July 15, 1969 E. J. WEBB 3,455,215

SEAL FOR EXPANSION JOINTS

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FIG. 1

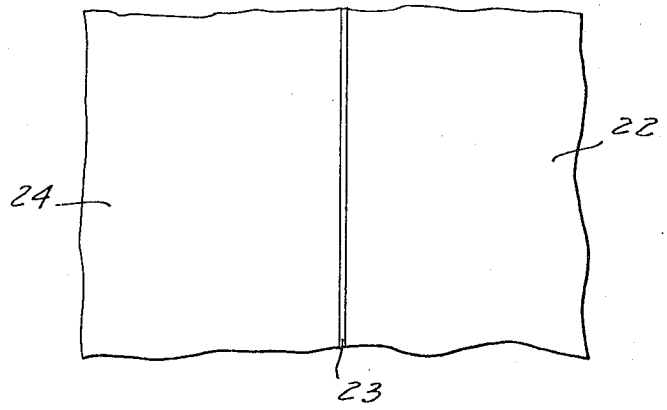


FIG. 7

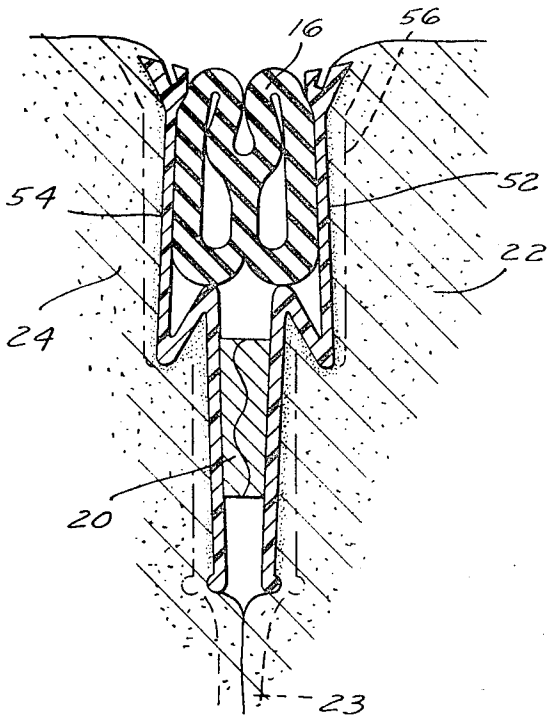
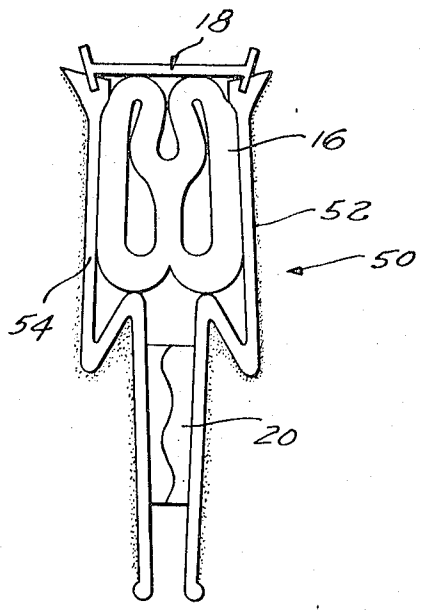


FIG. 6



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FIG. 2

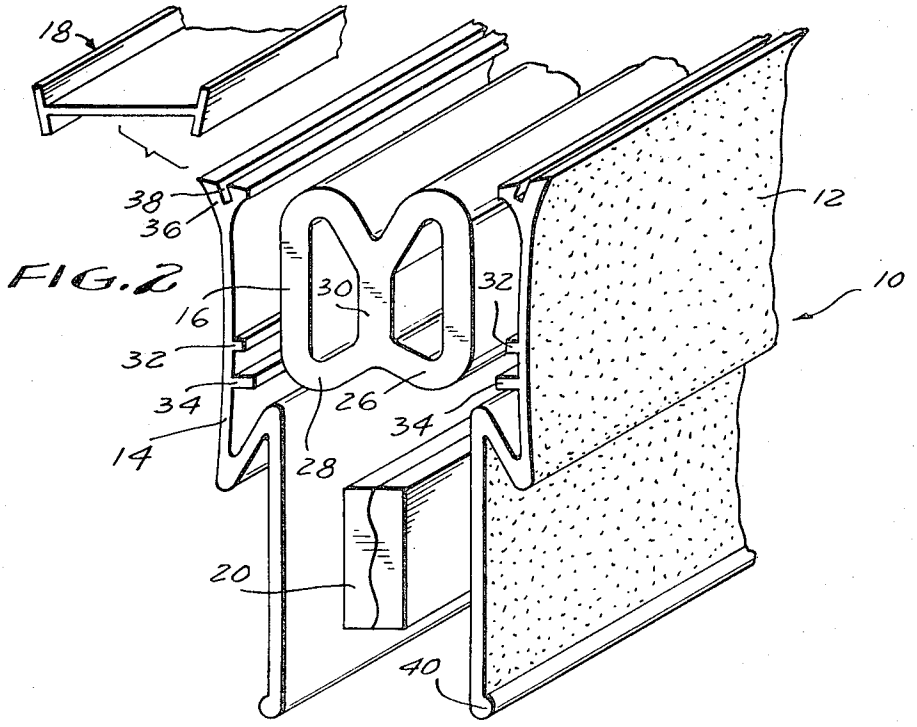


FIG. 3

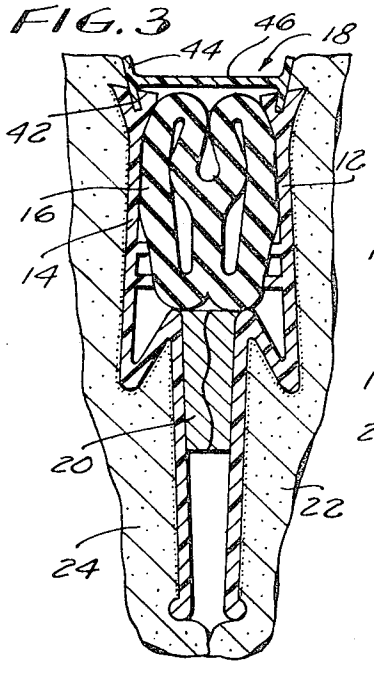


FIG. 4

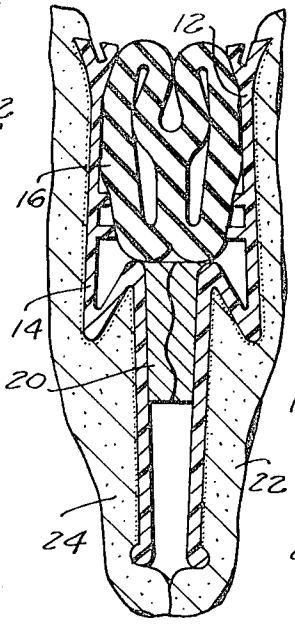
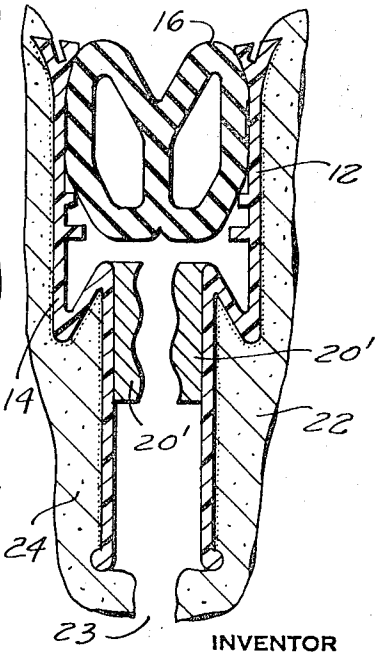


FIG. 5



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SEAL FOR EXPANSION JOINTS

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U.S. Cl. 94—18 6 Claims

ABSTRACT OF THE DISCLOSURE

In concrete road construction, a device for maintaining a positive seal between regularly spaced joints in preformed concrete sections during, due to ambient conditions, expansion and contraction of the sections. A flexible elastomeric strip sealingly disposed between a pair of side walls, initially connected at their ends to maintain the strip under compressive loading, that, in a working orientation, are in juxtaposed abutting and bonded relation with the adjoining concrete sections within the joint to follow section movement and seal the joint to prevent the introduction of foreign matter.

BACKGROUND OF THE INVENTION

In concrete highways spacings or joints, lying both transverse to and longitudinal with the traffic flow, compensate for linear expansion or contraction of the section and effectively control the random cracking and warping that the unsectioned pavement might otherwise undergo. Thus, the continuous concrete highway is provided with a pattern of straight transverse cracks effectively to provide lines of weakness whereby internal stresses which tend to break the section will act along the line of weakness rather than at random locations within the section. These lines of weakness are generally found at intervals of from approximately fifteen to one hundred feet, depending upon the type of pavement slab and the loads to be encountered. As can be appreciated, any necessary repair to the section will be more easily carried out along this line than at other points within outer confines of the section.

While it is necessary to provide the continuous concrete pavement with predeterminedly spaced joints it is also necessary and in fact imperative to seal these cracks to prevent the intrusion of foreign matter in the form of, for example, dirt, abrasives, chemical products and noncompressible material to the internal portion of the joint, thereby to act on the concrete fascia. It is the foreign material that causes or aids in the deterioration of the pavement itself.

Today, with highways being subjected to increased loads and greater use, together with the use of salts and other abrasive noncompressible thawing substances, the sealing of these cracks has become a major problem in concrete highway construction.

In the past, it has always been thought that water entering the point from the plane of the road was the major cause of such deterioration at the joint and that it was most important to exclude water. While, of course, water should be prevented from entering the crack from the top and accumulating and possibly freezing within the joint, it is relatively impossible or commercially impractical to eliminate the water since the most significant portion thereof enters the joint from the subgrade of the road. To seal this entrance to the joint from the subgrade would render the cost of road construction prohibitive.

Actually, water does not provide the deleterious effects on the joint as does the uncompressible foreign matter which, without an adequate seal, enters the joint in the concrete from the top or road surface. The uncompressible material causes a shearing or spalling of the concrete at the joint when the concrete sections are undergoing expansion. Therefore, upon expansion, upper portions of the concrete are broken away causing ruts and holes at the joint.

SUMMARY OF THE INVENTION

The present invention, accordingly, seeks to overcome the problems that develop in highway construction. Thus, in a broad sense the invention is directed to a sealing structure for sealing an expansion-contraction joint formed at regularly spaced intervals in a concrete pavement. The structure includes a pair of side walls of a length substantially equal to the width of roadway having means on the outer surface for bonding with the concrete fascia at the joint. A sealing strip of flexible elastomeric material is disposed between the side walls and sealed thereto, thereby to follow movement of the walls upon expansion of the concrete and cause movement of the walls upon contraction of the concrete whereby the expansion-contraction joint is sealed to prevent the entrance of foreign matter.

In view of the foregoing it is an object of this invention to provide a sealing means for road construction and particularly a structure that provides a greater working and sealing engagement with the concrete fascia of the crack, together with means for distributing any concentrated force, at a point, along the concrete length as a greatly diminished force at any one point. It is a further object to provide a sealing structure which bonds with the concrete fascia and provides sufficient compressive strength or lateral force when in sealing relation to prevent entrance to the joint of abrasive and uncompressible foreign matter. A further object is that during concrete placement the joint between adjacent concrete sections may be formed and sealed in one operation thereby to prevent the collection of foreign matter or powdered concrete within the joint.

Other objects and advantages of this invention will readily come to mind during the discussion which follows.

DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the invention. By these drawings:

FIGURE 1 is a plan view of a concrete roadway and a joint between adjacent concrete sections;

FIGURE 2 is a view in exploded perspective showing the joint sealing member of the present invention;

FIGURES 3–5 are vertical sectional views of the sealing member of FIG. 2 disposed within the joint and between adjacent concrete sections, the sealing strip being under compression and in the substantially expanded state;

FIGURE 6 is an elevational view of a modified sealing member; and

FIGURE 7 is a vertical sectional view of the sealing member of FIG. 6 in operative orientation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning to the figures and particularly FIG. 2, the sealing member of the present invention is indicated by the numeral **10**. In the exploded view, the parts are readily seen and generally include a pair of side walls **12** and **14**, a sealing strip **16** that is adapted to be supported between the side walls and means in the form of a cap **18** and connecting element **20** for joining the sealing member walls at both top and bottom to define a unitary structure.

The sealing member, as briefly discussed, may be easily introduced or otherwise positioned within a length of poured concrete to form and seal a joint **23** between the faces of adjoining concrete sections **22** and **24** (FIG. 1)

defined by the joint. Generally, the member **10** may be introduced into fluid or relatively fluid concrete by a vibratory movement to a position so that the upper surface of cap **18** lies in the plane of the roadway. The sealing member may otherwise be located and elevationally supported above the roadbed prior the the initial pouring concrete by structure similar to that disclosed in U.S. Patent No. 3,257,916 to Frederick P. Dickow and Walter C. Palmer. Thus, the member **10** may be supported by a center plate (not shown) below the plane later to define the upper surface of the concrete roadway, and after the concrete is poured pulled to a point at the concrete surface thereby similarly to form and seal the joint between the sections **22** and **24**. As discussed in the referenced patent, the center plate is, in turn, supported by a pair of cooperable load transfer members that rest on the roadbed. Since this particular structure does not form a part of the present invention further discussion is deemed unnecessary. Further, irrespective of the manner by which the sealing member is positioned and moved to the surface to define the joint **23**, its primary purpose is to seal the joint thereby to prevent the entrance of foreign matter, for the purpose discussed.

The sealing strip **16** is formed in one piece, as by extrusion, from a suitable elastomeric material. The material should be both abrasive and wear resistant and not adversely affected by extreme fluctuations in atmospheric temperature such as encountered when installed in a highway pavement joint. The material should also be unaffected by hydrocarbon products and other chemicals, such as salt, calcium chloride, etc., which might be deposited on the highway. For this purpose a suitable synthetic rubber such as neoprene, butadiene, polychloroprene or the like may be employed. Further, a synthetic plastic such as PVC or polyethylene may be employed. It has been found that satisfactory results are obtained using neoprene, and this material is preferred. Such strips are extremely flexible and have good return memory.

The sealing strip, as shown in both embodiments, and for the purpose of illustration, comprises a pair of generally oval side sections **26** and **28** that are integrally joined by a central connecting portion **30**. The side walls of each section are slightly outwardly convex and the upper portion of the strip is generally inwardly concave or V-shaped. As is apparent, the sealing strip is not provided with excessive internal truss structure which possibly causes non-uniform compression thereby increasing internal stress that aids in or hastens the crystallization of the material.

By providing the sealing strip of the present invention with slightly outwardly directed walls, the strip when placed in the sealing position between opposing faces of the side walls **12** and **14**, tends to flatten when under slight compression due to the walls thereby conforming with the opposing faces. The strip, however, tends not to collapse and the compressive forces that are developed by the structure maintain a tight seal between the strip and the side walls to prevent the entrance of non-compressible, abrasive and other foreign matter from entering the joint **23** (FIG. 1). This construction also allows that relative movement between the walls and the strip be at a minimum. The sealing strip **16** is received between the side walls **12** and **14** to be retained in this disposition by a neoprene adhesive which provides a firm and lasting bond between the strip and wall. Walls **12** and **14** may be formed of any suitable material having rigid or semi-rigid structural capability. Many plastics, such as vinyl plastic, rigid PVC, or metal may be used but in the preferred embodiment the walls are formed of rigid vinyl. The side walls, in section, are generally Z-shaped with elongated leg portions. Strip **16** is held between the upper legs. Overall the side walls are of an extended length which will be equal to the lateral dimension of the roadway of, for example, single or double lane width.

The junction between the upper and lower leg portions may also be defined by a somewhat right-angled or Z-shaped section, as choice dictates. With this type of junction it may be, especially if the member **10** is vibrated into position, that concrete will be disposed in the pocket thereby to create a better bond between the wall and the concrete.

As shown in FIG. 2, the upper leg portion of each side wall is, in the relaxed position, slightly inwardly concave. This configuration aids to compensate for any expansion the walls may undergo due to ambient conditions. Further, by means of this design, the walls, when subjected to lateral forces exerted by a compressed sealing strip, become planar rather than assuming an outward flexure. Thus, a firm bond may be developed between the concrete fascia of adjacent sections within the joint **23** and the external surface of both walls **12** and **14**. It should be noted that the walls are not so rigid as to prevent the foregoing flexure due to forces developed by the sealing strip **16**.

Raised ribs **32** and **34** are formed on the internal surface of each side wall. The ribs are generally directed towards one another and extend the length of each wall and as shown in FIGS. 3–5. Thus, the ribs interact during expansion and contraction, with the lower portion of sealing strip **16**. The ribs function in a manner such that the walls apply a uniform compressive force on the strip and the sections **26** and **28** due to expansive movement of concrete sections **22** and **24**. Conversely, the strip applies a uniform expansion force over the width of side walls **12** and **14** following contraction of the sections and a widening joint **23**. Of more importance, the ribs insure that the total width of the neoprene will not be adhesively sealed to the walls **12** and **14**. Thus, a portion of the sealing strip will be free from adhesion, thereby being capable of freely moving between the FIG. 3 and FIG. 5 positions.

Walls **12** and **14** are each formed with enlarged end portions **36** having a central channel **38** adapted to receive the cap **18** and a lip **40**, at the bottom, which functions in a manner to prevent the sealing member **10** from floating upwardly through the freshly poured cement.

Cap **18** (FIG. 3) may be of the material, as discussed in connection with the side walls and is generally formed with a pair of depending and inwardly directed legs **42** and a pair of upwardly and slightly outwardly projecting horns **44**. Both the legs and the horns are joined by a central connecting portion **46** of sufficient length to allow, with the strip **16** compressed, the legs to enter the channels **38** thereby securing the wall tops from lateral movement. Thus, the cap **18** acts to compressively close the top portion of the sealing member **10** and maintain the strip under compression until the cap is removed when the concrete has set-up sufficiently. It is also contemplated that the wall tops may be secured against motion by a tape which may be removed at the desired time or else a tape that may be water soluble so as to disintegrate after a time. The cap is preferred. Generally, then, the cap is removed after the concrete has had the opportunity to set. This time is generally from within a few to several hours, depending upon the type and consistency of concrete poured, the surrounding ambient conditions, etc.

Closing the bottom portion of the sealing member and aiding to maintain the strip **16** under compression is a connecting element **20**. Element **20** is received within the bottom section of the side walls **12** and **14**, below the junction, and adhesively sealed between the lower legs thereby to act as a closure. Element **20** is in the form of two or more layers of corrugated paper that are individually joined together by a water soluble adhesive yet with the outer layers more positively joined to the walls **12** and **14**. A paper of this type is one sold under the trade name of V-Board. Thus, the paper will, as discussed below, break internally before breaking its seal with the walls.

Referring more specifically to FIGS. 3–5, it is seen that the sealing member of FIG. 2 is in final orientation thereby sealing the joint **23** between concrete sections **22** and **24**. As previously stated, the member **10** may be positioned in the concrete to form and seal the joint by vibrating it into freshly poured cement or drawing it upward through freshly poured cement. Obviously other methods of locating the sealing member of the roadway surface may be resorted to.

In FIG. 3, the sealing member is disposed at the surface of the roadway. Actually, the top portions or horns of the cap **18** lie substantially in the plane of the roadway so that, when the cap is removed, the structure left in situ within the joint will be spaced (FIG. 4) a small distance below the roadway surface. This allows the member to remain in sealing engagement with the concrete walls at the joint since it will not be subjected to any violent downward forces caused by vehicular traffic. Actually the member will be subject to some downward force but by depressing its upper surface below the roadway this force will be greatly reduced.

As clearly shown in FIG. 2 the total outer surface of the walls **12** and **14** carries a coating layer. This layer comprises an epoxy resin from any suitable epoxy system that will bond to the walls, as discussed, and in turn accept and hold a layer of sand or similar granular material having a relatively small grain size. Construction sand may be used. The epoxy-sand layer may also be seen in the sectional views of FIGS. 3–5 and due to this layer a strong bond may be created thereby bonding an otherwise unbondable wall to cement fascia at the joint. As already stated, the bond between the cement and outer wall surfaces prevents the entrance, to joint **23**, of non-compressible foreign material that aids in destruction of the joint. Further, the bond eliminates or at least greatly reduces any relative movement between the individual walls and the concrete faces which might otherwise occur.

The cap **18** (FIG. 3) is allowed to remain in place until the concrete has set sufficiently. At this time (FIG. 4) the cap is lifted at an end so that the legs disengage from the channels **38** supporting and holding the same. By means of the horns **44** the cap may be stripped from the walls and cement with a clean rather than a ragged break at the junction of sections **22** and **24** along the length of the joint **23**. When the cap **18** is removed (FIG. 4) the neoprene sealing strip, bonded to the interior wall surface, will be exposed at the joint. Finally (FIG. 5), after the member **10** has been in place for a length of time, accumulations of moisture will begin to attack the connecting member **20** so that, after a short time, the corrugated paper **20'**, due to a breakdown in adhesion of the water soluble adhesive and/or disintegratable paper, opens allowing freedom of movement of the walls **12** and **14** in both lateral directions due to any contraction or expansion of sections **22** and **24**. Thus, the member **10** in the FIGS. 4 and 5 positions will properly seal the expansion-contraction joint **23**.

A second embodiment of the sealing member, indicated by the numeral **50**, is shown in FIGS. 6 and 7.

Generally the sealing member **50** is similar to the sealing member discussed above. In this regard similar structure is referred to by the same reference characters. As evident from the figures, the member **50** is defined by a pair of side walls supporting a sealing strip **16** that is held in a condition of compression by the cap **18** and connecting member **20**. In a manner similar to that discussed, the walls **52** and **54** are coated with an epoxy-sand layer to create a firm positive bond. Actually, the walls differ from those discussed in that they are not provided with the ribs as shown in FIG. 2. In this connection, the strip **16** is adhered, by a neoprene adhesive, within only its upper portion to the inner surfaces of walls **52** and **54** thereby to allow freedom of movement for the bottom portion during expansion and contraction. FIG. 7 illustrates, in solid line, the member in compression and, in dotted line **56**, the member in expansion or tension.

From the foregoing discussion it is apparent that the various embodiments of the sealing member of the present invention carry out the objects and provide the advantages as well as other objects and advantages that may be apparent to one skilled in the art. While this discussion has been limited to a description of the figures, the discussion is not meant to be of a limiting nature for certain changes in construction will be within the bounds of the invention whose limits are defined by the scope of the appended claims.

Having described the invention what is claimed is:

1. A sealing device for sealing pavement joints in concrete highway construction comprising a compressible-expandable sealing member, a pair of juxtaposed side wall element each including an upper and lower wall portion connected by a substantially Z-shaped junction, the sealing member upon expansion and contraction of the pavement sections being supported between the upper wall portions, a closure member removably received by said walls' upper portion for holding said upper portion together thereby to maintain said sealing member under compression when disposed in freshly poured concrete at the joint then removable after said sealing device has been disposed within said pavement joint for a time sufficient to allow the concrete to set thereby to permit the walls and sealing member to move as a unit upon contraction and expansion of the concrete sections at the joint, a connecting member for joining the walls' lower portion said connecting member being formed of a water-destructible material thereby to lose its holding capacity due to moisture whereby the lower wall portions move freely with the upper wall portions and the concrete sections upon expansion and contraction at the joint, and bonding means on said walls' outer surfaces for creating a bond between the walls and the concrete fascia of adjacent pavement sections, said bonding means being a rough particulate material adhered to substantially the entire surface of each outer wall, said rough surface being capable of cooperating at the joint with the substantially fluid concrete thereby to allow the latter to mechanically and chemically bond upon setting with said rough wall surface.

2. The sealing device of claim **1** wherein said walls upper portion is enlarged and provided with a channel, said closure member being in the form of a cap having a pair of depending legs, and said legs being received within said channels.

3. The sealing device of claim **1** wherein said sealing member is substantially in the form of a pair of oval sections integrally joined at their sides and along the major axis by a central truss member.

4. The sealing device of claim **1** wherein the particulate material is sand.

5. In an expanded joint, the combination of a pair of spaced concrete sections capable of both expanding and contracting due to ambient conditions and a combined forming and sealing means installed during concrete placement to seal the joint thereby to prevent the entrance of non-compressible foreign material, said sealing means comprising a compressible-expandable sealing member, a pair of juxtaposed sidewall elements each including an upper and lower wall portion connected by a substantially Z-shaped junction, the sealing member upon expansion and contraction of the pavement sections being supported between the upper and lower wall portions, a closure member removably received by said walls' upper portion for holding said upper portion together thereby to maintain said sealing member under compression when disposed in freshly poured concrete at the joint then removable after said sealing device has been disposed within said pavement joint for a time sufficient to allow the concrete to set thereby to permit the walls and sealing member to move as a unit upon contraction and expan-

sion of the concrete sections at the joint, a connecting member for joining the walls' lower portion said connecting member being formed of a water-destructible material thereby to lose its holding capacity due to moisture whereby the lower wall portions move freely with the upper wall portions and the concrete sections upon expansion and contraction at the joint, and bonding means on said walls' outer surfaces for creating a bond between the walls and the concrete fascia of adjacent pavement sections, said bonding means being a rough particulate material adhered to substantially the entire surface of each outer wall, said rough surface being capable of cooperating at the joint with the substantially fluid concrete thereby to allow the latter to mechanically and chemically bond upon setting with said rough wall surface.

6. A sealing device for sealing pavement joints in concrete highway construction comprising a compressible-expandable sealing member substantially in the form of a pair of oval sections integrally joined at their sides and along the major axis by a central truss member, a pair of juxtaposed side wall elements, said sealing member being adhesively joined to the side wall elements over a major part of its surface area, and supported therebetween, a closure member removably received by said walls' upper portion for holding said upper portion together thereby to maintain said sealing member under compression then removable after said device has been

disposed within said pavement joint and the concrete has set sufficiently to allow the wall and sealing member to move as a unit upon contraction and expansion of the concrete sections at the joint, a connecting member for joining the walls' lower portion, said connecting member being formed of a water-destructible material thereby to lose its holding capacity due to moisture, bonding means on said walls' outer surfaces for creating a mechanical bond between the walls and the concrete fascia of adjacent pavement sections, and inwardly directed rib pairs on each wall element, said ribs being formed in said walls' upper portion thereby to abut against said base portion of said sections thereby to stabilize the sealing member within the area free of said adhesive bonding and allow freedom of movement of the sealing member sections upon said expansion and contraction.

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