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[54] **COMPOSITE EXPANSION JOINT ASSEMBLY**

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[52] **U.S. Cl.** **404/69**, 14/16

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

[58] **Field of Search** 404/69, 47, 56, 64, 57; 14/16

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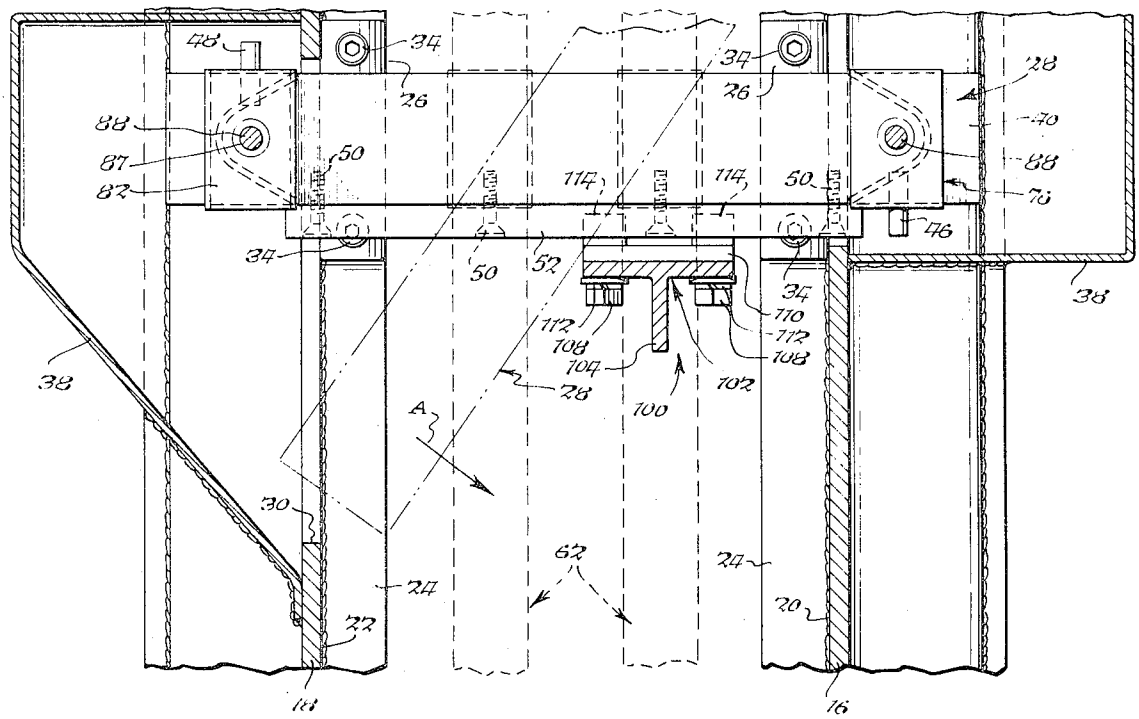
Primary Examiner—Nile C. Byers, Jr.

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[57] **ABSTRACT**

A composite expansion joint assembly of alternating elastic sealing elements and rigid structural members slidably mounted on transversely extending support bars by tie-down assemblies restricting vertical and rotational displacement of the structural members. Retainer assemblies limit vertical displacement of the supporting bars relative to their supports. Means, including leaf springs, equalize lateral movement of the sealing elements during compression and expansion thereof.

15 Claims, 8 Drawing Figures



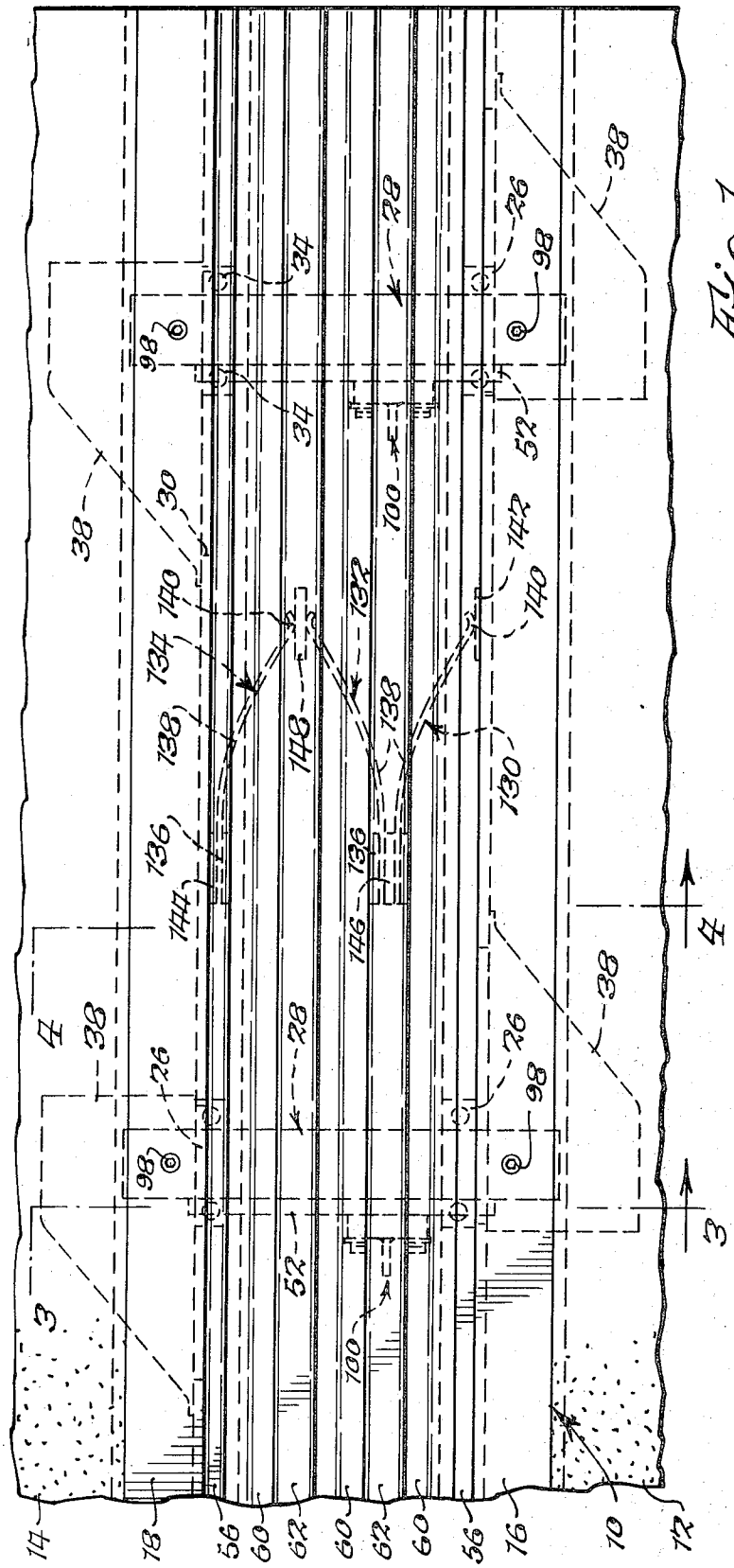

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Fig. 1.

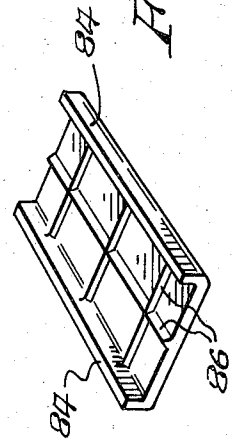

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Fig. 2.

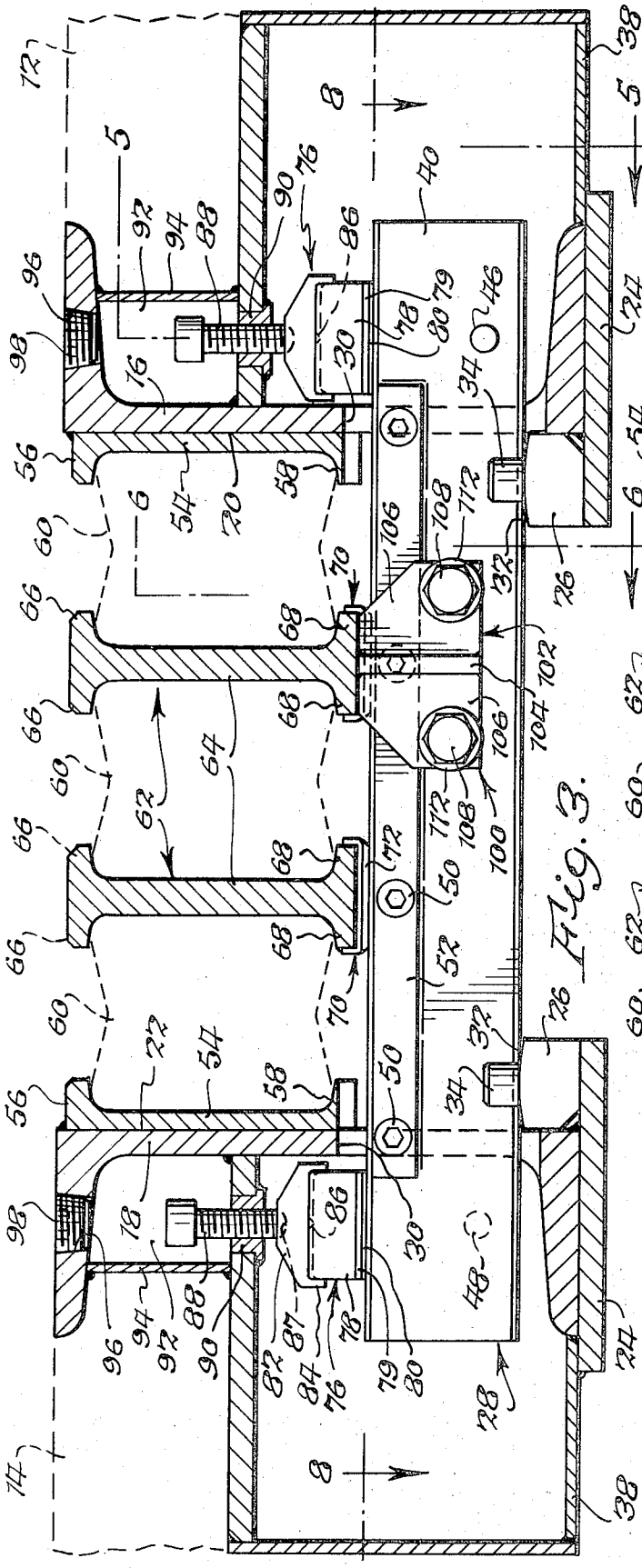


Fig. 3.

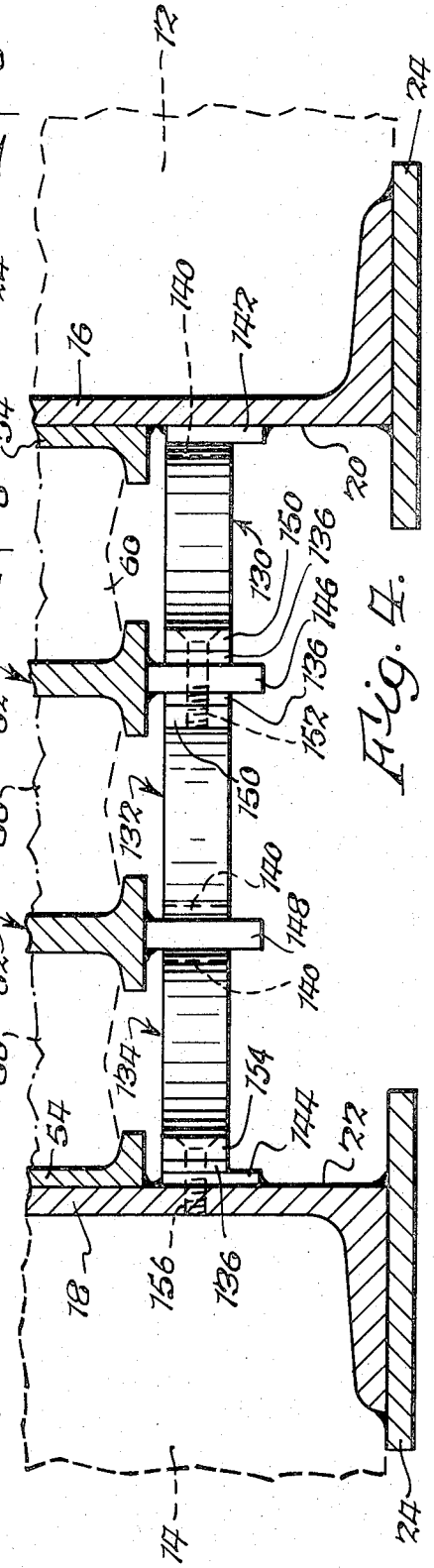


Fig. 4.

Fig. 5.

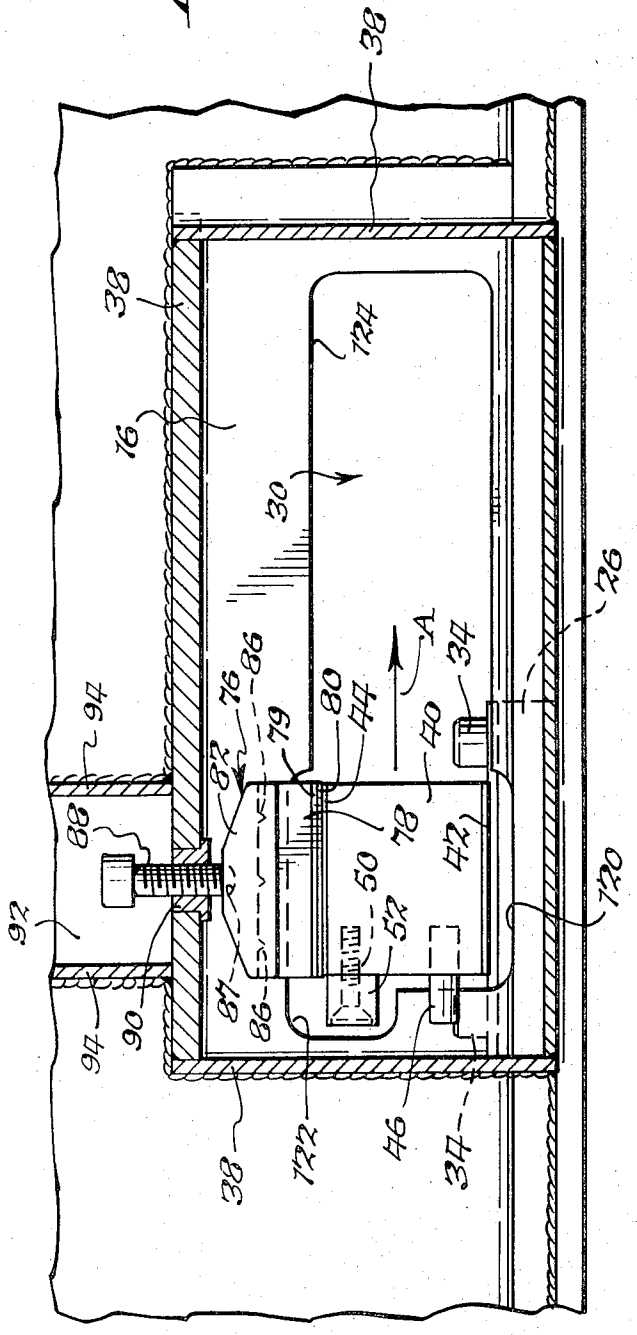


Fig. 7.

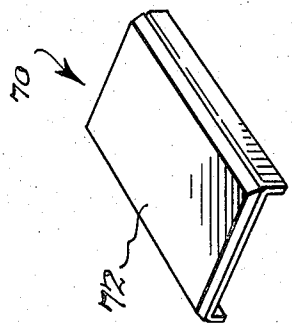
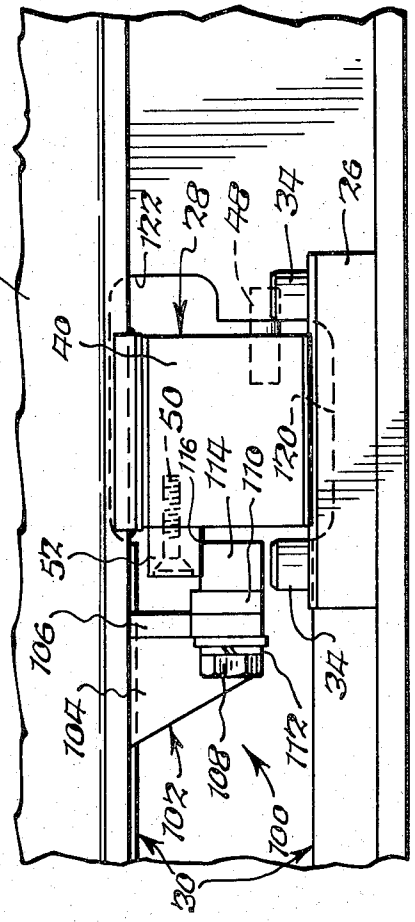


Fig. 6.



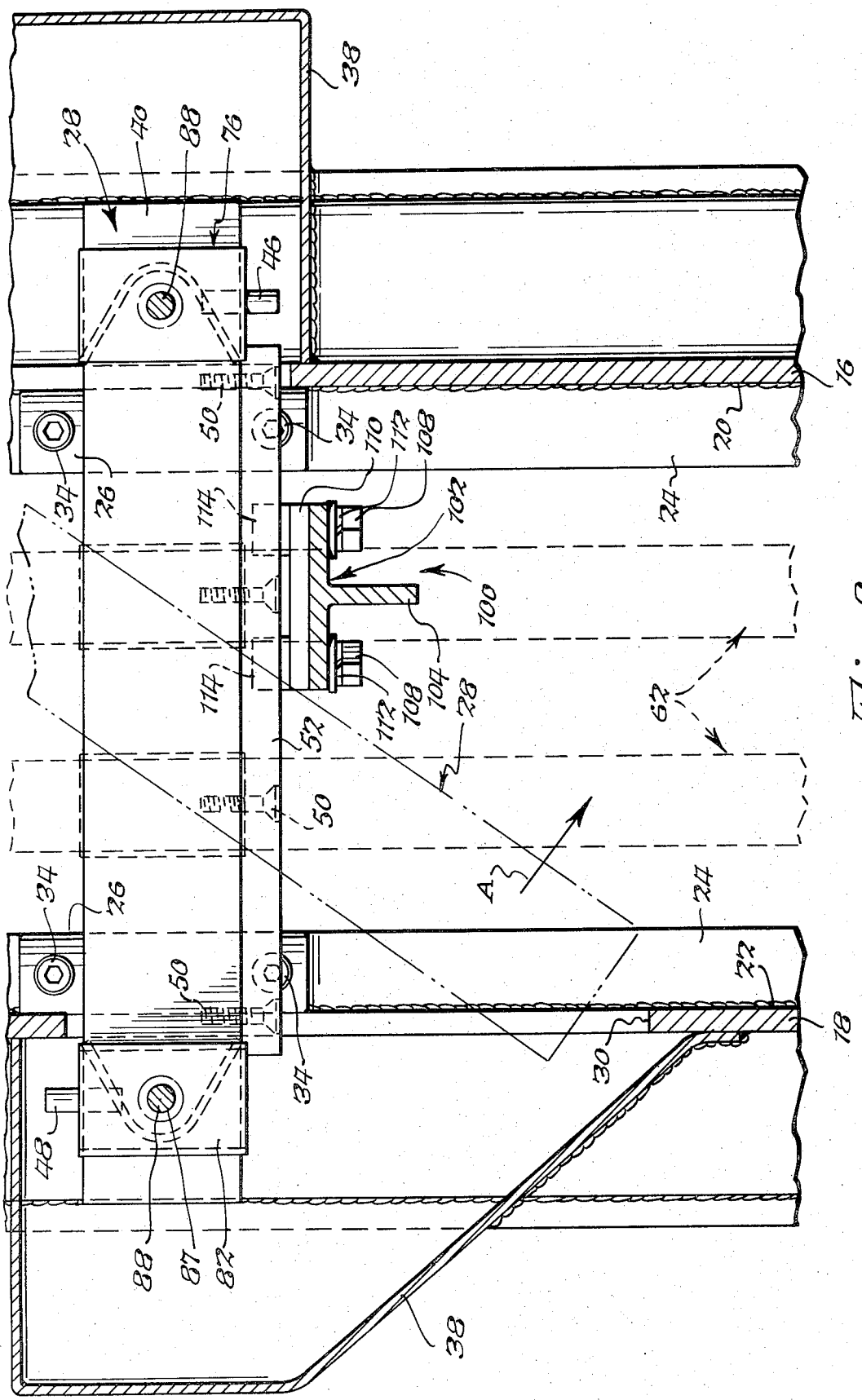

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Fig. 8.

COMPOSITE EXPANSION JOINT ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to expansion joints and, more particularly, to composite expansion joints of the type employed in bridge deck constructions for accommodating large movements between adjacent deck sections.

Composite expansion joints are conventionally used in those constructions, such as bridge structures and the like, wherein the relative movement between adjacent deck sections in response to temperature changes is too great to be accommodated by a single seal unit. These known composite expansion joints often consist of a series of laterally spaced elastic seals separated by rigid structural members or plates and extend lengthwise of the expansion groove between adjacent bridge deck sections. Such composite expansion joints usually are embedded in the adjoining bridge deck sections in such a manner that they are not readily removable, which poses a problem when repair and or replacement are indicated. As a result, large sections of the bridge deck adjacent to the expansion joint must be cut away to gain access to the expansion joint components embedded in the deck sections on opposite sides of the expansion groove.

Also, in many of these prior composite joint assemblies, the intermediate rigid members tend to shift vertically and sometimes tilt about the longitudinal axis thereof as traffic moves thereacross, causing distortion of the expansion joint assembly and creating undesirable noise. Often, excessive friction is generated upon relative sliding movement of the various components, causing wear thereof and creating additional noise. Also, these elastic seals are not always contracted and expanded uniformly, thereby causing unequal stresses therein resulting in premature failure.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved composite expansion joint assembly overcoming the above noted disadvantages.

It is another object of this invention to provide a composite expansion joint assembly having components which are readily removable for replacement or repair without completely removing the joint from the bridge deck.

It is still another object of the present invention to provide the foregoing composite expansion joint assembly with means for restraining vertical and tilting movement of various components forming a part of this assembly and to minimize friction between relatively movable components thereof for quietness in use.

It is a further object of this invention to provide the foregoing composite expansion joint assembly with means equalizing lateral movement of the expansion joint during contraction and expansion thereof.

The composite expansion joint assembly of this invention is characterized by the provision of a plurality of resiliently yieldable sealing elements adjacent ones of which are supported in laterally spaced relation by structural I-beams slidably mounted on transversely extending support bars having opposite end portions projecting axially beyond the sides of the expansion groove, the support bars being swung laterally into the confines of the groove for removal of the same from the groove for servicing or replacement. Restraining assemblies limit vertical displacement of the support bars relative to their supports and the I-beams relative to the support bars, respectively. Means are provided for equalizing the movement of the sealing elements during expansion and contraction thereof.

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 DRAWING

FIG. 1 is a plan view of a composite expansion joint assembly of indeterminate length, constructed in accordance with this invention, and shown disposed between a pair of bridge deck sections;

FIG. 2 is a perspective bottom plan view of a cap member used in conjunction with this invention;

FIG. 3 is a transverse sectional view, on an enlarged scale, taken about on line 3—3 of FIG. 1;

FIG. 4 is a transverse sectional view, on an enlarged scale, taken about on line 4—4 of FIG. 1;

FIG. 5 is a fragmentary, longitudinal sectional view, taken about on line 5—5 of FIG. 3;

FIG. 6 is a fragmentary, longitudinal sectional view, taken about on line 6—6 of FIG. 3;

FIG. 7 is a perspective view of a shoe element used in conjunction with this invention; and

FIG. 8 is a horizontal sectional view, taken about on line 8—8 of FIG. 3.

DETAILED DESCRIPTION OF AN ILLUSTRATED EMBODIMENT

Referring 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 shown installed in an expansion groove of substantial width between adjacent bridge deck slabs or sections **12** and **14** formed of reinforced concrete or any other suitable material, which can extend downwardly to the bottom of joint assembly **10**, or therebelow, as dictated by the specific construction. Bridge 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. 3) 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** for the full length of the groove transversely to the length of sections **12** and **14**.

The lower flanges of edge channels **16** and **18** are rigidly secured to horizontally extending plates **24** as by means of welding for example. A pair of bearing bars **26** are juxtaposed against the inner faces **20** and **22** of edge channels **16** and **18** within the groove defined therebetween for slidably supporting a support bar **28**, which extends transversely across the expansion groove and through specially configurated openings **30** (FIG. 5) provided in the lower portions of edge channels **16** and **18**. Bearing bars **26** extend transversely of support bar **28** and are provided with slightly arcuately-shaped upper bearing surfaces **32**. Bearing bars **26** are secured

at their opposite ends by means of bolts 34 threaded into plates 24. Bolts 34 are provided with enlarged heads which serve to limit lateral movement of support bar 28.

A plurality of support bars 28 are provided and extend transversely across the expansion groove in laterally spaced apart relation lengthwise of the groove. Bars 28 support the anticipated loading on the expansion joint and are of a size and spacing dictated by the particular application. The opposite ends of each support bar 28 are enclosed within protective casings 38 built up from structural plates and projecting outwardly away from the expansion groove.

Each support bar 28 comprises a generally flat-sided, solid body 40 having a bottom layer 42 of stainless steel for example, which slides on bearing bars 26. The upper surface of body 40 also is provided with a layer 44 of stainless steel to facilitate sliding movement of the I-beams thereon, as will hereinafter be described. These layers of stainless steel also offer resistance against corrosion to prolong the useful life of support bars 28. Support bars 28 are movable relative to bearing bars 26 during expansion and contraction of the joint upon contraction and expansion of bridge deck sections 12 and 14. A pair of studs 46 and 48 project laterally from the opposite sides of body 40 adjacent the opposite ends thereof and are engagable with the outer faces of edge channels 16 and 18 for limiting movement of support bar 28 in either axial direction. Rigidly secured to the upper end of support bar 28 along one side thereof by means of screw fasteners 50 is an elongated restraining bar 52 for a purpose to be explained.

A pair of seal locking channel members 54 extend length-wise of the expansion groove and have upper flanges 56 and lower flanges 58. The outer faces of channel members 54 are secured to vertical faces 20 and 22 of edge channels 16 and 18, respectively, as by means of welding for example.

A plurality of resiliently yieldable sealing elements 60 are disposed between seal locking channel members 54 with the outermost sealing elements 60 received and positioned between flanges 56 and 58 of channel members 54 as shown in FIG. 3. A plurality of I-beam members 62 also are positioned within the space defined by locking channels 54, there being an I-beam 62 interposed between each pair of adjacent sealing elements 60. While three such sealing elements 60 are shown in the illustrative embodiment depicted in FIG. 3, it should be understood that more or less than three sealing elements 60 can be utilized in the expansion joint of this invention, depending on the width of the expansion groove.

Sealing elements 60 comprise tubular members of elastomeric material each having an internal supporting truss structure which can take various configurations, and are secured to channel members 54 and the opposite sides of I-beam members 62 by a suitable adhesive, all in a manner well known in the art. Each I-beam member 62 is provided with a vertical web 64 and upper and lower flanges 66 and 68 extending laterally outwardly from opposite sides of web 64. These flanges 66 and 68 receive and position the intermediate sealing elements 60 in place.

I-beam members 62 are supported on bar 28 for lateral sliding movement relative thereto and the lower flanges 68 of I-beam members 62 are capped with bearing shoes 70 (FIGS. 3 and 7) of generally U-shaped configuration adapted to conform to the shape of flanges 68 and attached thereto. These shoes 70 are spaced longitudinally along I-beam members 62 at substantially equal distances corresponding to the distance between support bars 28 and are aligned therewith. The outer surface of the straight portion of each shoe 70 is provided with a layer of anti-friction, wear resistant material 72, such as filled polytetrafluoroethylene for example. The filled polytetrafluoroethylene layer 72 bearing against the stainless steel layer 44 on bar 28 reduces friction to a minimum, facilitating sliding movement between I-beams 62 and support bars 28 and dampening the noise therebetween. Of course, other suitable materials exhibiting similar anti-friction, wear resistant characteristics can be used in lieu of filled polytetrafluoroethylene, if desired.

Means are provided for adjustably restraining support bars 28 against vertical lifting or bouncing on bearing bars 26. Such means comprise a pair of composite bearing block assemblies, generally designated 76, mounted in casings 38 and supported on the top surfaces of each support bar 28 adjacent the opposite ends thereof. Each assembly 76 includes a generally rectangular block 78 of a resiliently yieldable material, such as neoprene for example, an intermediate layer 79 of rigid material, such as steel, and an outer layer 80 of anti-friction, wear resistant material, such as filled polytetrafluoroethylene for example, engagable with the stainless steel lining 44 on the upper surface of support bar 28. Layers 79 and 80 can be adhesively fixedly secured by any suitable laminating process. A cap 82 is mounted on block 78 and is provided with dependent flanges 84 overlying the upper side portions of block 78. The inner surface of cap 82 is provided with a grid arrangement (FIG. 2) comprised of intersecting ribs 86 having a generally V-shaped configuration in cross section (FIG. 5), adapted to be firmly impressed in the upper surface of block 78 for interlocking engagement therewith preventing relative sliding movement therebetween in a horizontal plane.

The upper surface of cap 82 is provided with a central, inwardly dished portion 87 adapted to receive the distal end of an adjustment screw 88 threaded through a bushing 90 mounted in the top wall of casing 38. Screw 88 is effective to adjust the bearing pressure on support bar 28. The exposed portion of screw 88 is protectively encased in a compartment 92 defined by the top wall of casing 38, the upper web portion and upper flange of the edge channel, and cover plates 94 fixedly secured at their opposite ends to the casing top wall and the edge channel upper flange. In order to gain access to the heads of screws 88, openings 96 are provided in the upper flanges of edge channels 16 and 18. Suitable plugs 98 are threaded into openings 96 to prevent dirt and other debris from entering into compartment 92. Thus, restraining assembly 76 bears against support bar 28 to hold such bars 28 firmly against their associated bearing bars 26 and restrict vertical lifting thereof or bouncing on bearing bars 26. The resiliently yieldable material of which block 78 is formed serves to dampen or cushion vertical movements of support bar 28 thereby reducing noise caused by vehicle traffic on the bridge deck. Also, the low friction characteristic of the filled polytetrafluoroethylene layer 80 facilitates sliding movement between support bar 28 and restraining block assembly 76.

I-beam members 62 are held against unrestrained bouncing on support bars 28. To this end, a plurality of tie-down assemblies, generally designated 100, are connected to the bottom surfaces of I-beam members 62 for restraining or limiting vertical displacement of I-beam members 62 relative to support bars 28. Such tie-down assemblies 100 are spaced longitudinally along I-beam members 62 in a staggered relation so that at least one assembly 100 is provided for cooperation with the restraining bar 52 of each support bar 28. As shown in FIGS. 3, 6 and 8, each tie-down assembly 100 comprises a bracket 102 welded or otherwise fixedly secured to the bottom surface of I-beam member 62 and having a web 104 and a pair of right angularly related plates 106 extending outwardly from web 104. A pair of bolts 108 extend through plates 106 and a plate 110 positioned against the inner faces of plates 106. Washers 112 are interposed between the bolt heads and the outer faces of plates 106 and nuts 114 are threaded on the distal ends of bolts 108. Nuts 114 are provided with upper, arcuately curved, bearing surfaces 116 for bearing engagement with the bottom surface of restraining bar 52. Thus, upward movement of I-beam member 62 is limited by the engagement of surfaces 116 of nuts 114 against the lower surface of restraining bar 52. Also, the engagement of bearing surfaces 116 with restraining bar 52 at spaced points therealong prevents tilting of I-beam member 62 about its longitudinal axis, which might otherwise occur as a result of forces caused by vehicle traffic and/or vehicle braking. A layer of low friction material can be provided on surfaces 116 or on the lower surface of restraining bar 52 to facilitate sliding movement between nuts 114 and restraining bar 52. Tie-down assemblies 100 severely limit vertical displacement of I-beam members 62 relative to support bars 28, without interfering with relative sliding therebetween. This, together with restraining block assemblies 76, prevents possible deterioration of support bars 28 and I-beams 62 consequent upon unrestrained bouncing, and virtually eliminates the problem of noise.

I-beam members 62 and support bars 28 of expansion joint assembly 10 are interconnected in a manner enabling them to be readily removed for repair or replacement or to gain access to bearing bars 26 for repair or replacement without removing or destroying a portion of bridge deck sections 12 and 14 adjacent the expansion groove defined between edge channels 16 and 18. However, since the opposite ends of support bar 28 extend axially outwardly beyond such expansion groove, provision is made for enabling support bars 28 to swing laterally about a vertical axis, as shown in FIG. 8, to bring the opposite ends thereof within the confines of the expansion groove defined between edge channels 16 and 18. To this end, each opening 30 in edge channel 16 is provided with a generally square-shaped section 120 (FIG. 5) for accommodating support bar 28 in its normal position of use perpendicularly to edge channels 16 and 18, an offset section 122 on one side of section 120 for accommodating restraining bar 52, and an elongated, rectangularly-shaped section 124 on the other side of section 120. Cut-out section 124 has a lesser depth than section 120 but slightly greater than the depth of support bar 28. It should be understood that sections 122 and 124 of the opposite opening 30 in edge channel 18 are oriented in opposite directions so that lateral swinging movement of one end of support bar 28 in the direction of arrow A in FIGS. 5 and 8 into section 124 causes the opposite end of bar 28 to swing in an opposite direction. These elongated sections 124 enable support bar 28 to be swung laterally about a vertical axis from the solid line position to the position shown in phantom in FIG. 8 until the opposite ends thereof clear edge channels 16 and 18 for confinement within the expansion joint defined by edge channels 16 and 18.

In order to remove support bars 28, the bearing pressures of restraining block assemblies 76 are relieved by threading screws 88 outwardly, access being had to screws 88 by removing plugs 98 from openings 96 in edge channels 16 and 18 for the insertion of an appropriate tool through such openings 96. The outermost sealing elements 60 are cut away to provide access to tie-down assemblies 100, bolts 34 and support bars 28. Tie-down assemblies 100 are disassembled by removing bolts 108 and nuts 114 to permit vertical displacement of I-beam members 62 out of the expansion groove. Alternatively, restraining bars 52 may be detached from support bars 28 to permit vertical displacement of I-beam members. At least one bolt 34 of each bearing bar 26, adjacent the opening section 124, is removed to free support bar 28 for lateral movement into such sections 124. Support bars 28 can then be swung laterally in the manner shown in FIG. 8 to clear edge channels 16 and 18 until they are wholly disposed within the expansion groove. Support bars 28 can then be completely removed from the expansion groove for repair or replacement without destroying the same and without cutting away or destroying portions of the adjacent bridge deck sections 12 and 14. Since bearing bars 26 are located within the confines of the expansion groove as defined by edge channels 16 and 18, they are accessible for repair or replacement. Upon replacement, support bars 28 are lowered into the expansion groove to the required level with their longitudinal axes disposed in a generally longitudinal direction. When bars 28 are aligned with openings 30, the former are swung laterally to insert the opposite ends thereof into the opposite opening sections 124 until properly positioned transversely of the expansion groove on bearing bars 26. Bolts 34 can then be threaded into bearing bars 26 for restricting lateral movement of the opposite ends of support bar 28 and screws 88 can be adjusted to urge bearing blocks 76 against the upper surfaces of support bars 28. I-beam members 62 are then lowered into place and tie-down assemblies 100 are assembled to position nuts 114 beneath restraining bar 52 in the manner shown in FIG. 6. New sealing elements 60 are then adhesively secured in place between I-beam members 62 and locking channels 54. Thus, support bars 28, bearing bars 26 and tie-down assemblies 100 can be easily removed from the expansion groove for repair or replacement without the customary block out and without severing or destroying any of the structural components.

It is another feature of this invention to provide means at longitudinally spaced intervals along expansion joint assembly 10 for equalizing the lateral movements of sealing elements 60 during compression and expansion thereof. To this end, a plurality of laterally aligned, heavy-duty leaf springs 130, 132 and 134, corresponding in number to the number of sealing elements 60 employed, are mounted below the later to transmit excessive pressures imparted to one of these

sealing elements **60** to the others thereof. As shown in FIG. **1**, each of these springs is provided with a flat end portion **136**, an elongated, intermediate curved portion **138**, and a reversely bent end portion **140**.

The means for mounting springs **130-134** include a pair of plates **142** and **144** welded or otherwise fixedly secured to vertical faces **20** and **22** of edge channels **16** and **18** below channel members **54**. I-beam members **62** are provided with depending plates **146** and **148**, respectively, rigidly secured to the bottom surfaces thereof. As shown in FIG. **1**, plates **144** and **146** are in lateral alignment and longitudinally offset from plates **142** and **148**, which also are in lateral alignment. The flat end portions **136** of springs **130** and **132** are secured to plate **146** by means of clamping members **150** secured together by means of a screw fastener **152**. The intermediate curved portions **138** of springs **130** and **132** diverge away from each other, as shown in FIG. **1**, and their respective end portions **140** bear against plates **142** and **148**. The flat end portion of spring **134** is secured to plate **144** by means of a clamping member **154** attached to plate **144** by a screw fastener **156**. The other end of spring **134** bears against plate **148**. These springs **130-134** insure uniform lateral movement of sealing elements **60** during expansion and contraction thereof. Excessive pressures, accompanied by excessive lateral movement, imparted to one of the sealing elements **60** will be transmitted through leaf springs **130–134** and I-beam members **62** to the other sealing elements **60** to equalize the pressure acting thereon, thereby providing uniform lateral movement throughout.

In use, sealing elements **60** of composite expansion joint assembly **10** are compressed and expanded to accommodate relative movement of bridge deck sections **12** and **14** toward and away from each other while maintaining pressure sealing engagement against channels **54** and I-beam members **62** to prevent the entry of moisture, dirt particles, deleterious chemicals and the like into the joint. During movement of deck sections **12** and **14** toward each other, I-beam members **62** move laterally toward each other with shoes **70** sliding on support bars **28**. Sealing elements **60** are compressed between locking channels **54** and adjacent I-beam members **62**, the joint movement of the composite expansion joint assembly of the present invention being the sum of the movements of sealing elements **60**. Since a typical sealing element in the illustrative embodiment can be compressed two inches under maximum compression, the total movement in the illustrated expansion joint assembly will be six inches. The number of sealing elements **60** and I-beam members **62** can of course vary as dictated by the total movement required for a specific application. Upon movement of deck sections **12** and **14** away from each other, the reverse action occurs. I-beam members **62** will move substantially uniformly due to the leaf spring arrangement. It will be appreciated that the expansion joint assembly is shown fully expanded in FIG. **3**.

From the foregoing, it is apparent that the present invention fully accomplishes its intended objects and provides an improved composite expansion joint assembly having components capable of being wholly removed from an expansion groove even though certain of the elements forming a part of the assembly project beyond the expansion groove side walls in their normal positions of use. The retaining block assemblies **76** and the tie-down assemblies **100** limit vertical displacement of the I-beam supporting bars **28** and the I-beams **62** relative to such bars **28**, respectively, to insure a relatively level deck surface and to minimize noise resulting from overhead traffic loads. Moreover, tie-down assemblies **100** serve to prevent tilting or rocking of I-beams **62** about their longitudinal axes as a result of impact loads caused by vehicle braking and the like. Heavy-duty leaf springs are utilized to provide uniform lateral movement of the sealing elements during the compression and expansion thereof.

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

We claim:

1. A composite expansion joint assembly comprising: a pair of edge members adapted to define the opposite sides of an expansion groove between bridge deck sections; said edge members having oppositely directed elongated openings extending lengthwise of said edge members; laterally spaced support bars extending transversely of said groove with the opposite ends of said bars extending through said openings beyond the opposite sides of said groove; a plurality of elongated resiliently yieldable sealing elements in a side-by-side relation extending longitudinally of said groove; elongated rigid structural members interposed between said sealing elements and extending lengthwise thereof; said structural members being supported on said support bars for lateral sliding movement relative thereto; releasable means restricting lateral movement of said support bars within said openings whereby removal of said restricting means frees the opposite ends of said support bars for lateral arcuate movement through said elongated openings to position said support bars wholly within said expansion groove for convenient removal from said expansion groove.

2. A composite expansion joint assembly according to claim **1** including means supporting said support bars for sliding movement relative thereto.

3. A composite expansion joint assembly according to claim **2** wherein said means supporting said support bars include paired bearing bars releasably mounted within said expansion groove adjacent said edge member openings for supporting the opposite ends of one support bar.

4. A composite expansion joint assembly according to claim **3** wherein said restricting means comprises a pair of spaced bolts threaded into each of said bearing bars on opposite sides of said support bar limiting lateral movement of said support bar and maintaining said bearing bar in place.

5. A composite expansion joint assembly according to claim **1** including casings adjacent said edge member openings extending outwardly from said edge members into said deck sections for receiving the opposite ends of said support bars.

6. A composite expansion joint assembly according to claim **1** including means outwardly of said opposite sides of said groove engagable with said support bars for limiting vertical displacement thereof.

7. A composite expansion joint assembly according to claim **6** wherein each of said limiting means comprises a resiliently yieldable block having an outer layer of low friction material bearing against a support bar and means for adjusting the bearing pressure of said block against said support bar.

8. A composite expansion joint assembly according to claim 1 including means on said structural members and said support bars coacting for limiting vertical displacement of the former relative to the latter.

9. A composite expansion joint assembly according to claim 8 wherein said limiting means includes restraining means secured to a structural member and engagable with a separable bar secured to the side of a support bar.

10. A composite expansion joint assembly according to claim 9 wherein said restraining means comprises a bracket depending from said one structural member; said bracket having fastening means disposed beneath said separable bar and engagable therewith.

11. A composite expansion joint assembly according to claim 1 including means for equalizing the lateral movement of said structural members and said sealing elements.

12. A composite expansion joint assembly according to claim 11 wherein said equalizing means comprises a plurality of leaf springs; and means mounting each of said leaf springs below each of said sealing elements.

13. A composite expansion joint assembly according to claim 12 wherein said mounting means comprises plates mounted to said edge members and to the lower ends of said structural members in spaced relation to said support bars; each of said springs spanning the space between adjacent plates and rigidly secured at one end thereof to one of said adjacent plates and bearing against the other of said adjacent plates.

14. A composite expansion joint assembly according to claim 1 wherein said each of said support bars is provided with a lining facilitating sliding movement of said rigid structural members thereon.

15. A composite expansion joint assembly according to claim 14 wherein said rigid structural members are provided with shoes having a layer of low friction material thereon engagable with said support bar lining further facilitating relative sliding movement therebetween.

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