite sides of each of said support bars and fastening means extending through portions of said angle members and said body removably securing the same to said rigid structural member.

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