United States Patent

Kolm et al.

[15] **3,650,184**

[45] **Mar. 21, 1972**

[54] CURB EXPANSION JOINT

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[22] Filed: **Aug. 18, 1970**

[21] Appl. No.: **64,712**

[52] **U.S. Cl.** **94/18,** 94/31

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

[58] **Field of Search** 94/31, 18; 14/16

[56] **References Cited**

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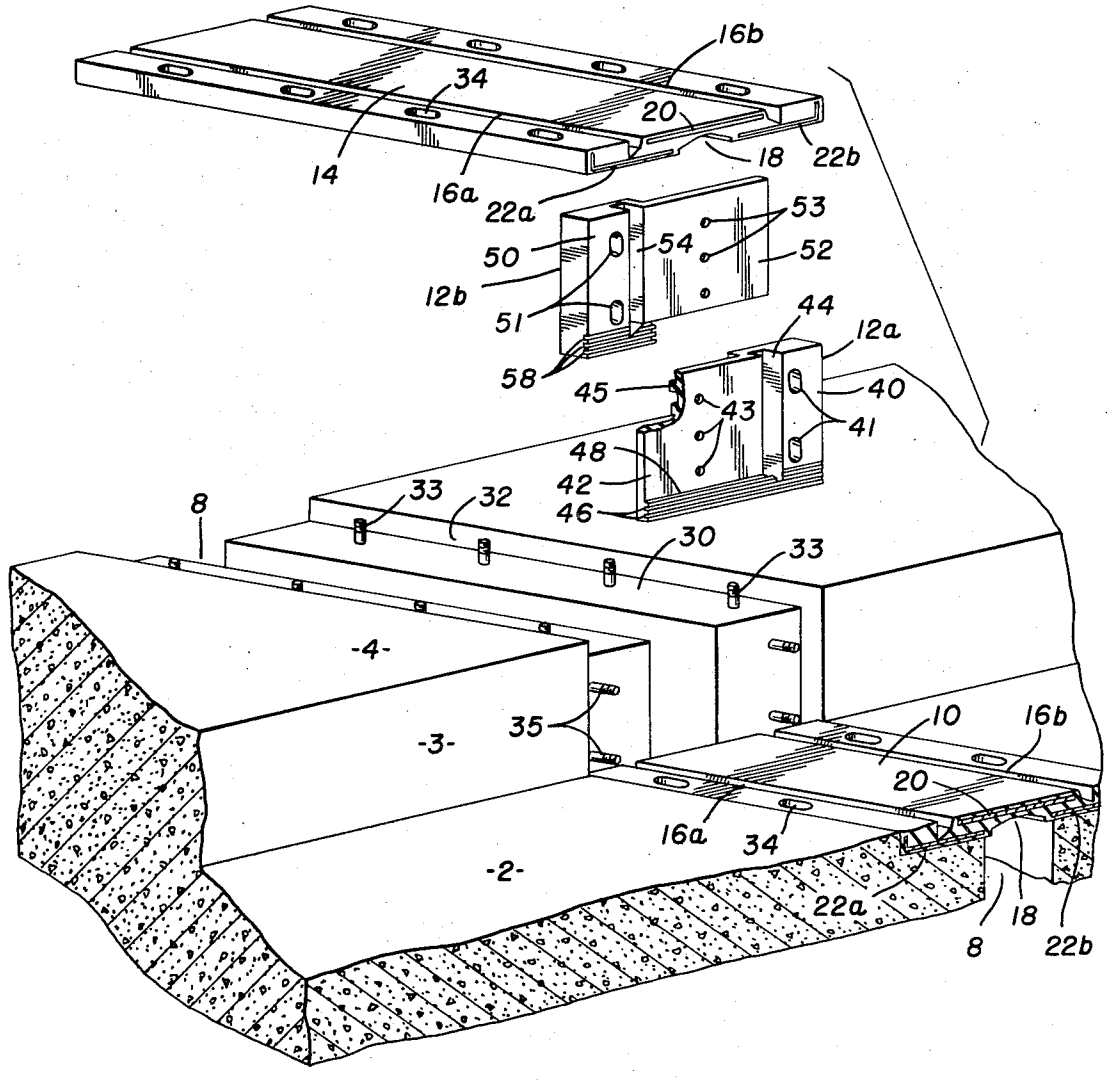
[57] **ABSTRACT**

A curb expansion joint is used in combination with a shear-type elastomeric expansion joint to seal the expansion slot extending across a bridge or similar structure. The expansion slot allows for relative movement of the various components of the bridge caused by thermal expansion and contraction. The curb expansion joint is typically fabricated in two sections. Each section comprises a first portion which is fastened to the curb by studs or the like, and a second portion comprising a wing extending laterally outwardly from the first portion in overlapping engagement with the wing portion of the other section. The two sections are bolted or otherwise secured together, and when assembled, contain vertical expansion grooves which permit the assembled joint to expand and contract jointly with the bridge deck expansion joint. A suitable cement can be used to form a waterproof seal between the bridge expansion joint and the curb expansion joint.

13 Claims, 9 Drawing Figures



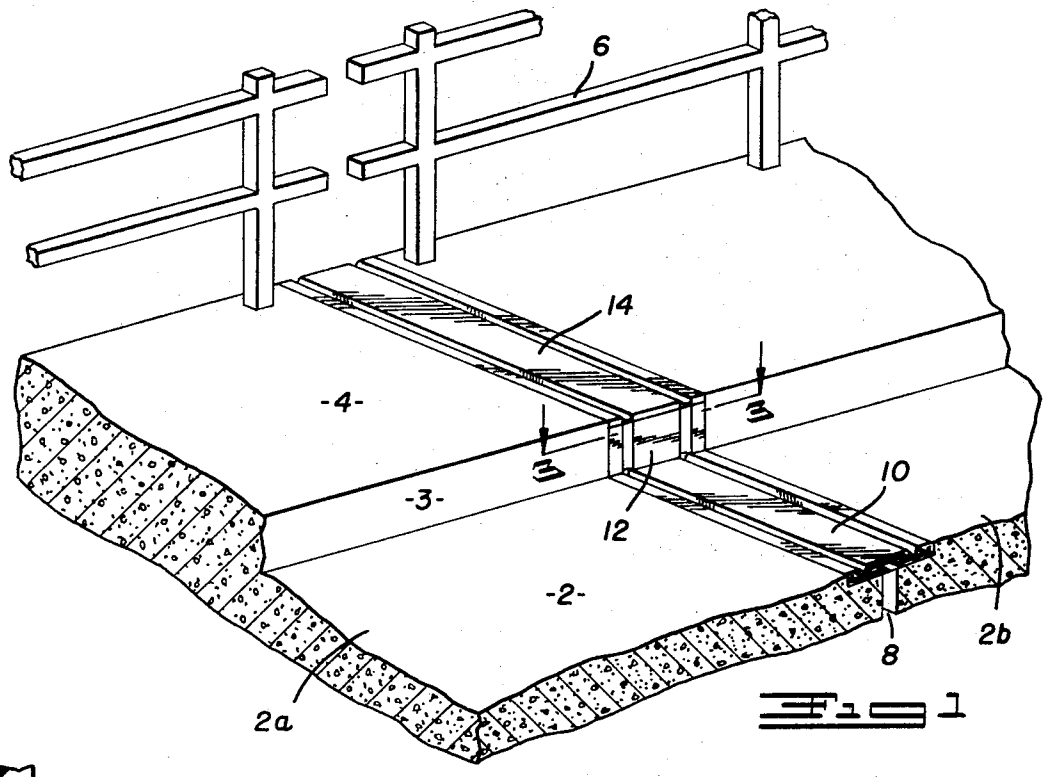


Fig 1

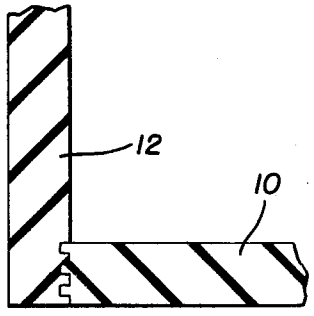


Fig 5a

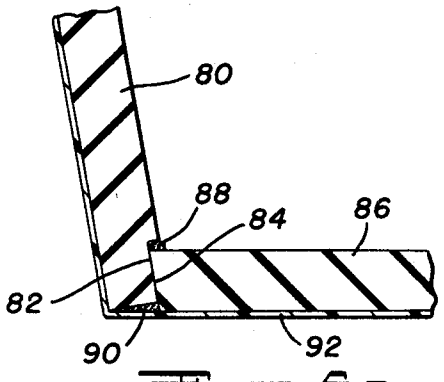


Fig 5c

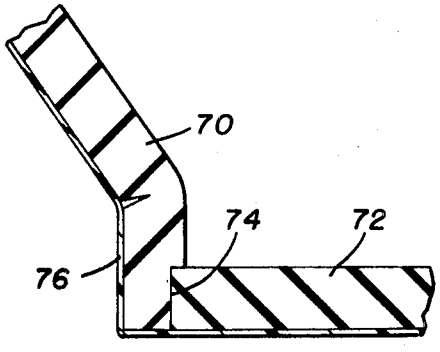


Fig 5b

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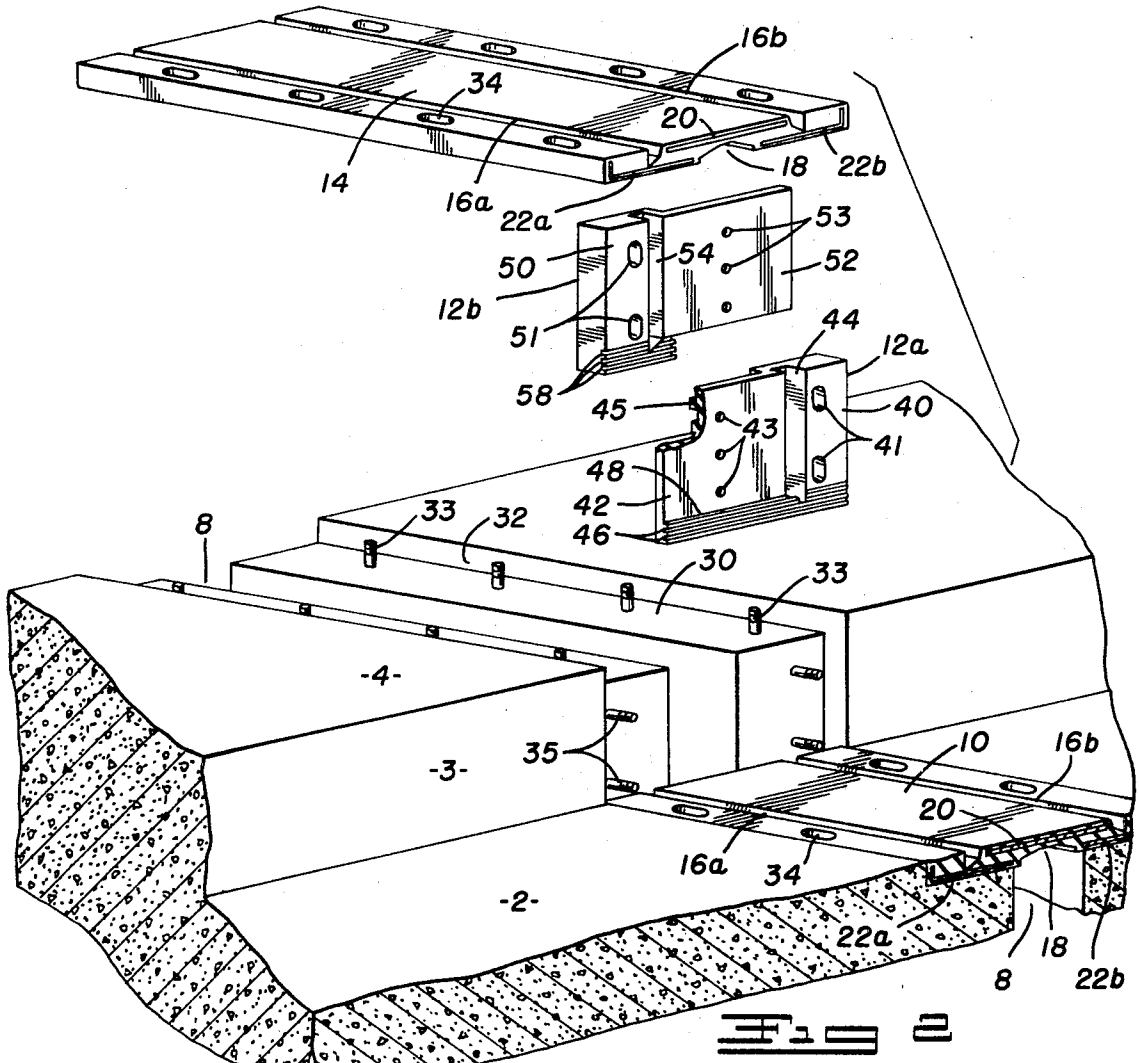

Fig 2

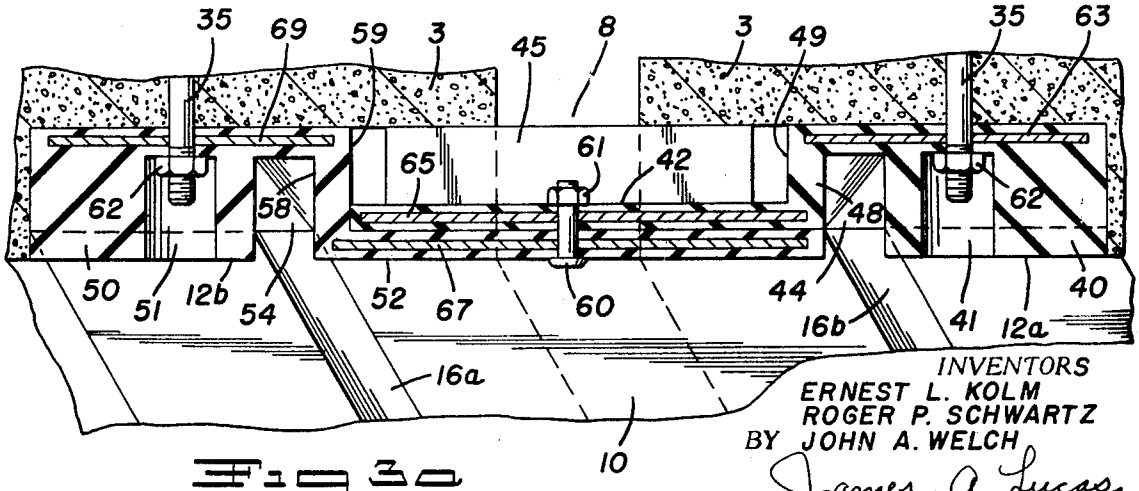

Fig 3

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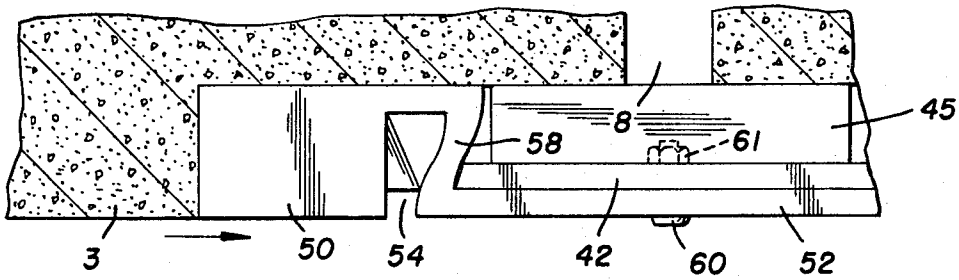

Fig 3b

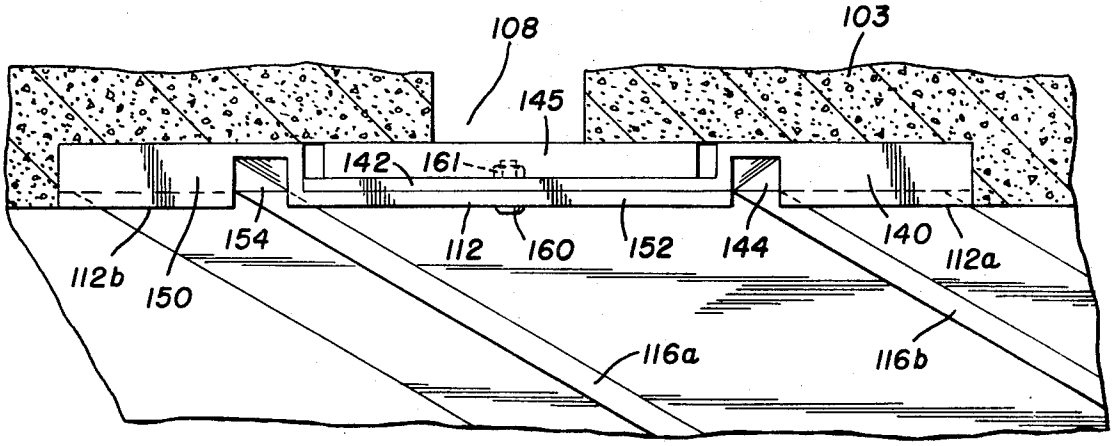

Fig 6

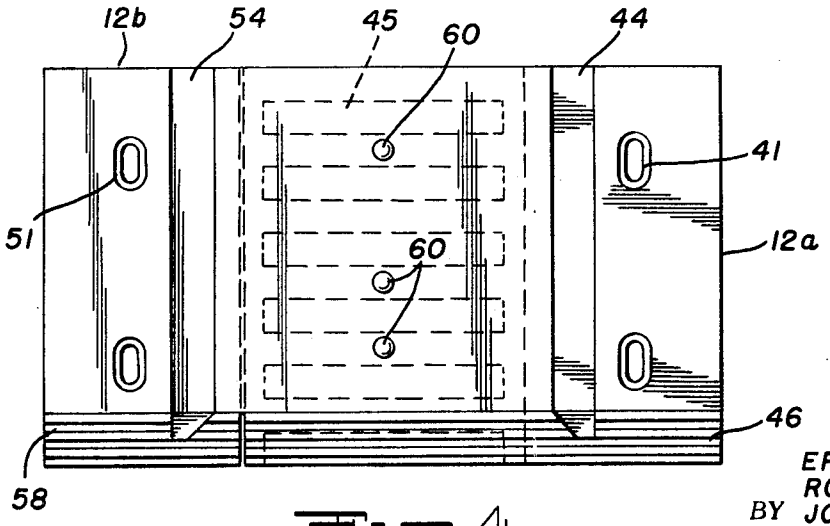

Fig 4

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CURB EXPANSION JOINT

BACKGROUND OF THE INVENTION

This invention relates to a joint of the type used to span an expansion slot in roadways and bridges. More particularly, it relates to a joint that can be used in an expansion slot along the curb and gutter of a roadway or a bridge deck surface.

In highway and building tower expansion and contraction of the various structural components occurs because of fluctuations in ambient temperatures. The highway or building is provided with expansion slots or spaces to allow for these dimensional changes. In a highway, these slots are located between adjacent sections of concrete and permit these sections to expand longitudinally without buckling or otherwise causing damage to the concrete. In bridge construction, the thermal expansion and contraction is much more pronounced because the sections of the bridge deck are supported on reinforced concrete beams which also expand and contract. The slots typically extend at an angle of between about 20° and 90° with respect to the longitudinal direction of the bridge deck and allow for expansion and contraction of as much as several inches in that direction.

Many attempts have been made to seal the expansion slot of a bridge deck to prevent rain water and other contaminants from contacting and corroding or otherwise damaging the bridge structure beneath the deck. These have included the use of various types of elastomeric expansion joints. A recent joint of this type is shown and described in U.S. Pat. No. Re. 26,733 owned by the assignee of the present invention. This type of joint is generally rectangular in shape and contains one expansion more expansion grooves in the top surface and one or more reinforcing plates embedded in the elastomer parallel to this top surface. Because of the location of the expansion grooves and the reinforcing plates in the joint, the movement of the joint is not uniform across its entire width during compression or expansion but instead is concentrated in the region of each expansion groove. The joint is generally molded in sections which are placed end-to-end in the slot along the entire length thereof across the bridge deck and are cemented together to form a waterproof joint. The edge of each section of the bridge deck along the slot is relieved to provide shoulders on which the joint rests and to which it is secured by bolts or studs. The bridge deck is generally crowned whereupon rain water and the like flows from the middle of the roadway toward the curb and into the gutter and thence to a drain.

At the curb it has been common practice to use a portion of the roadway expansion joint as a curb and gutter joint and to use a cement or other material to form a watertight connection between that joint and the roadway joint. This works satisfactorily where the expansion slot extends across the road at right angles, i.e., 90° to the curb. However, where the slot extends across a roadway at an angle of less than 90°, it is necessary to cut or otherwise trim one end of the normally rectangular roadway expansion joint at an appropriate skew angle so that it will fit against the curb. As this angle increases it becomes increasingly difficult to use a portion of the same expansion joint as a curb joint and to form and maintain a watertight seal between the two.

BRIEF DESCRIPTION OF THE INVENTION

One object of the present invention is an improved expansion joint for use as a curb joint at the sides or a roadway or bridge deck.

Another object is a curb expansion joint which is used with and forms a permanent seal with a sliding plate or a shear-type expansion joint, irrespective of the angle at which the expansion slot extends across the roadway.

Yet another object is a reinforced rubber expansion joint comprising one or more sections wherein each section is adapted to be secured to a curb on one side of an expansion slot and comprises a curb fastening portion and a wing portion separated by an expansion groove.

Still another object is a curb expansion joint comprising a pair of sections, which are secured together and which can be readily adjusted in width to fit any expansion slot.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a bridge deck showing an expansion slot, extending across the roadway and curb, with an expansion joint spanning the slot;

FIG. **2** is a partial perspective exploded view of FIG. **1** showing details of the curb expansion joint;

FIG. **3***a* is a cross-sectional view of the curb joint taken through lines 3—3 of FIG. **1** with a roadway expansion joint forming an angle of about 60° with respect to the curb;

FIG. **3***b* is a partial cross-sectional view showing the same joint in compression;

FIG. **4** is a front elevation view of the curb joint of FIG. **1**;

FIGS. **5***a*, *b* and *c* are enlarged cross sections of different variations of a seal formed between the curb joint and the roadway joint; and

FIG. **6** is a simplified cross-sectional view similar to FIG. **3***a* wherein the expansion slot forms an angle of about 30° with respect to the curb.

DETAILED DESCRIPTION OF THE INVENTION

In more detail, FIG. **1** shows a portion of a bridge deck composed of a roadway **2** and a walkway **4**, separated from one another by a curb **3**, of concrete or other durable material. A guard rail **6** is securely anchored to the bridge deck. The entire deck is normally supported on reinforced beams which are carried on movable bearings mounted on cross members atop concrete piers or the like. The deck is formed in sections **2***a* and **2***b* separated by an expansion slot **8** extending entirely across the structure. Disposed along the surface of the roadway and walkway, over the slot **8**, is a roadway expansion joint **10**, which joins a vertical curb joint **12** which in turn abuts joint **14** extending across the walkway. Generally, this latter joint is similar to that used in the roadway but can be of lightweight construction inasmuch as it need not support heavy vehicular traffic.

Further details of the curb joint and the method of anchoring the joint to the bridge deck are shown in FIG. **2** in which it is noted that the roadway joint **10** and the walkway joint **14** are generally of similar construction. Each has a pair of deformation grooves **16***a* and **16***b* extending along its exposed surface and a deformation groove **18** extending along the bottom surface. A rigid reinforcing plate **20** is located between the deformation grooves **16***a* and **16***b* and generally spans the expansion slot **8**. In addition to the spanning plate **20**, each joint has two L-shaped reinforcing plates **22***a*, **22***b* under each of the deformation grooves **16***a*, **16***b*. The sections of bridge deck on either side of the expansion slot **8** are provided with a platform **30** and a shoulder **32**. A plurality of studs **33** are anchored in the concrete and project up from the platform, spaced to cooperate with holes **34** molded or otherwise formed in the expansion joint. As the sections **2***a* and **2***b* of the bridge deck expand, the width of slot **8** decreases and the shoulders **32** and studs **33** exert a compressive force against the sides of the expansion joint. This compressive force causes the rubber of the expansion joint to deform in shear resulting in closing of the deformation grooves **16***a* and **16***b* on top of the joint and groove **18** on the bottom of the joint. Sheartype expansion joints of this type are sold by The General Tire & Rubber Company as Transflex Model 200 and Model 250 and are described in U.S. Pat. Re. 26,733 owned by the assignee of the present invention. Because of the arrangement of the plates and grooves in the expansion joint, changes in width of the joint result in shear movement of the rubber in the region of the exposed deformation grooves with very little movement occurring at the top surface of the joint along the spanning plate **20**.

The curb joint **12** is composed of two sections, **12***a*, **12***b* adapted to be bolted together. First section **12***a* comprises a

relatively thick curb fastener portion **40** and a relatively thin wing portion **42** extending out from the fastener portion and separated therefrom by a vertical, generally channel shaped, expansion groove **44**. On the front of the section are a number of grooves **46** extending horizontally along the bottom thereof. A shoulder **48** is formed at the juncture of the wing portion **42** and the grooves **46**. The fastener portion **40** contains two slots **41** to receive studs **35** for attaching the section to the curb. The wing portion has three holes **43** by which the two sections of the joint are bolted together. A plurality of horizontal spacer ribs **45** are located on the backside of the wing portion.

The second section **12*b*** of the curb joint is likewise composed of a relatively thick curb fastener portion **50** and a wing portion **52** separated by a vertical expansion groove. The exposed front surface of the two portions **50** and **52** are coplanar. Three horizontal grooves **58** extend part way across the front section and are adapted to abut and cooperate with the corresponding grooves **46** of the first section **12a** when the two are bolted together. Slots **51** are adapted to receive the studs **35** embedded in the curb, and bolt holes **53** are arranged to coincide with bolt holes **43** to permit the two sections of the plate to be secured together. When the two sections are mated together, the wing portion **52** of section **12*b*** rests on the shoulder **48** of the first section **12*a***.

FIG. **3*a*** shows a cross-sectional view of a curb joint in a typical installation such as that shown in FIG. **1**. For clarity the same numbers will be used to designate the parts of FIG. **3** as were used in FIGS. **1** and **2**.

Each section of the rubber joint is strengthened by suitable reinforcing means such as thin metal plates. The first section **12*a*** is shown with one plate **63** embedded in the curb fastener portion, located so that the studs **35** pass therethrough, and a spanner plate **65** embedded in the wing portion **42**. These plates are separated by a thin elastomeric flexing member **49** comprising one side of the groove **44**. The second section **12*b*** likewise contains one plate **67** located in the wing portion and the other plate **69** embedded in the fastener portion, separated by flexing member **58**. Further support is provided by the spacer ribs **45** on the back of the back section, which ribs serve to maintain the spacing between the platform **30** of the concrete recesses and the overlapping wing portions. tower

The exposed surface of wing portion **52** of section **12**b is coplanar with the front of the fastener portion **50**, while the front surface of the wing portion **42** of section **12**a is displaced from the front surface of fastener portion **40** an amount equal to the thickness of wing portion **52**. Thus, when the two sections are bolted together the two fastener portions **40**, **50** and wing **52** all cooperate to present a generally coplanar exposed surface. The combined thickness of the two wing portions normally will not exceed 40 to 50 percent of the thickness of the fastener portions and should be no more than is necessary to provide adequate structural strength.

The two sections **12*a***, **12*b*** of the joint are secured together by nuts threaded onto bolts **60** passing through holes **43** and **53** in the respective sections. The joint assembly is secured to the curb by nuts **62** threaded on the studs **35** embedded in the curb **3**. When the two sections are assembled together, the wing portion **42** of section **12*a*** terminates along flexing member **58** of section **12**a while the wing portion **52** of section **12*b*** terminates along the edge of the groove **44** of section **12*a***.

As further shown in FIG. **3**a, the curb joint abuts a roadway expansion joint **10** of the type previously described, which is located in a recess of an expansion slot extending across the roadway at an angle of about 60° with respect to the curb **3**. The end of the roadway joint **10** is cut at a 30° angle so as to be parallel with the curb. As previously mentioned, the bridge deck can be built so that the expansion slot extends across the deck at right angles to the curb, or at an angle as small as about 20° with respect to the slot. As this angle decreases, the roadway joint must be cut at an increasingly larger skew angle to fit against the curb. Accordingly, the distance between two grooves **16*a*** and **16*b*** at the curb increases. To insure that the curb joint expands the same amount and in the same manner as the roadway joint, it is important that the expansion grooves **44** and **54** of the curb expansion joint are in alignment with the grooves **16*a*** and **16*b*** of the roadway joint. Thus, as the distance along the skew angle between the grooves of the roadway joint increases, the two sections of the curb joint are adjusted to increase the spacing between the two grooves of the curb joint, thus insuring that the expansion characteristics of the two joints coincide. This adjustment can be achieved in any one of several different ways. For instance, the two sections of the curb joint can be molded so that when they are bolted together the grooves are sufficiently far apart to permit utilization of the joint with the roadway joint at the maximum predictable skew angle. If the curb joint is then used in an installation where the skew angle is less than the maximum, i.e., where the distance between the grooves of the roadway is less than maximum, the total width of the curb joint can be reduced by cutting off or otherwise shortening the length of the wing portion of each section before assembly. The joint is typically produced by compression molding. If desired, mold inserts can be used to produce molded sections having a number of different wing widths from which sections of the correct size may be selected. If the sections are to be cut to size, the holes **43** and **53** are not normally molded into the wings but instead are drilled after the nominal width of the curb joint has been determined. If, however, the sections are to be molded to the correct size, these holes may be molded into the parts. Alternatively, horizontal slots may be molded into the wings thereby permitting adjustment in the width of the joint during assembly.

FIG. **3*b*** shows the same joint in compression, as where thermal expansion of the sections of curb **3** causes a substantial reduction in the width of the expansion slot **8**. As previously mentioned, forces of compression acting against the roadway joint cause the rubber in this joint to deform in shear resulting in a substantial reduction in the width of the two grooves but with very little reduction of the distance between the grooves. At the same time, the embedded studs **35** exert a force against plates **63** and **69** in the direction parallel to their planar surfaces along the bottom of the grooves **44** and **54**. This causes the bottom of each flexing member to move toward one another in shear. Concurrently therewith, reinforcing plates (**65**, **67** not shown) prevent the top of each flexing member from moving toward each other, and this causes each groove **54** to close as shown. Preferably as much of the flexing member as possible should be free to move in shear. Thus, the wing portions should be thin so that they do not restrict the movement of the flexing member.

FIG. **4** is an elevational view of the curb joint showing the location of the bolt holes, vertical expansion grooves and horizontal sealing grooves. Using the same reference numbers as before it can be seen that the joint comprises a first section **12*a*** and a second section **12*b*** secured together by bolts **60** extending through aligned holes in the two sections. The joint contains two expansion grooves **44**, **54**. The two sections cooperate to provide continuous horizontal grooves **46**, **58** along the bottom of the joint. As seen in FIG. **5*a***, these grooves cooperate with similar grooves in the end of the roadway expansion joint to form a seal. A suitable cement such as an epoxy resin or a polyurethane cement is used to insure the formation of a watertight seal between the two joints at the gutter. It can be readily seen that if the curb and roadway joints deform differently during expansion and contraction of the expansion slot, differential movement will occur along the tongue and groove joint resulting in severe strain and eventual failure of the waterproof seal. The present invention prevents this failure when the novel curb joint is used with a shear joint of the type herein previously described.

FIGS. **5*b*** and **5*c*** show other variations in the type of seal that can be used between the curb joint and the roadway joint.

FIG. **5*b*** shows the use of a lap joint to form a tight seal between the curb joint **70** and roadway joint **72**. A suitable cement is applied to the contacting surfaces **74** to join them

securely together. A plastic or thin rubber strip **76** is adhered to the underside of the two joints to further insure a watertight seal.

The joint of FIG. **5***c* is adapted for use when the curb joint is used along a curb that is not vertical and does not form a right angle with the roadway. The curb joint **80** is provided with an undercut **82**. The end **84** of the roadway joint **86** is chamfered so as to form a surface that is parallel with the curb. A suitable cement **88** is used to form a seal along the exposed surface of the two joints. Additional cement **90** is used along the bottom surface. To further insure a watertight seal, a strip of film such as polyethylene **92** is wrapped around the corner of the two joints and is cemented thereto.

FIG. **6** shows the use of a joint in an installation wherein the expansion slot forms an angle of about 30° with respect to the curb. Because of this low angle, one end of the roadway joint must be cut or otherwise formed at a correspondingly high 60° skew angle, thereby increasing the length of the side, and the space between the expansion grooves **116***a* and **116***b*. With this type of installation, the curb joint is assembled so that there is a correspondingly greater distance between its expansion grooves **144**, **154** as shown.

Other variations can be made in the curb joint of the present invention without departing from the concept herein described and claimed. For example, the shape, size and depth of the expansion grooves in each section of the joint can be changed without materially affecting the operation of the joint. Instead of nuts and bolts, other means such as rivets may be used to secure the two sections of the joint together and to fasten the joint to the concrete. The number, size and location of the reinforcing plates can be varied to match the expansion characteristics of the curb joint with those of the roadway joint.

The novel curb joint can be used with other types of roadway expansion joints by adjusting the size, number and location of the grooves so that the movement of the curb joint closely duplicates the contraction and expansion movement of the roadway joint. For example, if the roadway joint contains three or four expansion grooves rather than two as shown in the drawings, the curb joint may be modified to include a larger number of sections or grooves, or may be otherwise altered so that the areas of movement of the curb joint will coincide with the opening and closing of the grooves of the roadway joint. Conversely, if the roadway joint does not have any exposed expansion grooves but instead contains internal voids or pockets to permit the joint to contract and expand the curb joint can be modified to include a similar pattern of movement. Furthermore, it is possible to use one section of the curb joint with a sliding plate roadway joint in which event the wing portion of the curb joint is secured to the curb rather than to another section of the joint.

As previously mentioned, spacer ribs are used to space the center portion of the joint from the curb. The number and spacing of these ribs is not particularly critical. The purpose of the ribs is to prevent movement of the joint inwardly toward the curb when the roadway expansion joint is expanded or compressed. Outward movement is prevented by abutment with the roadway expansion joint. These ribs should not interfere with the shear movement of the flexing members. They should be sufficiently thick to maintain the coplanar relationship of the exposed surface of the one wing portion with that of the two fastener portions.

As shown, the various reinforcing plates in the curb joint are generally thin and planar. Although typically made out of steel, these plates can be made from any other metallic or nonmetallic material that is capable of performing the intended function. Furthermore, changes can be made in the shape, size, number and location of these plates while remaining within the purview of the present invention. For example, the plates **63** and **69** can be L-shaped rather than planar, with one leg extending along the shoulder **32** of the recess in the curb and the other along platform **30**.

The joint is preferably fabricated by molding in a compression mold. The reinforcing plates are positioned in their proper location in the mold, and during the molding and subsequent curing become embedded in and bonded to the elastomer. Alternatively, the plates may be bonded to the exposed surface of the rubber after molding. The joint is preferably compounded from an elastomer such as chloroprene or natural rubber formulated to have good resistance to environmental conditions such as sunlight and heat and chemicals such as gasoline and oil. The cured rubber should have a Durometer hardness of between about **40** and **60** and should have good abrasion resistance and flexural strength.

Although this novel curb joint has been described for use in bridges and roadways, it can likewise be utilized in other structures such as runways, parking lots and garages and the like.

We claim:

1. A generally rectangular curb joint for use in spanning an expansion slot at the ends of a roadway expansion joint extending across a bridge or the like, said curb joint comprising a first section and a second section, each section composed of a curb fastener portion and a wing portion, the curb fastener portion of the first section adapted to be joined to the curb on one side of the slot and the curb fastener portion of the second section adapted to be joined to the curb on the other side of the slot, each of the wing portions extending laterally outwardly from the curb section, in overlapping engagement with the other wing portion, each section containing a vertically extending expansion groove between the fastener portion and the wing portion.

2. The joint of claim **1** wherein each expansion groove is generally channel shaped and one side of the channel comprises a flexing member which is joined to the wing portion at the top of the groove.

3. The joint of claim **1** further including a tongue and groove joint extending along the front surface at the bottom thereof adapted to engage a corresponding tongue and groove joint on the end of a roadway expansion joint.

4. An elastomeric expansion joint adapted to be used at the curb of a bridge deck over and expansion gap, said joint having an exposed planar surface containing a pair of vertical expansion grooves, said joint comprising:

A. a first section having
   1. a fastener portion for attachment to the curb on one side of the gap and having an exposed generally planar surface,
   2. a generally rectangular wing extending laterally from the fastener portion, with one surface thereof coplanar with the exposed planar surface of the fastener portion, and
   3. a vertical groove between the fastener portion and the wing;

B. a second section comprising
   1. a fastener portion for attachment to the curb on the other side of the gap having an exposed planar surface
   2. a generally rectangular wing extending laterally from the fastener portion parallel to the exposed surface and offset therefrom a distance equal to the thickness of the wing of the first section, and forming a lap joint therewith, and
   3. a vertical groove between the fastener portion and the wing; and

C. means for joining the two wings together.

5. The joint of claim **4** wherein the groove of each section is generally channel shaped, and one wall of the groove comprises a flexing member joined to one end of the respective wing.

6. The joint of claim **5** wherein each wing has at least one reinforcing plate embedded therein.

7. The assembled joint according to claim **6** wherein the wing of the second section abuts the flexing member of the first section and the wing of the first section terminates at the edge of the groove of the second section.

8. The joint according to claim 7 assembled by fasteners passing through the wings.

9. The joint of claim 8 further including a plurality of spacer ribs on the wing of the second section extending rearwardly thereof.

10. The joint of claim 9 wherein each fastener portion is adapted to receive studs and nuts for attachment to the curb.

11. The joint of claim 10 in which the fastener portion of each section is reinforced by plate means in the area of attachment to the curb.

12. In combination with the curb of a bridge deck wherein the deck is divided into sections separated from one another by expansion gaps extending thereacross at an angle to the curb, each section along the gap provided with a recess and an elastomeric expansion joint anchored in the recess and containing longitudinally extending grooves in the upper surface thereof separated by rigid reinforcement means, which grooves become narrower and wider upon expansion and contraction of the gap, the improvement comprising an elastomeric curb expansion joint spanning the gap at the curb and composed of two sections bolted together, each section comprising a fastener portion and a reinforced wing portion Separated by a vertical expansion groove the fastener portion of each respective section anchored to one side of the gap and the wing portion overlapping the corresponding wing portion of the other section, the distance between the two vertical grooves corresponding to the spacing between the grooves of the expansion joint anchored to the bridge deck at the curb.

13. The combination of claim 12 wherein the distance between the vertical grooves is determined by the width of the overlapping wing portions.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,650,184 Dated March 21, 1972

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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the printed specification, between lines 11 and 12, the following should be inserted: Assignee The General Tire & Rubber Company, a corporation of Ohio.

Column 1, lines 31 and 32, the phrase "one expansion more expansion" should read -- one or more expansion --.

Column 3, line 43, the phrase "portions. tower" should read -- portions. --.

Signed and sealed this 24th day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents