April 7, 1970 R. L. PARE 3,504,597

ROADBED JOINT SEAL

Filed May 13, 1969 2 Sheets-Sheet 1

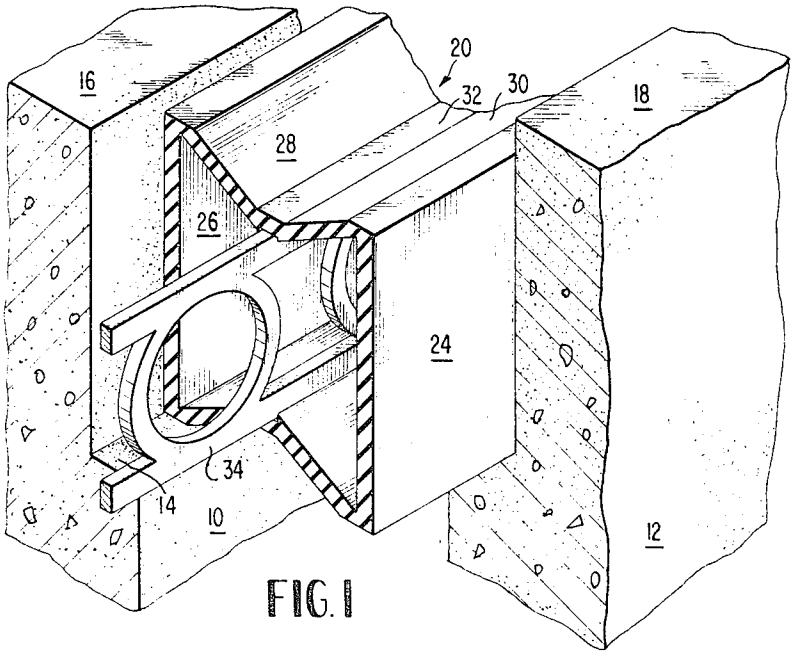


FIG. 1

FIG. 2

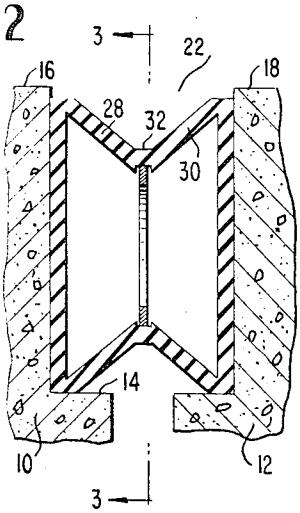
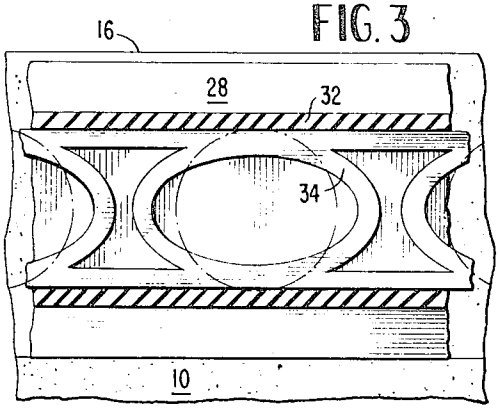


FIG. 3



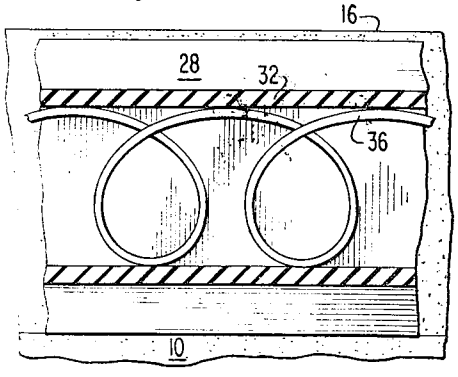


FIG. 4

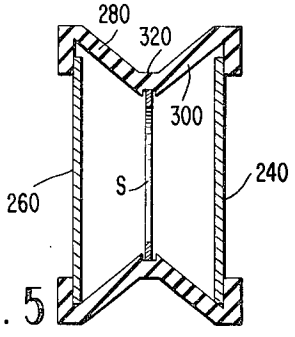


FIG. 5

ROADBED JOINT SEAL

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FIG. 6

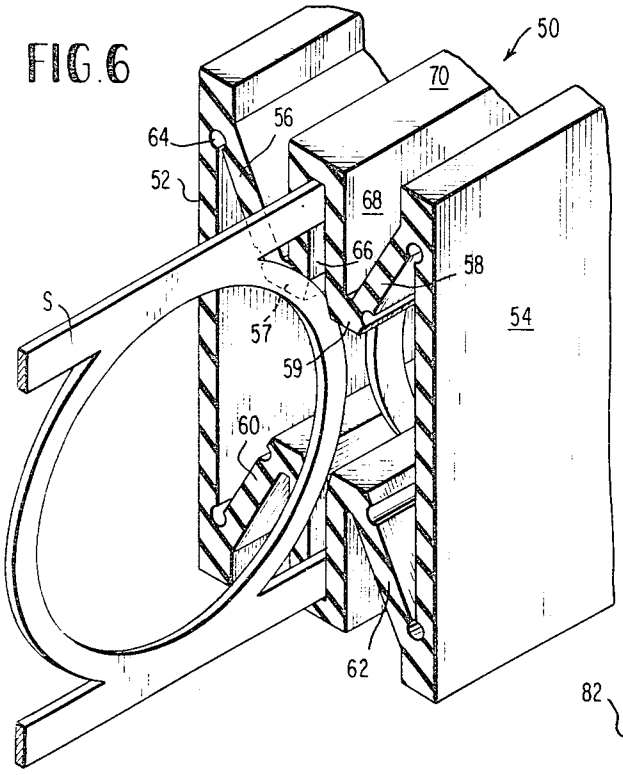


FIG. 8

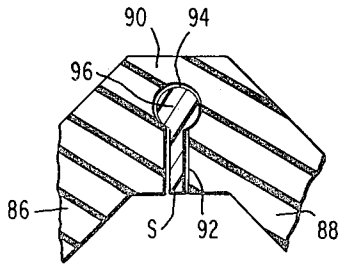
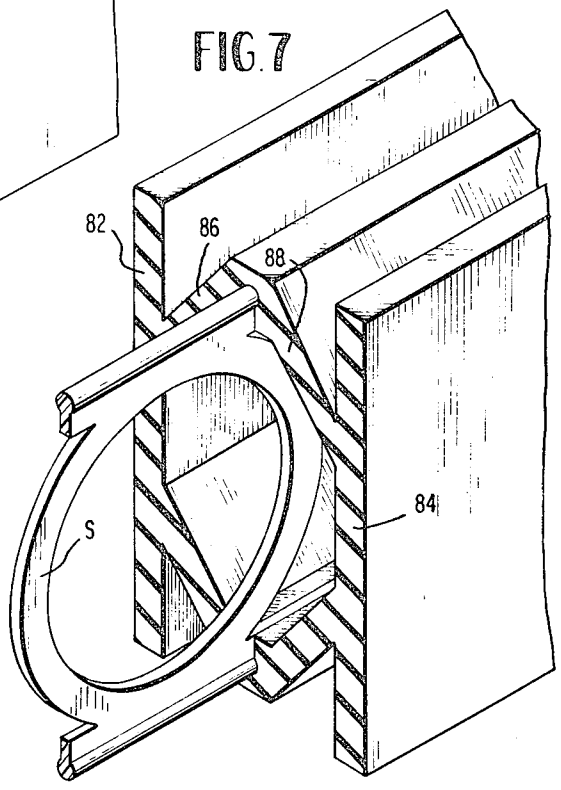


FIG. 7



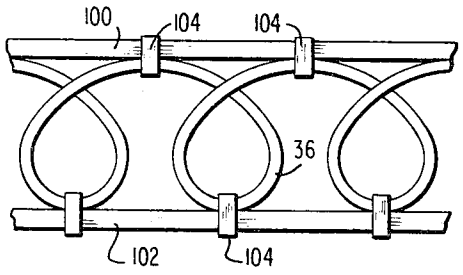


FIG. 9

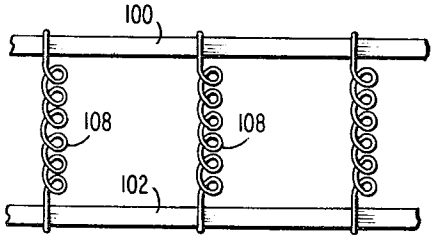


FIG. 10

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ROADBED JOINT SEAL

Robert L. Pare, 27 Chiswick Road,
Edgewood, R.I. 02905

Continuation-in-part of application Ser. No. 647,503, June 20, 1967. This application May 13, 1969, Ser. No. 837,982

Int. Cl. E01c 11/10

U.S. Cl. 94—18 10 Claims

ABSTRACT OF THE DISCLOSURE

An elastomer joint seal for modular, slab-like construction elements such as pavements, roads, wall panels and the like. The seal is generally elongated and is placed between facing edges of adjacent modular elements. A spring element runs longitudinally of the seal and is vertically disposed. By virtue of the internal geometry of the elastomer, movement of the modular elements in relation to each other results in deformation of the spring element in a vertical plane. The plane of the spring is thus at right angles to the horizontal plane of modular elements.

This is a continuation-in-part application based on my co-pending application Ser. No. 647,503, filed June 20, 1967, and now abandoned.

This invention relates to a seal for use in joints for pavements, roadbeds, wall panels, and the like, wherein the pavement or road is composed of a plurality of modular sections or units each subject to expansion and contraction as occasioned by changes in ambient temperature or moisture.

In the construction of a pavement or roadbed, the top surface is defined by a plurality of aligned and generally rectangular concrete slabs, either formed in situ or prefabricated, placed on a base or substrate. Spaces are left between the aligned slabs to allow for individual expansion and contraction of the slabs due to ambient temperature variations. Thus, the resultant pavement or roadbed is defined by a substrate or base upon which are placed a plurality of generally rectangular slabs, with gaps between the slabs running generally transverse to the longitudinal axis of the pavement or roadbed. It will be apparent that the gaps are entirely necessary in the case of expansion of the slabs, otherwise, buckling or fracture of the individual slabs would accompany temperature increases and failure or the slabs in tension would accompany temperature decreases.

This art has long been aware of various sealing elements between such modular units. Here, the worker in this art is referred to the following U.S. patents as exemplary of sealing elements between pavement of roadbed sections—3,324,775; 3,276,336; 3,179,026; 2,315,588 and 2,071,299. In the latter two United States patents an elastomeric element, such as rubber, is provided with an internal cavity and a sheet metal spring element placed within the cavity. The function of the internal spring element is to produce forces laterally of the gap between the slabs, i.e., in a direction parallel to the longitudinal axis of the roadbed, for the purpose of taking up increases in the width of the gap which would accompany contraction of the individual modular units. The deformation of the seal which is defined by the elastomer and the spring element further accommodates a narrowing of the gap upon expansion of the individual modular elements. In the first three mentioned United States patents, an internal spring element is absent and the required resiliency of the sealing member is provided by the properties of the elastomer member itself. Thus, deformation of the sealing element is made possible by cavities therein.

While prior art structures such as those above listed have probably been at least partially satisfactory, certain disadvantages have been observed such as the formation of a depression or of a bulge in the top portion which is substantially coplanar with the pavement or roadbed surface. In the case of a seal entirely formed of an elastomer, the struts are folded inward on one another causing severe bending in the walls in the compressed position, thus developing compression set and reduction in recovery to the expanded position. Continued exposure of the seal to the atmosphere further inhibits the ability of the seal to expand during periods of low temperatures.

Prior art structures, such as those listed as 2,315,588 and 2,071,299, overcome the difficulty of permanent set in the elastomer by the insertion of a spring element made of a material which has a defined yield point, such as metal. However, they suffer from having the deformation of the spring equivalent to the displacement of the modular elements. By virtue of the construction of the subject invention, the deformation or strain undergone by the spring is only a fractional part of the displacement of the modular elements. By such a fractional reduction in spring movement, the concomitant stresses arising in the spring are reduced. Such reduction, in turn, allows a greater movement of the modular elements without the stress approaching the yield point of the spring. Still further, recalling the law of Young that stress is linearly proportional to strain, by diminishing the range of strain of the spring element, the sealing force of the seal is maintained more constant.

According to the practice of the present invention, a joint which seals the gap between adjacent modular sections in a roadbed or pavement is provided which employs an elastomer in combination with an internal spring element. A spring element having a substantially well defined plane and also generally elongated is inserted within the elastomer seal. The plane of the spring is at right angles to the horizontal surface of the roadbed and is accordingly vertical. The top and bottom parallel edges of the spring element are contacted by portions of the elastomer. The upper and the lower portions of the elastomer member are either concaved toward the interior of the seal and movement of the modular roadbed sections towards each other makes the top and bottom portions still further concave thus compressing the spring element in its own vertical plane, or, convexed away from the interior of the seal and movement of the modular roadbed sections towards each other makes the top and bottom portions still further convex, thus tensioning the spring element in its own vertical plane.

In the drawings:

FIGURE 1 is a perspective and partially broken view of the joint seal of this invention according to a first embodiment;

FIGURE 2 is a cross-sectional view, looking longitudinally of the joint, of the joint shown in FIG. 1;

FIGURE 3 is a view taken along line 3—3 of FIG. 2;

FIGURE 4 is a view similar to FIG. 3 and illustrating a second embodiment of the invention;

FIGURE 5 is a view similar to FIG. 3 and illustrating another embodiment;

FIGURE 6 is a view similar to FIG. 1 and illustrates an embodiment;

FIGURE 7 is a view similar to FIG. 1 and illustrates still another embodiment, this embodiment employing a tension spring as opposed to a compression spring;

FIGURE 8 is a magnified view of the indicated portion of FIG. 7;

FIGURE 9 is a view showing another form of a spring adapted for use in the seal of FIG. 7;

FIGURE 10 is a view showing yet another form of spring adapted for use in the seal of FIG. 7.

Turning now to FIG. 1 of the drawings, the numerals **10** and **12** denote adjacent and facing modular roadbed sections of concrete or the like. Each section is formed with a ledge **14** such as illustrated on the section **10** and each with a top load-bearing portion **16** or **18**. It will be understood that the surfaces **16** and **18** constitute adjacent surfaces which may either define a primary load bearing surface or may be covered with a suitable cover or secondary layer such as asphalt.

The numeral **20** denotes generally an elastomer seal element according to this invention and is in the form of an elongated and hollow element having two generally opposite and parallel facing sides, each of which is substantially planar, and having top and bottom portions which are generally concave, i.e., with depressed portions relative to the adjacent side portions. The element **20** extends completely across the gap between the adjacent modular sections **10** and **12**, the gap being denoted by the numeral **22** in FIG. 2.

The number **20** is composed of an elastomeric substance and comprises generally opposite and planar facing walls **24** and **26** which abut modular concrete sections **12** and **10**. The top of the elongated seal element **20** is generally concave and comprises a first dowardly sloping planar portion **28**, a second similar portion **30**, and a mid-portion **32**. In cross-section, as illustrated at FIG. 2, the portions **28** and **30** may be regarded as leg portions which are joined at **32**, and to the outer parallel faces **24** and **26** at their remote edges. For reasons of symmetry, the lower counterparts of **28**, **30** and **32** would bear the same numbering. The element **34** denotes a spring or resilient element having parallel top and bottom edges, these edges being received in notches or grooves interiorly of portions **32**. The element **34** is illustrated in the form of an integral piece of plastic having a plurality of circular portions, spaced from each other, with the top and bottom portions of each circle being integrally connected by the top and bottom edges.

In practice, the depth below the top surfaces **16** and **18** to which the top concave portion of seal **20** is positioned may be varied. In certain applications it is desirable to position the top seal surface below the surfaces **16** and **18**, as herein illustrated, and place a deformable member over the seal to present a surface flush with the surfaces **16** and **18**. Alternatively, the seal element may be positioned as illustrated with no member over its top surface. A still further alternative is to position the top of the seal **20** substantially flush with the top portion of the roadbed.

It will be apparent from a consideration of FIGS. 1 and 2 that upon expansion of the individual modular elements which define the roadbed, the ends of adjacent sections such as **10** and **12** will move toward each other. This will result in a movement of the juncture of leg portions **28** and **30** toward each other in a vertical plane, against the top and bottom edges of spring element **34**. Such movement will be resisted by the elastic properties of the individual circles or arcs although their elasticity is such as to permit deformation. As greatly exaggerated at FIG. 3 of the drawings, the circular portions of the spring element now become elliptical under the influence of compressive forces applied to the sides **24** and **26** of the seal. Conversely, it will be apparent that upon contraction of the ends of the modular elements **10** and **12** due to lower ambient temperatures for example, the resilient element **34** will expand in a vertical plane and move the top and bottom edges away from each other, with corresponding movement away from each other of the apices **32** of the legs **28** and **30**. Thus, the spring element **34** will maintain the sides **24** and **26** of the seal in surface contact with the facing walls of sections **10** and **12** under variations in ambient temperature.

In FIG. 4 of the drawings an embodiment is illustrated which differs in the form of the resilient element

employed. A continuous wire spring, formed either of metal or plastic, is denoted by the numeral **36** and is defined by a plurality of generally parallel whorls. It will be apparent that the spring **36** is positioned and functions in the same manner as that described with reference to spring element **34**. Spring elements of various shapes can be employed to produced the vertical compression forces.

The top and bottom portions of the individual whorls contact the inner portions of the apices **32** spaced points along the latter and hence define, as in the case of the sheet resilient element **34**, a spring having top and bottom generally parallel edges.

It will be observed that buckling out of a vertical plane of the spring element is inhibited by the moving together of the sides **24** and **26**.

In FIG. 5 of the drawings, a modification is shown wherein the top and bottom concave portions are separate from the side panel portions **240** and **260**. A spring element S, which may be of either illustrated form, is positioned at the apices **320** as previously. The top and bottom sections may be of elastomer with the sides of metal, plastic or any desired material. The mode of attachment of the skirt portions of the top and bottom to the side panels is not critical.

Referring now to FIG. 6 of the drawings, the numeral **50** denotes generally an elongated elastomer seal similar to that illustrated at FIG. 1 of the drawings. The numerals **52** and **54** denote vertically disposed side walls whose upper ends are integrally joined to leg or sheet portions **56** and **58**. Lower leg or sheet portions **60** and **62** are joined to the lower edges of the side walls **52** and **54**. The numerals **57** and **59** denote thickened portions of the inner ends of the legs, these portions being integrally secured to upstanding and generally U-shaped structure defined by leg portions **66** and **68** and bight portion **70**. The lower portion of the seal is completely symmetrical and a description will accordingly not be required. The spring S is, for example, of plastic or metal, and has the shown cut-away portions to facilitate bending of the ring portions. As in the embodiment of FIG. 1, the spring is adapted to function as a compression spring. In operation, movement of adjacent modular sections causes the side walls **52** and **54** to move together, just as in the embodiment of FIG. 1 with regard to side walls **24** and **26**. With movement of these walls towards each other, the angle between the legs **56** and **58** changes and the apex of these legs, considered generally to be elements **57**, **68**, **70**, **66** and **59**, moves towards the interior portion of the seal, towards the corresponding apex associated with the bottom legs **60** and **62**. In this embodiment, the reader will recognize that the generally U-shaped portion defined by **66**, **70** and **68** effectively heightens the spring S. Upon expansion of the roadbed sections, compression in a vertical plane takes place. By virtue of the relatively increased height of the spring in this embodiment, as opposed to the embodiment of FIG. 1, the proportion or percentage of strain is diminished. Thus, even though the absolute magnitude of the movement due to either expansion or contraction is the same, the unit strain will be less. This in turn yields the advantages of working in lower stress ranges and in maintaining the force exerted by the seal upon the edges of the modular sections more uniform because of less variation in unit strain. As in the embodiment of FIG. 1, the seal and its components are so dimensioned with respect to the gap between the roadbed sections so that the spring is never in a state of tension even for the widest anticipated gaps between the modular elements.

Referring now to FIG. 7 of the drawings, an embodiment is illustrated wherein a tension spring S is employed. The numerals **82** and **84** denote vertically disposed side walls having upper and integral leg portions **86** and **88**. Corresponding leg portions are on the bottom portion of the seal and are completely similar. Again, any specific

spring may be employed, here denoted by the S. The numeral **90** denotes a portion of the apex of the legs **86** and **88** and the numeral **92** denotes a slot longitudinally formed therein. The numeral **94** denotes an enlarged bore communicating with the slot. The bore similarly runs the entire length of the elastomer seal. The numeral **96** denotes a continuous bead formed on the longitudinal edges of the spring S. The reader will now be in a position to appreciate that, upon expansion of the individual modular units, the sides **82** and **84** of the seal will move towards each other. This in turn will cause the angles between the legs **86** and **88** to change, with the apex of these legs moving upwardly and the corresponding lower apex moving downwardly. The spring S will now be placed under greater tension. One advantage of the embodiment such as just described wherein tension is employed is that due to the initial configuration of the top and bottom legs or sheets the height of the spring is inherently greater than in the embodiment of FIG. 1 and accordingly the unit strain due to expansion and contraction of the modular sections is diminishtd. The proportions of the seal and its components are so dimensioned that the spring S is never in compression, even in the greatest anticipated gap width.

At FIG. 9 of the drawings, an embodiment of a spring is illustrated wherein the spring **36** (see FIG. 4) defined by a plurality of sidewise displaced whorls of a resilient material is joined to two parallel running bars **100** and **102**. Portions of the spring **36** are joined to the parallel bars by windings or threads of, for example, thin wire denoted by the numeral **104**. In practice, such a spring element is employed with the embodiment of FIG. 7, with the upper and lower bars **100** and **102** being inserted in the longitudinal bores **94**. It will be appreciated that the specific manner of joining the spring S to the elastomer seal (shown at FIG. 8) is susceptible to use with either the embodiment of FIG. 1 or FIG. 7.

FIGURE 10 is a view similar to FIG. 9 and shows yet another form of spring susceptible of use with, particularly, the embodiment of FIG. 7. The numeral **108** denotes any one of several tension, coil springs positioned between the parallel bars **100** and **102**. As before, the bars are positioned in the bore **94**, the uncoiled ends of the springs **108** passing through the slots **92**.

I claim:

1. A seal adapted to be placed between facing edges of adjacent modular units, such as roadbed slabs, and wall panels, said seal being generally elongated and hollow and having sides, said seal in cross-section including first and second, upper leg portions joined to each other at their inner ends to form a first apex, their outer ends joined to the sides of the seal, said upper leg portions being at an angle to each other, third and fourth, lower, leg portions coupled to each other at their inner ends, their outer ends coupled to the sides of the seal, their inner ends forming a second apex, said first and second apices pointing in opposite directions, a spring element within said seal, one portion of said spring element being in contact with said first apex, another portion of said spring element in contact with said second apex whereby movement of the outer ends of the leg portions changes the angles between the legs and distorts the spring element.

2. The seal of claim **1** wherein said sides of the seal are parallel, and wherein said sides and said leg portions are integral.

3. The seal of claim **2** wherein said spring element lies within a plane generally parallel to said parallel sides.

4. The seal of claim **1** wherein at least the upper and lower leg portions are formed of elastomer.

5. The seal of claim **1** wherein said spring is formed of an elastic material having a defined yield point.

6. The seal of claim **1** wherein said spring element comprises a continuous wire in the form of a plurality of sidewise displaced whorls.

7. The seal of claim **1** wherein said spring element comprises a sheet formed of a resilient material, said sheet having a plurality of apertures therethrough, opposite edges of said sheet making continuous contact with the said apices.

8. A roadbed or the like joint including,

(a) two modular roadbed sections spaced from each other,

(b) an elongated seal positioned in the space between said roadbed sections, said seal being generally hollow and having sides abutted by facing edges of said roadbed sections,

(c) said seal including within it a resilient spring element,

(d) said seal having a pair of sheet-like leg portions extending thereacross at both the top and bottom thereof, the leg portions of each pair being at an angle to each other and define apices pointing in opposite directions, said spring element contacting said apices, said apices moving in opposite directions in a vertical plane upon horizontal motion of the sides.

9. The roadbed joint of claim **8** wherein,

(a) said resilient spring element comprises a continuous wire in the form of a plurality of sidewise displaced whorls.

10. The roadbed joint of claim **8** wherein,

(a) said resilient spring element comprises a sheet of resilient material having a plurality of apertures therethrough, opposite edges of said sheet making continuous contact with said apices.

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JACOB L. NACKENOFF, Primary Examiner