United States Patent [19]

Neff

[11] **3,814,530**

[45] **June 4, 1974**

[54] **METHOD OF SEALING A CURB AND GUTTER ROADWAY GAP AND SEALING ASSEMBLY THEREFOR**

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[22] Filed: **Feb. 18, 1972**

[21] Appl. No.: **227,410**

[52] **U.S. Cl.** **404/67,** 404/74

[51] **Int. Cl.** **E01c 11/02,** E01c 11/12

[58] **Field of Search** 404/47, 64, 67, 74; 52/396; 14/16

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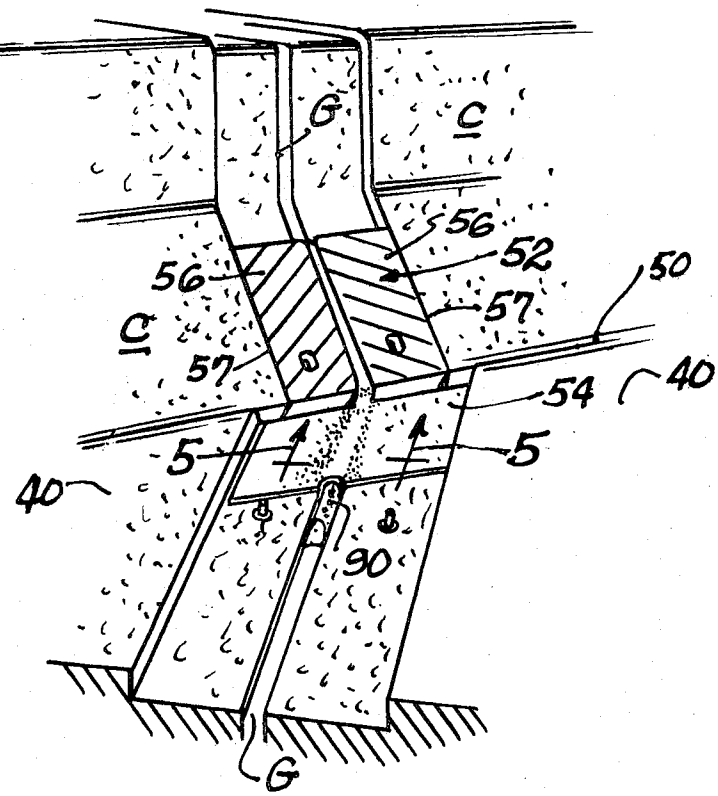
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Primary Examiner—Roy D. Frazier
Assistant Examiner—Thomas J. Holko
Attorney, Agent, or Firm—Dressler, Goldsmith, Clement & Gordon, Ltd.

[57] **ABSTRACT**

An improved sealing assembly for sealing the curb and gutter portions of a roadway gap at the intersection of adjacent roadway slabs. The sealing assembly includes a curb face piece assembly providing an elastic, flexible sealing flap spanning the intersection of the curb and gutter portions, and which is sealingly joined to the curb face piece assembly and to a complementary gutter gap sealing member. The sealing flap is conformed to portions of the curb face piece assembly and gutter gap sealing member, particularly in their regions overlying the curb and gutter gap portions. Desirably those regions comprise flexible joint membranes. A shaping member disposed in the gap, and extending upwardly therefrom, shapes the flap to assist in conforming it to those regions. The curb face piece assembly is affixed to the curb portions of the slabs adjacent the gap, the flap is conformed to the shaping member and the gutter gap sealing member is positioned over and conformed to the shaped flap. Suitable adhesive or mastic material seals the several members in a water-tight relationship and in a relationship resistant to separation due to forces encountered in dynamic loading of the adjacent roadway slabs.

20 Claims, 20 Drawing Figures



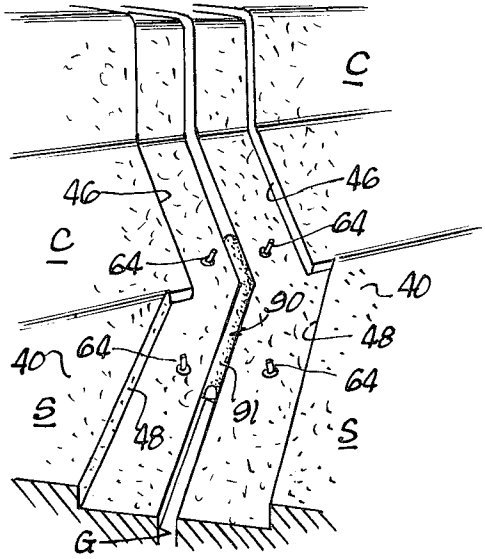


FIG. 1

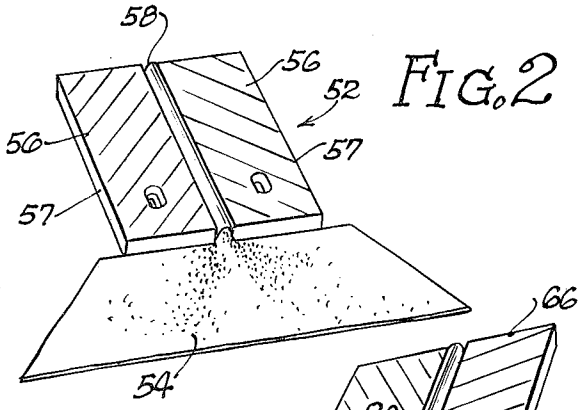


FIG. 2

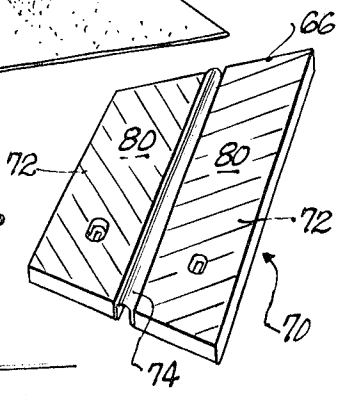


FIG. 3

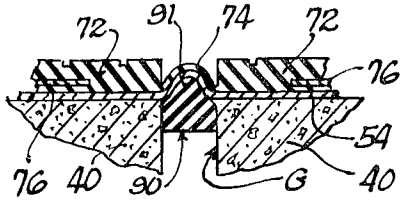
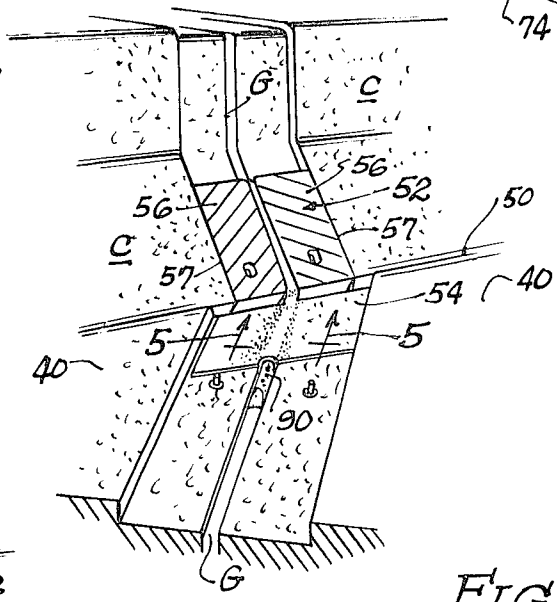


FIG. 8

FIG. 4



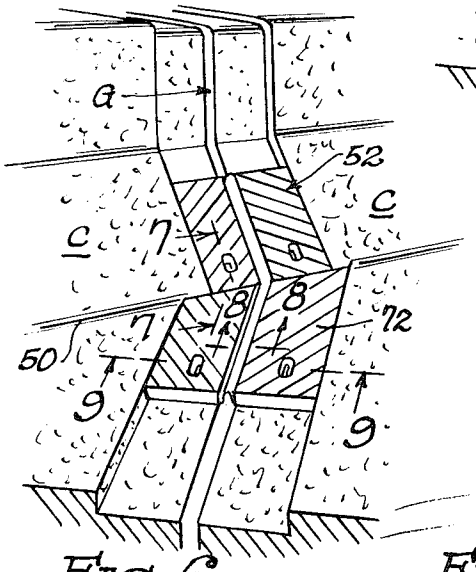


FIG. 6

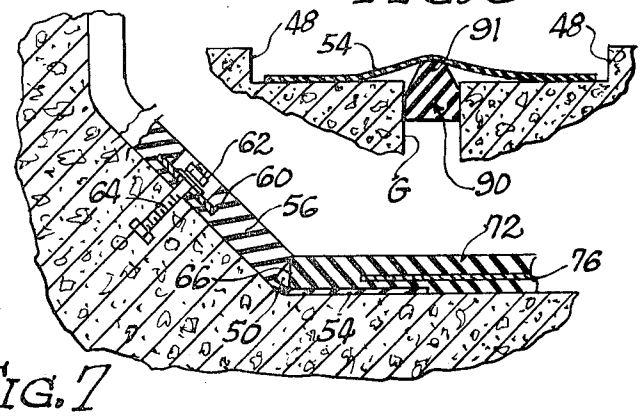


FIG. 7

FIG. 5

FIG. 9

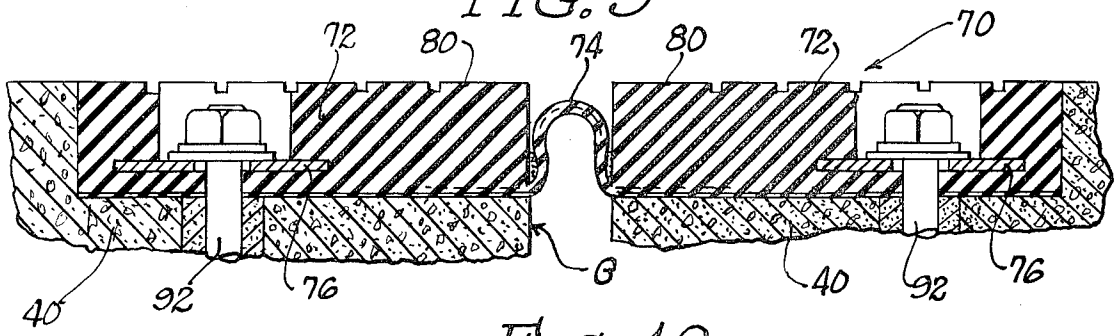


FIG. 10

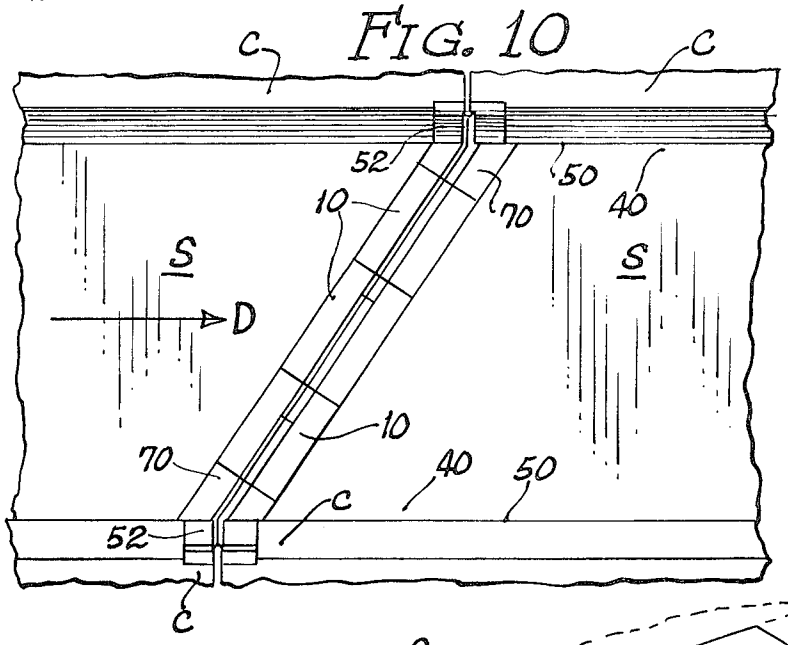


FIG. 11

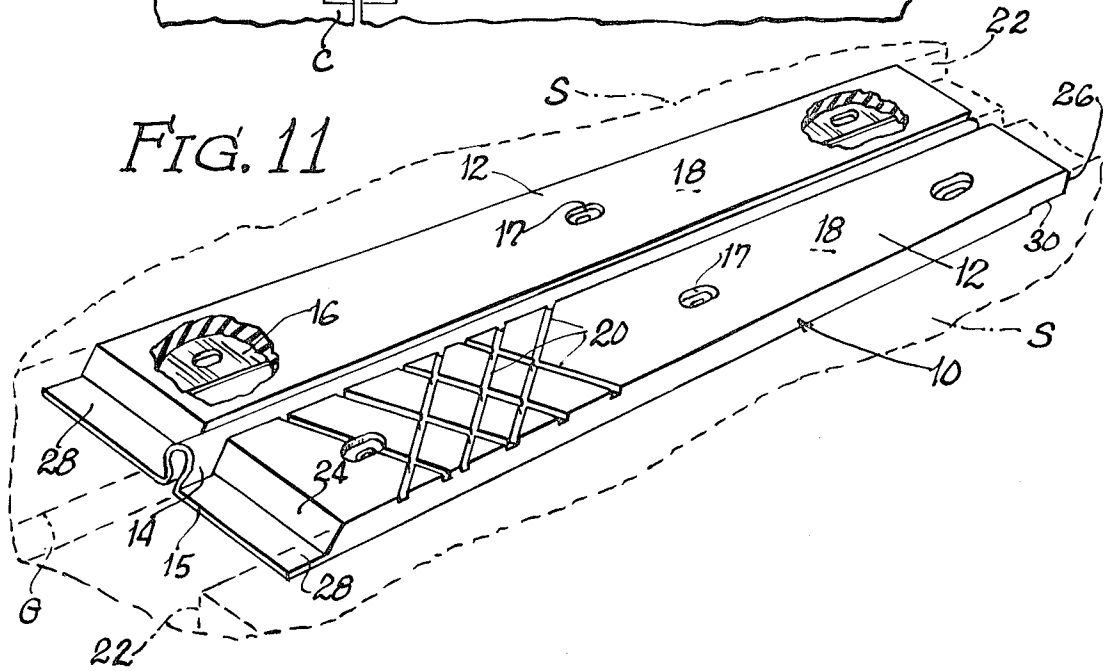


FIG. 12

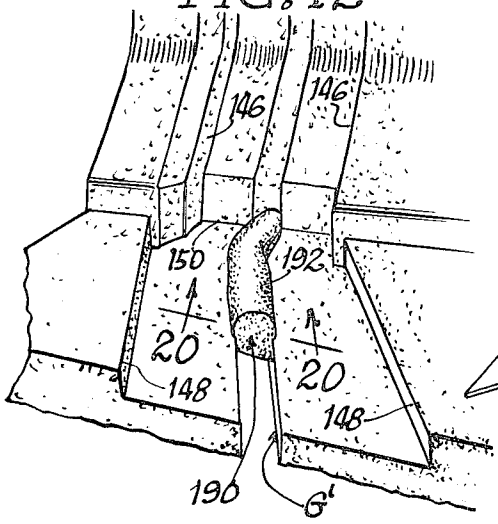
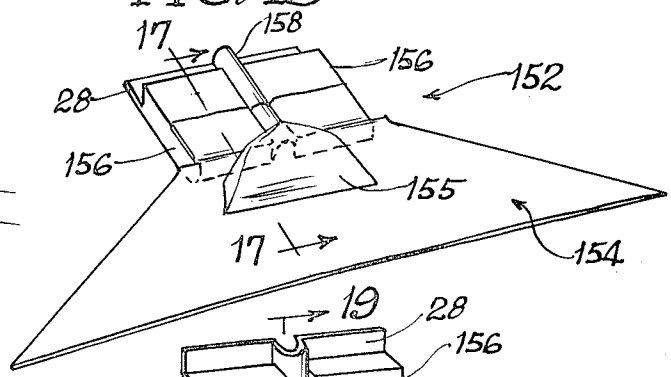


FIG. 13



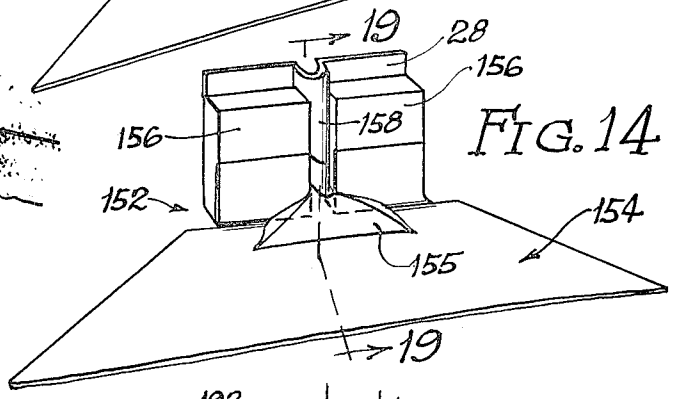
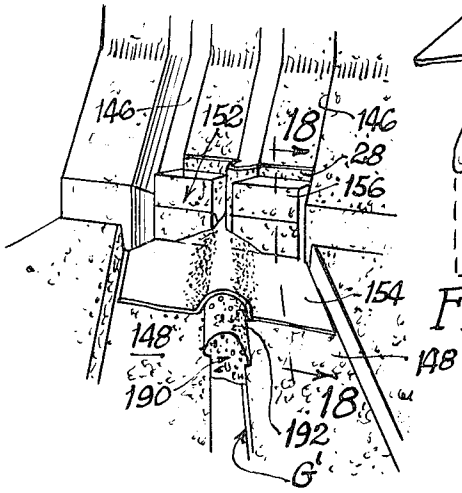


FIG. 14

FIG. 15



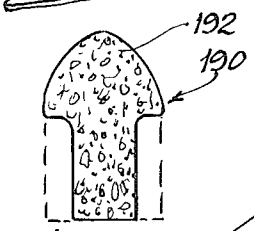


FIG. 20

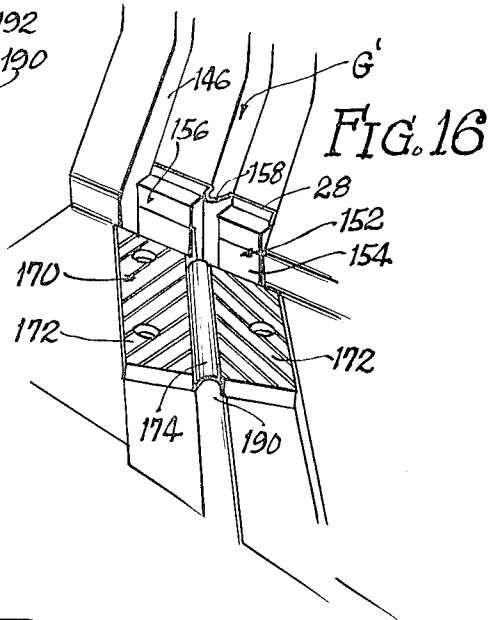


FIG. 16

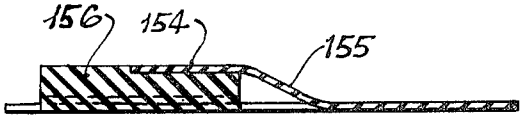


FIG. 17

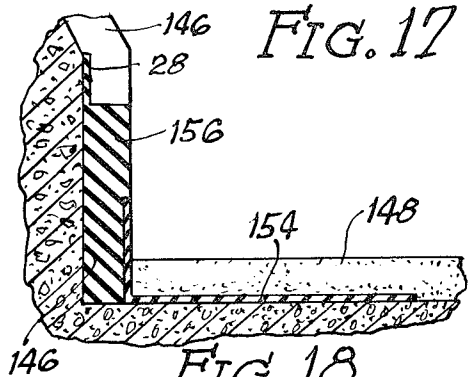


FIG. 18

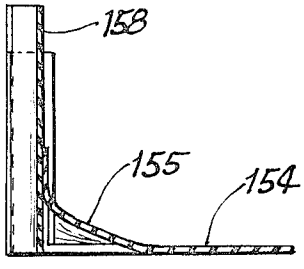


FIG. 19

METHOD OF SEALING A CURB AND GUTTER ROADWAY GAP AND SEALING ASSEMBLY THEREFOR

This invention relates to an improved roadway joint assembly, and particularly to a method and to a joint seal assembly for dynamically sealing a narrow gap between curb and gutter portions of adjacent roadway or deck slabs.

An increasing number of highways today are elevated and comprise deck structures supported on piers, archways, and the like. Such elevated deck structures are encountered on bridges as well. Because of the materials used, the deck structures must comprise a series of adjacent, but slightly spaced slabs to accommodate changes in weather conditions, dynamic loading and the like. For a number of reasons it is very important that the gap between adjacent slabs be sealed against the passage of water and other debris. Many roadways and deck structures provide gapped curb portions adjacent the gapped edge or gutter portions of the roadway slabs. It is also important to seal the curb and gutter gap portions against the passage of water and debris.

Many suggestions have been made for sealing roadway gaps. A recent innovation in such sealing is disclosed in U.S. application Ser. No. 191,996 filed on Oct. 26, 1971, now U.S. Pat. No. 3,713,368 issued on Jan. 30, 1973. The end dam assembly there disclosed has been found efficiently and effectively to seal transverse and longitudinal roadway gaps.

However, the devices currently available for sealing elongate slab gaps, such as those extending at a skew across the entire width of a roadway, have not been readily adaptable or usable for sealing the curb and gutter gaps of adjacent slabs, most particularly where the roadway gap is at a skew.

In accordance with this invention, an improved sealing assembly and an improved method for dynamically sealing the portions of a gap between curb and gutter portions of adjacent roadway slabs is provided.

A sealing assembly of this invention is adapted to be formed by securing specially formed curb gap and gutter gap sealing members at the intersection of curb portions and gutter portions of adjacent roadway slabs.

The slabs are first prepared, as by notching and by the provision of anchoring studs, to mount a curb sealing member and a gutter gap sealing member. A curb sealing member, which desirably comprises a pair of side pads connected by a flexible joint membrane, is sealingly secured to adjacent slab curb portions with the flexible joint membrane overlying the curb gap. The curb sealing member sealingly mounts an expansive sealing flap which projects from one end and which projects laterally beyond the sides of the sealing member. The sealing flap is sufficiently long and broad to overlie the curb and gutter intersection and to overlie and bridge a portion of the gutter gap.

A gutter gap sealing member, preferably comprising a pair of parallel side pads connected by a flexible joint membrane, is shaped to overlie the gutter gap, to be sealingly secured to the expansive flap and to closely confront an end portion of the curb sealing member. When it is secured to the gutter portions, the joint membrane bridges the gutter gap and lies parallel to it.

So that the sealing flap conforms as closely as possible to the contour of the surfaces of the gutter gap sealing member which it confronts, thereby to obtain maximum sealing engagement between them, and particularly in the regions of the joint membrane, a shaping means or mandrel is positioned in the gutter portion of the gap and is supported therein to project upwardly. The mandrel then serves to urge the elastic sealing flap into close conforming and sealing engagement with the joint membrane of the gutter gap sealing member. Where an upstanding arched joint membrane, such as that disclosed in the aforementioned application, is desired for sealing a roadway gap at the intersection of curb and gutter portions of adjacent slabs, the utilization of a thin flexible membrane, preferably integrally formed with a curb gap sealing member provides a continuous joint membrane, consisting of the curb and gutter sealing member membranes, which has been integrated by the sealing flap. The continuous joint membrane provides a substantial seal across the intersection of curb and gutter gap portions, even where there is a substantial skew and even under dynamic loading.

Further objects, advantages and features of this invention will become apparent from the following description and drawings, of which:

FIG. 1 is a fragmentary perspective view of adjacent curb and gutter portions of adjacent roadway slabs adapted to be sealed in accordance with this invention;

FIG. 2 is a perspective view of a curb face piece assembly of this invention;

FIG. 3 is a perspective view of a pad member adapted to be assembled with the curb face piece assembly of FIG. 2;

FIG. 4 is a view similar to FIG. 1 in which the curb face piece assembly of FIG. 2 has been positioned on the slabs;

FIG. 5 is a cross-sectional view taken substantially along the line 5—5 of FIG. 4;

FIG. 6 is a view similar to FIG. 4 in which the pad member of FIG. 3 has been positioned on the slabs;

FIG. 7 is a cross-sectional view taken substantially along the line 7—7 of FIG. 6;

FIG. 8 is a cross-sectional view taken substantially along the line 8—8 of FIG. 6;

FIG. 9 is an enlarged cross-sectional view taken substantially along the line 9—9 of FIG. 6;

FIG. 10 is a schematic plan view of a sealing assembly positioned to seal a substantially skewed transverse roadway joint and adjacent curb and gutter joint;

FIG. 11 is an enlarged perspective view of an end dam assembly of FIG. 10;

FIG. 12 is a fragmentary perspective view of adjacent curb and gutter portions of adjacent roadway slabs adapted to be sealed in accordance with a further embodiment of this invention;

FIG. 13 is a perspective view of a further curb face piece assembly of this invention;

FIG. 14 is a perspective view of the curb face piece assembly of FIG. 13 oriented generally as it is to be installed on the slabs of FIG. 12;

FIG. 15 is a view similar to FIG. 12 in which the curb face piece assembly of FIG. 13 has been positioned on the slabs;

FIG. 16 is a view similar to FIG. 15 in which a gutter pad member has been positioned in sealing engagement with the curb face piece assembly and roadway slabs;

FIG. 17 is a cross-sectional view taken substantially along the line 17—17 of FIG. 13;

FIG. 18 is a cross-sectional view taken substantially along the line 18—18 of FIG. 15;

FIG. 19 is a cross-sectional view taken substantially along the line 19—19 of FIG. 14; and

FIG. 20 is a cross-sectional view taken substantially along the line 20—20 of FIG. 12, showing a mandrel shape in phantom as it is prior to installation.

A schematic view of a typical skewed roadway joint defining a gap between adjacent slabs and associated curb and gutter portions is schematically illustrated in FIG. 10. As there seen, a pair of adjacent slabs S are positioned to accommodate vehicular travel, as in the direction D. The adjacent slabs S confront each other at a gap G which is at a substantial skew to direction D. The gap G extends between the slabs to the roadway edge (the gutter portion of the slabs) and also extends between the upwardly angled slab side portions, i.e., the curb portions C.

Substantially the entire length of the skewed gap G may be bridged and sealed by a plurality of end dam sections 10 which may be made and assembled in accordance with the disclosure of said U.S. Pat. No. 3,713,368. A typical end dam section 10 according to that application may comprise a pair of spaced, longitudinally extending parallel side pads 12 joined centrally by a gap-bridging flexible joint membrane 14. Membrane 14 is very substantially thinner than the side pads 12 (as is seen in the drawings) and is desirably secured to the side pads adjacent the lower edges thereof. Membrane 14 has an upstanding arched configuration to enhance its performance in use and under dynamic loading.

Each end dam section 10 is integrally formed, as by being extruded or molded of a suitable elastomeric material, such as rubber, or a polychloroprene or neoprene rubber. Preferably, the joint membrane 14 embeds one or more fabric layers 15, such as a woven polyester fabric, to enhance its tear strength, dimensional stability, wear, cut and abrasion resistance, and service life. An entire end dam section 10 may be made by assembling uncured rubber elements in which a fabric layer 36 and plates 16 are appropriately embedded, after which the uncured rubber is cured, as by vulcanizing it.

Each side pad 12 is generally rectangular in transverse cross section and embeds an elongate, longitudinally extending reinforcing plate 16. Plates 16 extend substantially the entire length of side pads 12, are parallel to the upper surfaces 18 of the slabs and serve to distribute anchoring stud loads between anchoring studs. Each side pad defines a suitable plurality of bolt holes 17, which are proportioned to accommodate and receive a threaded anchoring stud, washers, and a nut to assist in securing the side pads 12 to the edges of the deck slabs adjacent the gap G. The studs may be suitably secured in deck slab S, as by an epoxy-cement grout, and the bolt holes may later be filled with a suitable compound, such as a flexible epoxy or a vulcanizable liquid rubber, to bring the holes up to the level of the lower surfaces of traction and drainage grooves 20 in the side pad upper surfaces 18. Because the upper surfaces 18 of the side pads 12 actually serve as roadway or deck surfaces, the upper surfaces 18 should desirably be parallel to the upper surfaces of the slabs S.

When end dam sections 10 are installed in preexisting or finished cast slabs, the edges of the slabs adjacent gap G must be scarified (and then built up to level if necessary) to form notches 22 of substantially the same size and shape as the side pads. After installation of sections 10 it may be necessary to backfill the notches to completely fill any space between the side pad outer edges and the confronting vertical notch edges. If the final road wearing surface is to be such as of asphalt or macadam, to be deposited on the surface of a concrete or asphaltic concrete slab, then end dam sections 10 may simply be secured in position, after which such a road wearing or surfacing material is deposited up to the level of the upper surfaces 18 of the side pads, and against the outer edges of side pads 12.

To secure the end dam sections to the slabs S most effectively, it is desirable to adhere them (as well as to bolt them) to slabs S, as by an adhesive layer (such as a suitable neoprene adhesive) which is applied intermediate the lower surfaces of the pads 12 and the confronting surfaces of the slab. Where the slab is notched, as at 22, the adhesive layer may also be provided on the vertical wall of the notch. When so secured and positioned, side pads 12 not only seal against the passage of dirt and water under the pads and downwardly through the gap G, but also protect the edges of the slabs adjacent gap G from spalling.

End dam sections 10 are preferably formed so that they may be sealingly secured in an end-to-end array, thereby to act cooperatively therewith to provide the necessary sealing effect at adjacent ends and across the skewed gap G, to provide for thermal expansion and contraction longitudinally of the array, and to provide an effective seal under dynamic loading. As such, the end faces of the side pads 12 are beveled or tapered. One end of the side pads 12 has first tapered end faces 24 and the other end has second complementarily tapered end faces 26. At the end providing end faces 24, joint membrane 14 projects outwardly and integrally with additional longitudinal seal segments 28. The lower surfaces of side pads 12 at the end providing end faces 26 may define notches 30 to receive seal segments 28. When adjacent ends of sections 10 are juxtaposed, portions of joint membranes 14 of adjoining end dam sections will overlie each other, and seal segments 28 will underlie and fit within notches 30. When a suitable adhesive, such as a neoprene adhesive layer is interposed between confronting end faces 24 and 26, between overlapping areas of adjacent joint membranes 14, and between seal segments 28 and notches 30, a joint which is secure, watertight, and substantially permanent, even under dynamic loading, will be formed between adjoining end dam sections 10.

A suitable number of end dam sections 10 may be joined together to form a sealed, gap-bridging end dam assembly commensurate in length with any usual length of deck slab gap it may be necessary to seal.

Although the major length of the gap G may be sealed by a plurality of assembled end dam sections 10, it will be apparent from FIG. 10, especially where the gap G is substantially skewed, that problems will be encountered in attempting to seal the slabs at the gutter portions and curb portions of the slabs, and in attempting to seal the intersection between them, especially under dynamic loading.

A typical, difficultly sealable portion of a gap G between adjacent slabs S is enlarged in FIG. 1 to illustrate

the substantial skew and the problems which it poses to effective sealing. There, side edges or gutter portions **40** of adjacent slabs S terminate at their outer edges in curb portions C. Curb portions C may be integrally formed, as of concrete, with the gutter portions **40** at the time the slabs S are formed, or, alternatively, may be assembled at the gutter edges in any other conventional manner known to the art. In each instance, however, because the adjacent slabs S and the associated curb and gutter portions are adapted to move relatively to each other, and because it is desirable to protect the edges of the slabs S from moisture and seepage, both in the major roadway areas and in the curb and gutter areas, effective means must be provided for sealing the entire gap.

The curb and gutter portions and surfaces are illustrated in FIG. **1** as having been prepared to receive an appropriate sealing assembly. In the embodiment illustrated, portions **40** and C have been notched to receive a curb gap sealing member and a gutter gap sealing member. This curb notches **46** and gutter notches **48** may be pre-formed or, where an existing curb and gutter intersection **50** is to be sealed in accordance with this invention, roadway material may be removed to provide the notches **46** and **48.**

Curb notches **46** are proportioned to receive a curb face piece assembly **52.** The face piece assembly **52** comprises a pair of parallel, spaced apart side pads **56** centrally joined by a gap bridging, longitudinally extending, arched joint membrane **58.** Joint membrane **58,** like membrane **14,** is flexible and is substantially thinner than the side pads **56** and is preferably sealingly secured to the side pads **56** adjacent the lower edges thereof. Side pads **56** are adapted to secure the assembly **52** to curb portions C to anchor the joint membrane **58** for sealing the portion of the gap G between the curb portions C. Desirably, side pads **56** and joint membrane **58** are integrally formed, as by being extruded or molded of a suitable elastomeric material, such as rubber or polychloroprene or neoprene rubber.

Each side pad **56** is generally rectangular in transverse cross-section and embeds a reinforcing washer **60** which is adapted, to the extent necessary, to distribute the load applied by nuts **62** which are screwed onto anchoring studs **64.** Studs **64** may be suitably secured in the curb portions C, as by an epoxy-cement grout in a known manner.

Joint membrane **58** is preferably reinforced, as by embedding a fabric layer therein during the curing of the joint membrane. The fabric layer enhances the tear strength, dimensional stability, cut and abrasion resistance and surface life of the membrane **58.** When a fabric layer is incorporated, a molding procedure, rather than an extruding process is used to form assembly **52.**

As seen in FIG. **4,** the pad section extends downwardly along a length of the curb portions to the intersection **50.** The intersection is bridged by an expansive sealing flap **54** which may be of a suitable rubber-like material and which is either integrally molded and formed with the remainder of the assembly **52,** or which is otherwise suitably sealingly secured to the lower surfaces of the pads **56** and membrane **58** (see FIG. **8**), and projects from one end of assembly **52.** Desirably flap **54** is generally trapezoidal in shape and projects laterally beyond the outer side edges **57** of the side pads to accommodate a broad range of intersections and skewed gaps to be sealed. Flap **54** may be cut down as appropriate at the time of installation. Sealing flap **54** may be a sheet of rubber-like material or may embed a layer of reinforcing material. In any event, it is desirably substantially thinner than and more flexible than the joint membranes **58** and **74** to minimize interference with their sealing function and operation. The flap is also preferably quite elastic and stretchable to enable it to conform most closely to the joint membranes and to the mandrel.

When an edge **66** of a gutter pad member **70** is positioned closely to confront the lower edge of an assembly **52,** as illustrated in FIGS. **6** and **7,** and pad elements **72** are suitably sealed to sealing flap **54,** a water-tight joint at intersection **50** will be provided.

The gutter gap sealing pad member **70** may comprise a pair of spaced parallel side pad elements **72** joined centrally by a thin, integrally formed gap bridging joint membrane **74.** Pad elements **72** are adapted to secure the gutter pad member **70** the the slabs S, and also to act as an armor or dams for the roadway surface or gutter edges, thereby to prevent crumbling and spalling. Each side pad element is generally rectangular in transverse cross-section and embeds a longitudinally extending reinforcing plate section **76.** Plate sections **76** lie parallel to the upper surfaces of the pad elements **72** and serve to distribute the anchoring stud loads. The upper surfaces **80** of the side pad elements **44** are proportioned and adapted to serve as roadway surfaces, like the upper surfaces **18** of end dam sections **10.** Member **70** may be a portion of an end dam section **10** which has been cut to a proper skew.

Desirably, joint membranes **58** and **74** are formed to have an upstanding arched configuration in transverse cross-section. That enhances their sealing functions, generally as described in connection with the operation of joint membrane **14** in U.S. Pat. No. 3,713,368, and maximally and most effectively accommodates relative movement of the spaced adjacent slabs S at gap G. The shapes of joint membranes **58** and **74** desirably are the same, so that they will each accommodate maximum relative movement of the slabs S within a given design range, without transmitting significant reaction loads to the anchoring studs, to the adhesive securing the assembly **52** and gutter pad member **70** to the curb and gutter portions, and without exerting significant loads on the side pads **56** and pad elements **72.** To so act, while also sealing the gap G, requires the formation of a substantial seal across intersection **50** and between the assembly **52** and pad member **70.**

To seal the gap G at the intersection **50,** the sealing flap must be conformed to the shape of the confronting surfaces of pad member **70.** Accordingly, an elongate shaping means such as a crowned mandrel **90** is provided.

Mandrel **90** is proportioned to be forced into and positioned in gap G adjacent intersection **50,** to be supported therebetween to urge and bias sealing flap **54** into firm confronting engagement with the lower surfaces of joint membranes **58** and **74.** Mandrel **90** projects upwardly from the gutter surfaces for a length of gap G in gutter portions **40** and outwardly from the curb surfaces for a length between curb portions C. Desirably, mandrel **90** is of a resilient foam material, such as polyurethane foam having a density of about 3 pounds per cubic foot, for example one sold by Firestone under the designation No. 3,760. A piece of such

foam as much as double the width of the gap is compressed to fit it into the gap with the upper edge projecting upwardly to form a support for the flap **54** and membranes **58** and **74**. Preferably the mandrel is shaped to form a tapered or crowned upper edge portion **91** which remains uncompressed when the lower edge portion is seated in the gap. When so supported, mandrel **90** will resist downward and outward loads to the extent necessary to shape the flap **54** and to force it into conforming engagement, particularly with the lower confronting surface of joint membrane **74** since the flap may previously have been sealingly secured to membrane **58.** However, in the curb portions, mandrel **90** serves to assist in the initial assembly and shaping of the sealing assembly and to minimize bunching and wrinkling of the flap. Where the flap and membrane are preassembled or integrally molded, a mandrel portion in the curb gap may be unnecessary.

When the curb face piece assembly **52** is first mounted (generally as illustrated in FIG. **4**), the sealing flap **54** is draped across the upper crowned edge of mandrel **90,** substantially as illustrated in FIG. **5.** Because mandrel **90** provides a crowned upper edge portion **91** which is similar in cross-section to the shape of joint membrane **74** and which underlies and supports a central portion of the flap when gutter pad member **70** is positioned as illustrated in FIG. **8,** mandrel **90** will allow the flap to stretch and will urge flap **54** into expansive confronting engagement with joint membrane **74** to provide a secure, broad seal between flap **54** and joint membrane **74.** Of course, the major surfaces of flap **54** will also be disposed against the lower surfaces of pad elements **72,** to provide a broad expansive seal therebetween as well.

When a curb and gutter sealing assembly of this invention is to be utilized, a suitable plurality of anchoring bolts **64** are provided in the curb portions of adjacent slabs S. A pre-formed face piece assembly **52** is then trimmed to an appropriate length and a pad member **70** is then cut to an appropriate angle and length, usually to a skewed angle.

A mandrel **90** is positioned in gap G in the manner described. A suitable sealant or mastic is provided in notches **46.** Curb face piece assembly **52** is then positioned (as illustrated in FIG. **4**) and is bolted into position to hold assembly **52** in sealing engagement with the curb portions C and to sealingly bridge the curb gap. Notches **48** are then provided with a suitable mastic, and the expansive sealing flap **54** is evenly and smoothly draped across mandrel **90** and cut off as necessary (see FIG. **4**) to fit in the notches **48.** Further adhesive or mastic is then applied to the upper surface of flap **54** and at the ends of the side pads **56** preparatory to receiving a gutter pad member **70.**

Pad member **70** is then positioned (as illustrated in FIG. **6**), is manipulated to force the joint membrane **74** and sealing flap **54** into broad sealing engagement, is bolted down to maintain the sealing relationship, to bridge the gutter gap, and to hold edge **66** in close adjacency with a confronting end portion of assembly **52.** End dam sections **10** may be secured adjacent the other end of pad member **70** to bridge a gap G across the remaining width of the adjacent slabs S.

The foam material of which mandrel **90** is made, although substantial enough to force sealing engagement between flap **54** and joint membrane **74,** is soft enough so that it will not significantly impair the movement of joint membranes **58** and **74** as the slabs S move with respect to each other. The mandrel **90** need not be removed, but it will be clear that it will deteriorate rapidly under dynamic loading and the weather conditions to be encountered. It will have served its purpose, however, as soon as the initial installation procedure referred to above has been completed.

FIGS. **12** to **20** illustrate a further embodiment of a curb and gutter sealing assembly of this invention. The curb and gutter surface portions are illustrated as having been prepared to receive and mount a sealing assembly of this invention and have been provided with suitable curb notches **146,** gutter notches **148** and mounting bolts (not shown). It is also possible to surface mount such a curb and gutter sealing assembly in which event roadway surfacing material will be added adjacent gap G' to build it up to the level of the side pads and pad segments to be described after installation. The curbs may be a conventional curb 10 to 12 inches high and substantially vertical, or may comprise, as illustrated, a substantially vertical portion terminating upwardly in a sloping safety curb portion.

Curb notches **146** are proportioned to receive a curb face piece assembly **152.** Assembly **152** comprises an expansive, integrated stretchable, elastic sealing flap **154** which projects from one end. Sealing flap **154** is preferably generally trapezoidal in shape, so that it may be used to accommodate a wide range of skewed gaps. Assembly **152** further comprises a pair of parallel side pads **156** centrally joined by a gap bridging, longitudinally extending, upstanding joint membrane **158.** Joint membrane **158,** like membranes **14** and **58** described above, is substantially thinner than the side pads **156,** and may be integrally formed with the side pads **156,** as by being molded of an elastomeric material. Side pads **156** are adapted to secure the pad section in the curb notches **146,** thereby to anchor the joint membrane **158** for sealingly bridging a portion of the gap between the slab curb portions. Each side pad **156** is generally rectangular in transverse cross-section, may embed a reinforcing washer and may be secured to the curb portions generally in the manner described in connection with the embodiment of FIG. **1.**

The sealing flap **154** is sealingly integrated with the upper surfaces of side pads **156** and membrane **158** (rather than with the lower surfaces as was the case with assembly **52**). Preferably, flap **154** is integrally formed with assembly **152,** as by a molding procedure. In any event, flap **154** is sealed to the upper surfaces of side pads **156** as well as to the upper surface of joint membrane **158.** Although the portion of flap **154** which projects longitudinally from the side pads is generally planar or flat over most of its expanse, centrally and adjacent the side pads **156** in the region of joint membrane **158,** a downwardly opening concave area **155** is provided. Concave area **155** is generally trapezoidal in plan view and serves to facilitate sealing cooperation between the flap and the gutter sealing member to be described.

The hollow provided by concave area **155** allows assembly **152** to assume the position illustrated in FIG. **14** (and **19**). By providing such an area, particularly where a skewed intersection is to be sealed and the curb portions extend upwardly at a right angle (rather than sloping at a more gradual angle as illustrated in FIG. **1**), a substantially improved seal is obtained over that which may be obtained by using a flat flap, or one which is at-

tached to the bottom of assembly **152.** That is because maximum accommodation to the shape of a mandrel between flap **154** and the gutter sealing pad member **170** is obtained, and with a minimum of wrinkling and bunching. For the reasons stated above, flap **154** is preferably thinner than the joint membrane and is preferably substantially more flexible.

The intersection **150** is sealed, both by the curb face piece assembly **152** (and the associated flap **154**) and gutter pad member **170.** Gutter pad member **170** comprises a pair of spaced apart, parallel side pad elements **172** joined centrally by a thin, integrally formed gap-bridging joint membrane **174.** Pad elements **172** serve to secure gutter pad member **170** to the gutter portions and in gutter notches **148,** and act as armor in a manner and for the purposes described above. Pad member **170** may be substantially identical in construction and in configuration to gutter pad member **70.**

An elongate mandrel **190** is positioned in the gap G' between the adjacent roadway sections. Mandrel **190** may be formed or shaped of a sponge or foam material, such as that described above.

As illustrated in FIGS. **12** and **20,** the mandrel **190** may comprise a solid block of foam of substantial length which has been shaped and trimmed to provide contoured crown portion **192** at its upper edge. The foam mandrel is forced into the gap G' by compressing its sides, i.e., generally from the shape illustrated in phantom, to that illustrated in solid line in FIG. **20.** As such, a single mandrel **190** may be installed in gaps of varying width within a reasonable range of widths (such as from 1½ to 3 inches), and is strong enough and has sufficient body to be self-supporting and self-sustaining in the gap. When so positioned, the mandrel **190** will resist loading to the extent necessary to shape flap **154** generally to the contour of crown **192** (see FIG. **15**), and to force it into conforming engagement with the confronting surface of joint membrane **174** (generally as illustrated by FIG. **16**). It is to be noted (see FIG. **12**) that mandrel **190** is positioned only in the horizontal portions of the roadway gap G', i.e., in the gutter area, and that it does not extend upwardly in the curb areas as was the case in connection with the embodiment of FIG. **1.** It has been determined that with a curb face piece assembly generally in accordance with FIG. **13,** i.e., with the flap secured to the curb face piece at the upper, rather than at the lower surface, suitable sealing is obtainable without providing a mandrel portion in the curb area.

When curb and gutter gaps adjacent an intersection **150** are to be sealed, suitable mounting bolts as described above are provided in the curb and gutter notches and a mandrel **190** is positioned generally as illustrated in FIG. **12.** Sealant or mastic is then appropriately applied to the surfaces of notches **146** and **148** and the curb face piece assembly **152** is secured in notches **146** with the membrane **158** bridging the portion of gap G' between the curb portions of the adjacent slabs. Flap **154** is then draped across the mandrel **190** and stretched and conformed by hand to the mandrel, generally as illustrated in FIG. **15.** Because the flap is thin and elastic, it may be stretched somewhat, so that it will more closely conform to the mandrel and to the gutter pad when it is juxtaposed. After the flap is conformed to the mandrel, the flap side edges are trimmed off as necessary so that they fit neatly within notches **148.** The flap is smoothed out as much as possible to eliminate wrinkles and to minimize bunching which is a deterrent to good permanent sealing.

Once flap **154** has been properly positioned, its upper surfaces are coated with a suitable mastic or sealant. Gutter pad member **170** which has been cut to the appropriate skew is then positioned, as illustrated in FIG. **16,** preferably by first placing one of the pad elements **172** in its notch (and on its studs) and thereafter drawing the other pad element **172** downwardly over mandrel **190,** over its stud and into its notch **148.** By so doing, the joint membrane **174** is brought into expansive sealing contact with the flap. The resilience of mandrel **190** resiliently urges the flap upwardly into engagement with the lower surface of joint membrane **174,** thereby to provide a good secure seal between membrane **174** and flap **154.** It is to be noted that the skewed end of the member **170** closely confronts a lower end portion of assembly **152** to enhance the gap seal.

Where desired, a curb face piece assembly, such as assembly **152,** may be configured at its upper edge to mate with an end dam section or portion thereof, thereby to seal a greater length of the curb gap. To that end, the upper end of the curb face piece has been shown to include seal segments which may be the same as seal segment **28.** Alternatively, the upper end may provide notches, like notches **30,** proportioned to sealingly receive seal segments of an end dam section.

Curb and gutter assemblies in accordance with this invention have been found to function satisfactorily, effectively providing a continuous joint membrane **58–74** (**158–174**) which functions very much like the continuum of joint membranes **14** described in the above mentioned application. Indeed, a curb and gutter assembly sealing a gap having a skew angle of as much as 45° has been found to function satisfactorily under dynamic loading, while the joint membranes continue to perform their sealing functions.

The interposition of an elastic expansive sealing flap, especially one which is integrally molded with a curb face piece assembly, and preferably one which is formed with the upper surfaces of a face piece assembly, assures a continuous seal not only between the angularly related joint membranes of a curb face piece assembly and gutter pad assembly, but also between the face piece assembly side pads and pad elements. That provides a good and substantial seal across a slab gap, as well as across the intersection of the curb and gutter portions of the slabs. It effectively seals the gap at the intersection, even for skewed curb and gutter gaps where relative movement of adjacent slab sections not only expands and compresses joint membranes, but where it torques and twists them as well.

Although the expansive flap functions effectively to seal the gap at the intersection, it is the expansive sealing contact between the adjacent curb and gutter assemblies and the flap that makes the overall sealing assembly an effective one. The mandrel positioned in the gap to bias the sealing flap into conforming engagement with the gutter pad assembly assures an expansive seal, and accordingly, is an important component of the sealing assembly of this invention.

The foregoing description and drawings of presently preferred embodiments of this invention will suggest further modifications to those skilled in the art. Accordingly, the invention is to be limited only insofar as the claims may require.

What is claimed is:

1. A curb face piece assembly for dynamically sealing a gap between curb and gutter portions of adjacent roadway slabs comprising a pair of elongated parallel side pads adapted for securance to curb portions of adjacent roadway slabs to seal a curb gap portion, an elongate, arched flexible joint membrane sealingly secured to said side pads to prevent the passage of water and debris between the joint membrane and the side pads, an expansive, elastic sealing flap projecting from one end of each of said side pads and of said membrane and extending laterally beyond the outer side edges of said side pads, said sealing flap being sealingly secured to said side pads and membrane adjacent said one end, said sealing flap being proportioned to overlie and bridge the gap between gutter portions of adjacent roadway slabs and to cooperate therewith and with a gutter gap sealing member to seal a gutter gap portion and the intersection of the gap between adjacent curb and gutter portions.

2. A curb face piece assembly in accordance with claim 1 wherein said sealing flap is integrally molded with said side pads and with said flexible joint membrane.

3. A curb face piece assembly in accordance with claim 1 wherein said sealing flap is sealingly secured to upper surface portions of said side pads and of said flexible joint membrane.

4. A curb face piece assembly in accordance with claim 3 wherein said sealing flap is generally flat but defines a downwardly opening concave area adjacent the side pads in the region of the flexible joint membrane, to facilitate its cooperation with a gutter gap sealing member and to facilitate its sealing of a gutter gap portion and a said gap intersection.

5. A curb face piece assembly in accordance with claim 1 wherein said sealing flap is sealingly secured to lower surface portions of said side pads and of said flexible joint membrane.

6. A curb face piece assembly in accordance with claim 1 wherein said sealing flap is generally trapezoidal in shape in plan view.

7. A curb face piece assembly in accordance with claim 2 wherein said sealing flap is thinner than, and substantially more flexible than, said flexible joint membrane.

8. A curb face piece assembly in accordance with claim 1 wherein said sealing flap is generally flat but defines a downwardly opening concave area adjacent the side pads in the region of the flexible joint membrane, to facilitate its cooperation with a gutter gap sealing member and to facilitate its sealing of a gutter gap portion and a said gap intersection.

9. A method of sealing a roadway gap at the intersection of curb and gutter portions of adjacent roadway slabs to prevent the passage of water and debris through the gap at the intersection, comprising the steps of preparing upwardly extending curb and generally horizontal gutter surfaces adjacent the gap to receive a curb gap sealing member and a gutter gap sealing member, providing a curb gap sealing member having a thin elongate, elastic sealing flap extending from one end thereof, said sealing flap having a large sealing surface defining a downwardly open concave area within its perimeter, securing said curb gap sealing member in an upwardly extending position to said curb slab surfaces sealingly to bridge a curb gap portion and disposing said elongate sealing flap in a generally horizontal position across the intersection of said curb and gutter portions and across the gutter portions sealingly to bridge said intersection and a portion of the gutter gap, providing an adhesive sealant on the upper surface of said sealing flap, securing a separate gutter gap sealing member to said gutter slab surfaces to bridge a gutter gap portion adjacent the intersection and to closely confront and to overlie said elastic sealing flap, and shaping and forcing the concave area of said sealing flap into conforming engagement with extensive confronting lower surface portions of said gutter gap sealing member thereby to sealingly secure said sealing flap to said extensive confronting lower surface portions.

10. A method in accordance with claim 9 comprising the step of cutting an end of a gutter gap sealing member to a skewed angle prior to securing it to said gutter slab surfaces.

11. A method in accordance with claim 9 wherein each of said sealing members comprises a pair of pad members bridged by a central joint membrane positioned over and parallel to the associated gap portion, and wherein said sealing flap is sealingly conformed and secured to the contour of each joint membrane and is sealingly secured to each of said pad members.

12. A method of sealing a roadway gap at the intersection of curb and gutter portions of adjacent roadway slabs to prevent the passage of water and debris through the gap at the intersection, comprising the steps of preparing curb and gutter surfaces adjacent the gap to receive a curb gap sealing member and a gutter gap sealing member, securing a curb gap sealing member to said curb slab surfaces sealingly to bridge a curb gap portion, positioning an expansive sealing flap across the intersection of said curb and gutter portions and across the gutter portions to bridge a portion of the gap, securing a gutter gap sealing member to said gutter slab surfaces to bridge a gutter gap portion adjacent the intersection and to closely confront said curb gap sealing member, conforming said sealing flap to expansive lower surface portions of said gutter gap sealing member, and sealingly securing said sealing flap to said expansive lower surface portions, and further comprising positioning a shaping member in said gutter gap so that said shaping member extends upwardly beyond the said gutter surfaces to underlie and support thereon a central portion of said sealing flap, and wherein said conforming step comprises urging said central sealing flap portion into a central arched segment of said gutter gap sealing member to provide sealing securement between said central sealing flap portion and said central arched segment.

13. A method in accordance with claim 12 wherein said shaping member is a resilient foam member which is compressed to seat it in said gutter gap portion, an uncompressed crowned portion thereof projecting upwardly from said gutter slab surfaces.

14. A sealing assembly for sealing the gap between curb and gutter portions of adjacent, slightly spaced, relatively movable roadway slabs, and wherein the curb portions extend upwardly from their intersection with the gutter portions, a curb face piece assembly comprising a pair of parallel, spaced apart side pads secured to surfaces of said curb portions at opposite sides of the curb gap, a flexible membrane sealingly secured to the side pads and bridging said curb gap, an expansive, elastic sealing flap member sealingly secured to said side pads and to said flexible membrane, extending

across said intersection and bridging the gutter gap, a gutter sealing member comprising a pair of parallel, spaced apart side pad elements each having an upper surface adapted to serve as a roadway surface and each being secured to a gutter surface at a side of the gutter gap, and a flexible joint membrane sealingly secured to said side pad elements for sealingly bridging the gutter gap, said expansive sealing flap member lying in expansive confronting engagement with said side pad elements and joint membrane, and being sealingly secured thereto, and further comprising a shaping member disposed in said gutter gap, said shaping member projecting upwardly from said gutter surfaces, and wherein said shaping member urges said sealing flap member into said conforming engagement with said flexible joint membrane.

15. A sealing assembly in accordance with claim **14** wherein said shaping member is an elongate section of compressible foam, and lower portions of said section are compressed in said gutter gap.

16. A sealing assembly in accordance with claim **14** wherein said sealing flap is generally flat but defines a downwardly opening concave area adjacent the side pads in the region of the flexible membrane, to facilitate its cooperation with said gutter sealing member and to facilitate its sealing of said gutter gap portion and said gap intersection.

17. A sealing assembly for sealing the gap between curb and gutter portions of adjacent, slightly spaced, relatively movable roadway slabs, and wherein the curb portions extend upwardly from their intersection with the gutter portions, a curb face piece assembly comprising a pair of parallel, spaced apart side pads secured to surfaces of said curb portions at opposite sides of the curb gap, a flexible membrane sealingly secured to the side pads and bridging said curb gap, an expansive, elastic sealing flap member sealingly secured to said side pads and to said flexible membrane, extending across said intersection and bridging and overlying the gutter gap, said sealing flap member being generally trapezoidal in plan view, a gutter sealing member comprising a pair of parallel, spaced apart side pad elements each having an upper surface adapted to serve as a roadway surface and each being secured to a gutter surface at a side of the gutter gap, and a flexible joint membrane sealingly secured to said side pad elements for sealingly bridging the gutter gap, said expansive sealing flap member lying in expansive confronting engagement with said side pad elements and joint membrane, and being sealingly secured thereto.

18. A roadway face piece assembly for dynamically sealing a gap between first portions and second portions at a side of adjacent roadway slabs, said first portions and said second portions being disposed at an angle to each other, said assembly comprising a pair of elongated parallel side pads adapted for securance to said first portions of adjacent roadway slabs to seal a first gap portion, an elongate, arched flexible joint membrane sealingly secured to said side pads to prevent the passage of water and debris between the joint membrane and the side pads, an expansive, elastic sealing flap projecting from one end of each of said side pads and from the end of said membrane, and extending laterally beyond the outer side edge of at least one of said side pads, said sealing flap being sealingly secured to said side pads and membrane adjacent said one end and terminating in an end spaced from said side pads and from said membrane, said sealing flap being generally flat but defining a downwardly opening concave area adjacent the ends of the side pads in the region of the flexible joint membrane, to facilitate its cooperation with a second gap sealing member and to facilitate its sealing of a second gap portion and said gap intersection, said downwardly opening concave area being spaced inwardly of said terminating end, said sealing flap being proportioned to overlie and bridge the gap between said second portions at a side of adjacent roadway slabs and to cooperate therewith and with a second gap sealing member to seal said second gap portion and the intersection of the gap between said adjacent first portions and second portions.

19. A curb face piece assembly in accordance with claim **18** wherein said sealing flap is sealingly secured to upper surface portions of said side pads and of said flexible joint membrane.

20. A sealing assembly sealing the gap between first portions and second portions of adjacent, slightly spaced, relatively movable roadway slabs at one side of said slabs, said first slab portions and said second slab portions being angularly disposed with respect to each other to provide therebetween a first gap portion and a second gap portion, respectively, and merging in an angular gapped intersection, said sealing assembly comprising an expansive, generally flat elastomeric sealing flap having a first end, a second end opposite said first end and side portions circumscribing said sealing flap and defining a preformed downwardly open, concave region overlying said first portion of said gap and being positioned adjacent said intersection, said concave region being remote and spaced inwardly from said first end and from said side portions of said sealing flap, said concave region being proportioned to facilitate conformance of the sealing flap to said first slab portions adjacent said intersection with a minimum of bunching and wrinkling of said sealing flap and being deformed to conform to shaping means provided at said first gap portion, and shaping means extending upwardly from said first gap portion below said concave region against which said sealing flap is deformed to conform thereto, said second end being secured to said second slab portions and spanning the gap therebetween, and means sealingly securing said second end to said second slab portions and means sealingly securing said first end to said first slab portions.

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