

PATENT SPECIFICATION

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(54) EXPANSION JOINT SEAL ASSEMBLY

(71) We, ELASTOMETAL LIMITED, a company organised under the laws of the Province of Ontario, Canada of 3334, Mainway Drive, Burlington, Ontario, Canada, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an expansion joint seal assembly for positioning in a gap defined between the facing surfaces of two adjacent sections of a structure such as a roadway.

The proper design of large structures such as road beds and bridges for highways, concrete walls and the like require that provision be made to accommodate expansion and contraction due to temperature changes. Usually this is done by incorporating expansion joints in the structure which provide a gap between sections of the structure and which will accommodate some relative movement due to expansion or contraction.

It is often however necessary that expansion joints include a seal capable of providing a tight barrier against wind, water and dirt, etc. Typically, for instance a roadway or bridge will be designed with intermittent expansion gaps which run transversely across the roadway. Such an expansion joint often requires a seal capable of accommodating expansion and contraction and which can be secured to the road bed on each side of the gap.

Previously known expansion joint assemblies have been expensive to manufacture and difficult to install or replace. Some designs have been subject to failure in maintaining their weather-tight seal under repeated stress of expansion and contraction movement.

It is therefore an object of this inven-

tion to provide an improved seal assembly for expansion joints which will meet the requirements of its purpose and will be easier to install, maintain, or replace.

According to the invention, there is provided an expansion joint seal assembly for positioning in a gap defined between the facing surfaces of two adjacent sections of a structure such as a roadway, the assembly comprising:

two abutments each having a substantially vertical portion positionable along a respective one of said facing surfaces;

a respective upright clamping plate corresponding to each abutment and releasably connected to the vertical portion thereof on the side of the latter facing said gap, the clamping plate defining a space between itself and the vertical portion which extends lengthwise of the assembly;

a flexible sealing member of elastic material separate from said clamping plates and cooperable with said abutments and comprising a web portion spanning between two side wall portions extending perpendicular thereto, each side wall portion being received in a respective one of said spaces;

and adjustable threaded fasteners interconnecting said clamping plates and said vertical portions, said fasteners being adjustable in order to move the clamping plates and the vertical portions laterally relative to each other thereby to reduce the lateral dimensions of said spaces so as to squeeze said side wall portions into sealing engagement with said vertical portions.

Embodiments of the invention will now be described in detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a vertical cross-section view perpendicular to the direction of the joint of one embodiment of the invention as applied to a roadway;

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Figure 2 is a perspective view of part of a seal assembly as in Figure 1 joined in a pre-assembled position;

Figure 3 is a perspective view of a part of a modified embodiment of expansion seal assembly such as shown in Figure 1;

Figure 4 is a vertical cross-section view of part of another modified embodiment of the invention;

Figure 5 is a perspective view of part of a further modified embodiment of the invention, and illustrates, in part, installation thereof; and

Figure 6 is a cross-sectional view of part of a still further modified embodiment of the invention.

As illustrated in the embodiment shown in Figure 1 the present invention is useable in expansion joints between two sections of roadway slabs 2 which may be on a conventional road bed or a bridge or overpass, composed of a single slab the top of which constitutes the travel surface of the roadway. It should be understood of course that the invention is applicable to other forms of road design such as those with a concrete slab having a traction layer of asphalt on top.

As illustrated the gap 8 between the roadway sections is spanned and sealed by an expansion joint sealing assembly having a flexible elastic sealing member 10 spanning between and attached to abutments 12, both of which conventionally extend continuously the entire length of the joint (i.e. the entire width of the roadway) and are positioned facing each other on opposite side of the gap and mounted on the sections of roadway slabs.

The pair of abutments 12 in the embodiment illustrated in Figure 1 (which are mirror images of each other), have a right angle member 14 secured in place by anchors 16 and 18 embedded in the roadway, and have a horizontal portion 20, the top of which is level with the travelled surface of the roadway, and a vertical portion comprising a flange 22 defining the sides of the gap 8 (although they need not necessarily coincide exactly with the end of the roadway slab). At the upper end of the vertical flange an over-hanging portion 24 extends into the gap first horizontally and then downwardly thereby presenting an inverted, downwardly open channel 26.

The abutment also has a clamping plate 28 supported by and adjustably held to the vertical flange by a threaded bolt 30 protruding from the lower region of the vertical flange and extending horizontally into the gap and through corresponding holes in the lower region of the clamping plate. Such a bolt might be fusion-welded to the flange so as to provide a smooth

attachment without any shoulder which might obstruct a spacer sleeve 34.

Nut 32 threaded onto the end of the bolt 30 serves to hold the plate and to urge it in the direction of the vertical wall portion as desired. For this purpose a lock-nut might be preferred. Alternatively the plate could be attached by a bolt having its head behind the plate in the position of the nut shown in Figure 1. In this case female threads would be required in the flange wall 22 and a recess chamber would be provided behind the flange to allow for the end of the bolt to project there through when tightened. This arrangement, although more difficult to make would occupy less space in the gap and provide greater freedom in the dimensions designed for small gaps where space is critical. The sleeve 34 fits over the bolt between the vertical wall and the plate to serve as a spacer setting the minimum spacing between them.

The sealing member 10 in the illustrated embodiment has a generally horizontally disposed web portion 36 spanning the gap of the joint between the abutments at approximately the level of the roadway surface.

Although the illustrated sealing member is arched it may be corrugated in a variety of configurations well known to those skilled in the art. Whatever the configuration, it relies on flexibility and elasticity to accommodate the relative movement of the joint due to expansion and contraction.

In fact, for some purposes such as roadways where incompressible material such as gravel may collect in the contours of the seal, it may be desirable to use a shape in which the web portion 36 has a generally V-shaped configuration extending downwards. In such a design it would be desirable to provide sufficient space between abutments for the groove of the seal, filled with gravel or other material, to remain un-crushed at the minimum spacing of the gap. To this end the arrangement mentioned above may be employed in which the bolt 30 and nut 32 are replaced by a flat-headed bolt fitting flush with or flat against the plate 28. Thus, as shown in Figure 6, bolt 30 and nut 32 are replaced by a flat headed bolt 54 threadably engaging the flange 22 and extending into a prepared recess chamber 56.

To grip the sealing member and effect a seal along each side of the gap, the sealing member is provided with substantially vertically disposed side walls 38 running along each side of the web portion 36. The side walls are formed integrally with and normal to the web portion and have an upper bead 40 adapted to substantially fit the channel 26 and a downwardly extending leg 42 which occupies the space between

the vertical flange and the plate above the spacer 34.

5 The spacer is smaller than the thickness of the side wall 38 so that tightening the bolt an appropriate amount will squeeze the downward extending leg of the side wall tending to hold it tightly and sealingly against the vertical face of the flange 22. Furthermore the squeezing effect will tend to deform the elastic material thereby urging the material upward and creating an additionally tight seal between the bead 40 and the channel 26, and in addition, assisting the holding function of the over-hanging portion 24 to prevent pulling away of the sealing member from the abutment. It will of course be realized that a series of bolts will be employed spaced at intervals along the vertical flange of the expansion joint, the spacing depending upon considerations such as the support desired for the sealing member side walls and the rigidity of the plate which must provide adequate pressure against the side walls along the entire length including the area between the bolts.

25 Figures 3 illustrates a modified embodiment of the invention in which a flexible U-shaped channel strip 44 is employed to provide a bottom for the space between the vertical flange 22 and the clamping plate 28 thus providing continuous support along the length of the seal side walls between the bolts rather than only at the bolt locations. This strip being flexible will not effect the adjustment or the tightening of the clamping plate but will serve to resist bulging of the elastic material downward in the areas between the bolt locations thus aiding in providing better sealing pressure between the top of the bead 40 and the channel 26.

30 Figure 4 illustrates a further modified embodiment of the invention in which the plate 28 is spaced from the vertical flange 22 by a spacer sleeve 34 as in Figure 1 but the plate is urged toward the vertical flange to squeeze the leg 42 by means of a spring 46 positioned on the bolt, behind the plate and held against it by the nut 32. It will be appreciated that by selecting a spring of appropriate compressive strength, the squeezing pressure exerted by the plate to seal the sealing member against the flange will be relatively constant and correct even without precise tightening or adjustment of the nut 32.

35 The expansion joint is additionally advantageous for purposes of installation. If the expansion joint is to be pre-assembled in the shop before it is placed in position, between the adjacent slabs of the roadway for instance, the two abutment pieces 12 can be secured in their desired predetermined spacing parallel to each other by cross bars, such as those illustrated as 48

in Figure 2, temporarily spot-welded across the horizontal portion 20.

70 The seal can then be inserted with the plate 28 loosened (either with or without strip 44 as desired) and the seal clamped by tightening the bolts 32-32 the appropriate amount, access to the bolts being had from beneath or by assembling the joint up-side-down. The entire assembled expansion joint can then be taken to the installation location, positioned in the roadway gap and secured by whatever conventional means are intended to be used, which conventionally will include pouring concrete to embed the anchors such as 16 and 18 in the roadway. The temporary cross bars can then be removed to allow the expansion joint to function in accommodating the movement of the joint.

75 Where the expansion joint is to be assembled *in situ* the abutments will usually be placed and anchored to the respective adjacent slabs on either side of the gap. The seal, which of course will have to be designed in terms of dimensions and flexibility and elasticity to span between the abutments and accommodate the maximum movement of the slabs, will then be installed in the abutment on each side of the gap.

80 This can be done by inserting one side wall along one abutment first, with the clamping plate loosened, after which access can still be had to the nuts to tighten the plate the desired amount.

85 Since in most field locations access will not be available from beneath, installation of the second flange of the seal will be slightly more involved. Although it might be possible to tighten the nut on the second abutment and then force the seal flange in the space between the plate and the vertical member relying on lubrication and the elasticity of the seal material, this is a difficult procedure and presents the problem that it may only be possible when the space affords a sufficiently loose fit that the desired degree of sealing pressure may not be present.

90 Using the adjustable clamping plate it is possible to insert the side wall of the sealing member at one point (for instance at one end of the joint) and tighten the nuts such as 32 in turn as the insertion advances, the flexibility of the seal allowing the installer to reach the nut where the side wall has been inserted while the advanced portion of the side wall is still out of position.

95 Alternatively, using the embodiment of Figure 4 or Figure 5 in which the plate is backed up by a spring or other yieldable resilient elements, the installer can pry the plate out away from the vertical flange by inserting a lever or crowbar as seen at 50 in Figure 5, the bar being moved along in 130

advance of the insertion of the second side wall and used to pry the plate out from the vertical flange 22 enough to insert the side wall of the seal. Upon releasing the plate 5 the spring will urge the plate to press the side wall of the seal against the flange 22 (and also the channel 26) of the abutment.

It may on the other hand be convenient to install the seal member along both sides 10 at the same time by starting at one end for instance and inserting the side wall portion between the plate and flange in each abutment progressively along the length of the joint. This approach may be used either 15 with the embodiment of Figure 4 and 5 or by the technique of tightening the nuts 32-32 progressively as the seal insertion progresses in the manner previously mentioned.

Arrangement of the bolts 30 at staggered spacing on respective sides of the gap will allow greater leeway in the length of the bolt and the dimensions of the abutment assembly relative to the dimension of the 25 gap.

It should also be realised that the overhanging portion 24 of the abutment may be of a variety of shapes, or may in some cases be absent although some advantage may thereby be lost, but should preferably 30 provide an upper barrier against which the upper bead of the seal side wall will be pressed by the squeezing effect of the clamping plate. It will preferably have an additional downward projection, such as 35 illustrated in Figure 1, by which forces tending to pull the seal away from the abutment will be resisted.

Figure 5 illustrates another modification 40 in which the spacer, which sets the minimum spacing of the plate from the flange 22, is provided by an elongated bar 52 running parallel to and between the flange and the plate and having a series of holes 45 through which the bolts 30 extend. Such a bar provides both the spacer function and the function of supporting the underside of the side wall 42 continuously along the length of the joint in a manner similar to the strip 44 illustrated in Figure 3. In fact 50 upright walls on the bar 52 or a strip such as 44 might be used in conjunction with the bar 52 to prevent the elastic seal material from being pinched between the 55 plate and the bar and the flange when the bolts are being tightened.

Some conventional designs for expansion joints employ a lubricant-adhesive gel-like substance which lubricates the seal material 60 as it is being inserted into a fixed groove or channel member and acts as an adhesive to bond the seal member to the channel member. This technique however creates some problems in removing or replacing a 65 seal and, although it may be used where

desired it is for most cases made unnecessary by the present invention.

While the illustrated embodiments have a single seal member, the invention is also adaptable to the expansion joint in which 70 the gap is too great to be effectively spanned by a single seal such as shown in Figure 1. Such larger joints conventionally use one or more intermediate beam members running along the gap between 75 the sides so that two or more seals may be used spanning from one side to the beam and from the beam to the other side respectively. Since these beam members are conventionally supported by cross-members 80 running transversely underneath, the joint would merely require abutments such as shown in Figure 1 to employ the present invention.

Although the description of illustrative 85 embodiments herein being referred to as horizontally disposed seals spanning between vertical flanges of a horizontally spaced gap, it will be realized that this invention may be equally useful in expansion 90 joints in vertical or inclined structures, or even non-aligned sections of a structure, and is not limited to horizontal roadway slabs illustrated. The relative position, shapes and functions of the elements would 95 remain essentially the same.

Although the foregoing descriptions illustrate preferred embodiments additional varied and modified versions of the invention may be employed without departing 100 from the invention as defined in the claims.

Attention is drawn to the description and claims of our copending application No. 4337/78 (Serial No. 1521250) divided 105 out of this application.

WHAT WE CLAIM IS:

1. An expansion joint seal assembly for positioning in a gap defined between the facing surfaces of two adjacent sections of 110 a structure such as a roadway, the assembly comprising:

two abutments each having a substantially vertical portion positionable along a respective one of said facing surfaces; 115

a respective upright clamping plate corresponding to each abutment and releasably connected to the vertical portion thereof on the side of the latter facing said gap, the clamping plate defining a space 120 between itself and the vertical portion which extends lengthwise of the assembly;

a flexible sealing member of elastic material separate from said clamping plates and cooperable with said abutments and 125 comprising a web portion spanning between two side wall portions extending perpendicular thereto, each side wall portion being received in a respective one of said spaces; and adjustable threaded fasteners inter- 130



advance of the insertion of the second side wall and used to pry the plate out from the vertical flange 22 enough to insert the side wall of the seal. Upon releasing the plate

5 the spring will urge the plate to press the side wall of the seal against the flange 22 (and also the channel 26) of the abutment.

It may on the other hand be convenient to install the seal member along both sides at the same time by starting at one end for instance and inserting the side wall portion between the plate and flange in each abutment progressively along the length of the joint. This approach may be used either

15 with the embodiment of Figure 4 and 5 or by the technique of tightening the nuts 32-32 progressively as the seal insertion progresses in the manner previously mentioned.

20 Arrangement of the bolts 30 at staggered spacing on respective sides of the gap will allow greater leeway in the length of the bolt and the dimensions of the abutment assembly relative to the dimension of the

25 gap. It should also be realized that the overhanging portion 24 of the abutment may be of a variety of shapes, or may in some cases be absent although some advantage may thereby be lost, but should preferably provide an upper barrier against which the upper bead of the seal side wall will be pressed by the squeezing effect of the clamping plate. It will preferably have an

30 additional downward projection, such as illustrated in Figure 1, by which forces tending to pull the seal away from the abutment will be resisted.

Figure 5 illustrates another modification in which the spacer, which sets the minimum spacing of the plate from the flange 22, is provided by an elongated bar 52 running parallel to and between the flange and the plate and having a series of holes

45 through which the bolts 30 extend. Such a bar provides both the spacer function and the function of supporting the underside of the side wall 42 continuously along the length of the joint in a manner similar to the strip 44 illustrated in Figure 3. In fact upright walls on the bar 52 or a strip such as 44 might be used in conjunction with the bar 52 to prevent the elastic seal material from being pinched between the

55 plate and the bar and the flange when the bolts are being tightened. Some conventional designs for expansion joints employ a lubricant-adhesive gel-like substance which lubricates the seal material as it is being inserted into a fixed groove or channel member and acts as an adhesive to bond the seal member to the channel member. This technique however creates some problems in removing or replacing a

65 seal and, although it may be used where

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While the illustrated embodiments have a single seal member, the invention is also adaptable to the expansion joint in which the gap is too great to be effectively spanned by a single seal such as shown in Figure 1. Such larger joints conventionally use one or more intermediate beam members running along the gap between the sides so that two or more seals may be used spanning from one side to the beam and from the beam to the other side respectively. Since these beam members are conventionally supported by cross-members running transversely underneath, the joint would merely require abutments such as shown in Figure 1 to employ the present invention.

Although the description of illustrative embodiments herein being referred to as horizontally disposed seals spanning between vertical flanges of a horizontally spaced gap, it will be realized that this invention may be equally useful in expansion joints in vertical or inclined structures, or even non-aligned sections of a structure, and is not limited to horizontal roadway slabs illustrated. The relative position, shapes and functions of the elements would remain essentially the same.

Although the foregoing descriptions illustrate preferred embodiments additional varied and modified versions of the invention may be employed without departing from the invention as defined in the claims.

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a respective upright clamping plate corresponding to each abutment and releasably connected to the vertical portion thereof on the side of the latter facing said gap, the clamping plate defining a space between itself and the vertical portion which extends lengthwise of the assembly;

a flexible sealing member of elastic material separate from said clamping plates and cooperable with said abutments and comprising a web portion spanning between two side wall portions extending perpendicular thereto, each side wall portion being received in a respective one of said spaces; and adjustable threaded fasteners inter-



connecting said clamping plates and said vertical portions, said fasteners being adjustable in order to move the clamping plates and the vertical portions laterally relative to each other thereby to reduce the lateral dimensions of said spaces so as to squeeze said side wall portions into sealing engagement with said vertical portions.

2. A seal assembly according to claim 1, in which said threaded fasteners comprise bolts extending perpendicularly between said clamping plates and said vertical portions.

3. A seal assembly according to claim 2, in which each bolt has a nut threadably mounted thereon and operable to urge the respective clamping plate towards the corresponding vertical portion.

4. A seal assembly according to claim 3, in which each bolt extends horizontally from the lower region of the respective vertical portion to pass through a corresponding aperture in the lower portion of said clamping plate.

5. A seal assembly according to claim 4, in which a spacer cooperates with each threaded fastener to set a minimum spacing-apart of each clamping plate and vertical portion.

6. A seal assembly according to claim 5, in which said spacer comprises a sleeve mounted concentrically on said bolt between said vertical portion and said clamping plate.

7. A seal assembly according to claim 5, in which said spacer comprises an elongate bar extending parallel to said clamping plate between the latter and said vertical portion.

8. A seal assembly according to any one of the preceding claims, including a yieldable resilient element associated with each fastener and arranged to urge the clamping plate towards the vertical portion.

9. A seal assembly according to claim 8, when appendant to claim 3, in which said

yieldable resilient element is arranged between said plate and said nut.

10. A seal assembly according to claim 8 or 9, in which said yieldable resilient element is an helical spring.

11. A seal assembly according to any one of the preceding claims, in which each abutment has an overhanging portion extending from the upper part of the vertical portion to present a channel adapted to receive the upper edge of said side wall of the sealing member, and in which said web of said sealing member is attached to said side wall at a point spaced from said upper edge.

12. A seal assembly according to any one of claims 1 to 5 or 8 to 11, including a respective flexible upwardly open U-shaped side wall support strip extending along each space between the vertical portion and the clamping plate overlying said threaded fasteners and underlying the respective side wall of the sealing member.

13. A seal assembly according to claim 1 and substantially as hereinbefore described with reference to any one of the embodiments illustrated in the accompanying drawings.

14. A roadway including a seal assembly according to any one of the preceding claims.

HASELTINE, LAKE & CO.,
Chartered Patent Agents,
Hazlitt House,
28, Southampton Buildings,
Chancery Lane,
London WC2A 1AT,
—also—
Temple Gate House,
Temple Gate,
Bristol BS1 6PT.
—and—
9, Park Square,
Leeds LS1 2LH.
Yorks.