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 [33] **Germany**
 [31] **P 18 00 775.5-25**

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[54] **SEALING STRIP FOR EXPANSION GAPS,
 ESPECIALLY IN ROAD PAVEMENTS**
 9 Claims, 6 Drawing Figs.

[52] U.S. Cl..... 94/18
 [51] Int. Cl..... E01c 11/10
 [50] Field of Search..... 94/18, 18.2

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ABSTRACT: This invention relates to a sealing strip for expansion gaps, especially in road pavements, which strips are shaped with at least one horizontal wall connected to sidewalls with ridges cooperating with gripping means in said gaps to hold the strip in the gap. The horizontal wall is connected to the sidewalls by means of a connection triangle-shaped and positioned to keep substantially free from obstructions the space confined by said horizontal and sidewalls, whereby the strip may fold itself as it yields when the gap narrows, for example, due to pavement expansion.

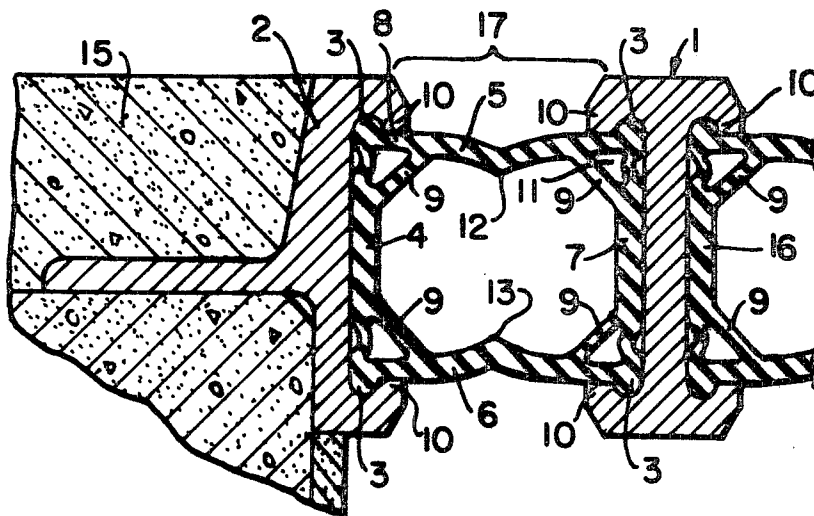


FIG. 1

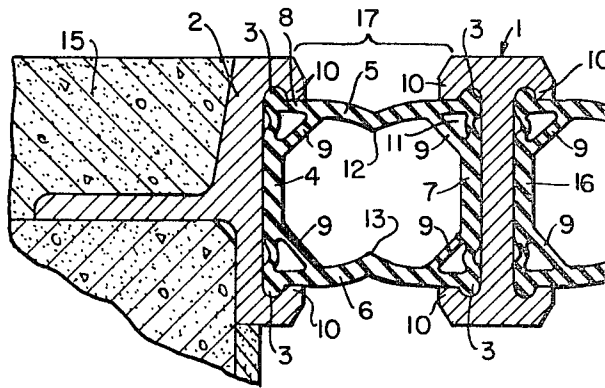


FIG. 1a

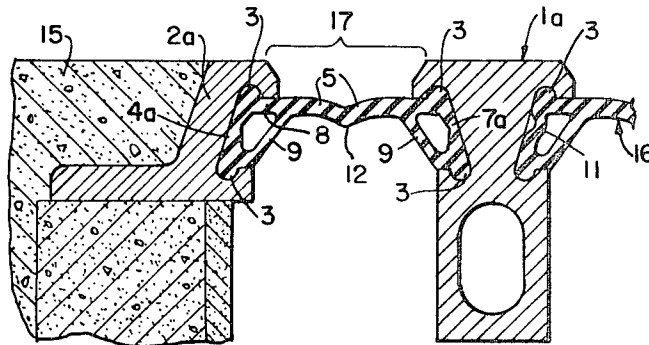
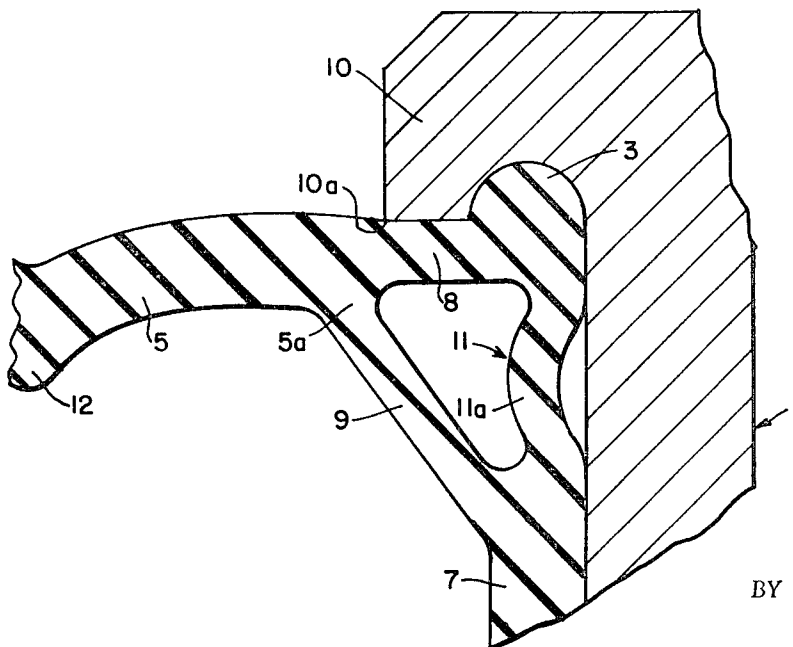


FIG. 2



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FIG. 3

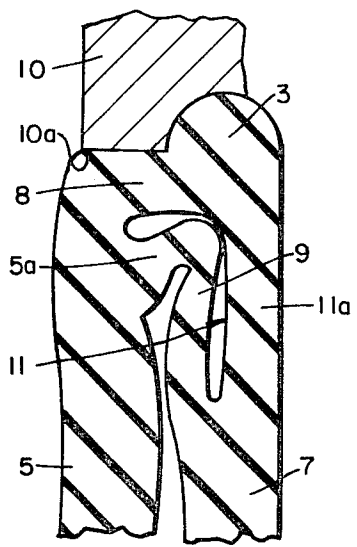


FIG. 4

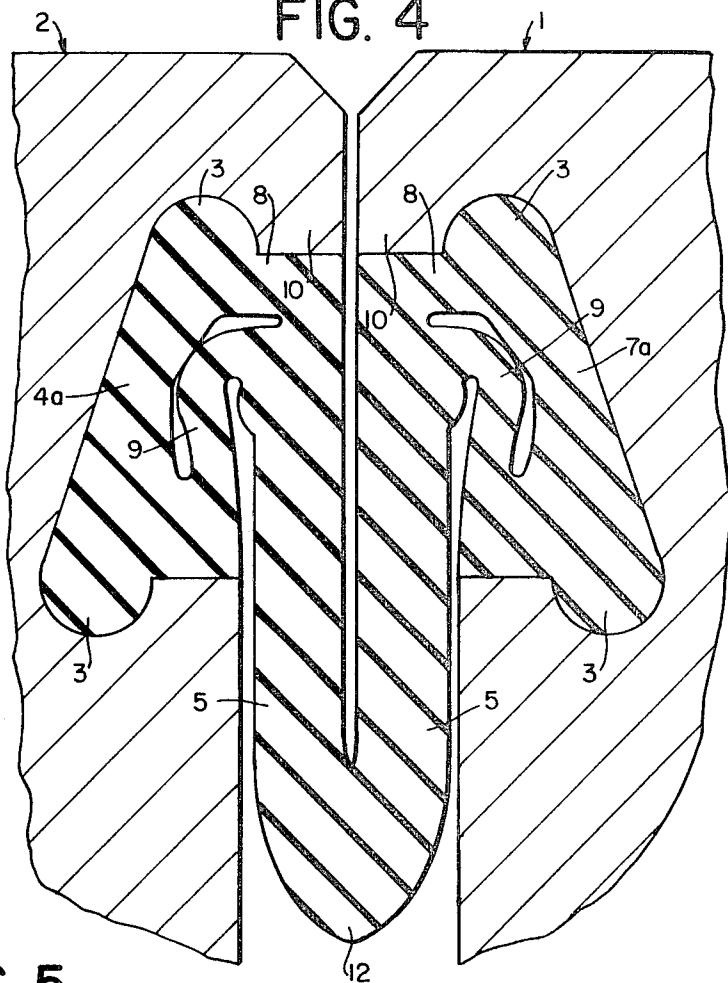
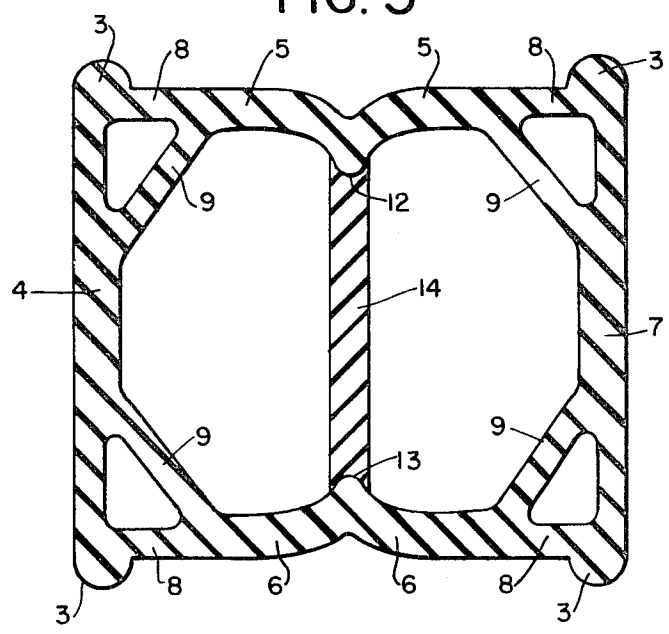


FIG. 5



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SEALING STRIP FOR EXPANSION GAPS, ESPECIALLY IN ROAD PAVEMENTS

BACKGROUND OF THE INVENTION

The present invention relates to sealing strips for expansion gaps, especially in road pavements. Such strips are made of a continuous piece of material and have a channel shape which may have an open or a closed cross-sectional area. The upper side of the channel and, if desired, also the lower side of the channel is formed by horizontal walls which are provided with longitudinally extending indentations approximately intermediate the sidewalls of the channel. The expansion gaps, for example, in road pavements are provided with gripping means extending within the gaps in parallel to each other and perpendicularly to the direction of traffic. Such gripping means comprise claws which face each other and which have free ends for cooperating with the sidewalls of the sealing strips to hold the strips in the gaps.

In order to assure a smooth ride for vehicles passing over a pavement which is provided with expansion gaps, it is necessary to properly close such gaps. Structures capable of performing said closing function are generally referred to as pavement crossings. Such pavement crossings frequently comprise gripping means connected to the edges of the adjacent pavement sections defining the gap, as well as elastic sealing means arranged between the gripping means. Where especially wide gaps are to be crossed or covered, additional gripping means may be arranged intermediate the edge gripping means. In the latter instance, the elastic means are held along one side by an edge gripping means and along the opposite side by an intermediate gripping means. The elastic means or members of a pavement crossing are largely made of Neoprene and serve for closing the crossed expansion gap against dirt and gravel as well as for making the gap watertight.

The width of the expansion gap may vary rather substantially depending upon the prevailing temperature. Therefore, the elastic sealing strips must be manufactured as expandable bodies. For this purpose Neoprene hollow tubular strips or profiles are arranged between the edge gripping means and the intermediate gripping means. The connection between the strips or profiles with the edge gripping means or with the intermediate gripping means is accomplished by means of gluing or by means of clamping.

However, the above-described pavement crossings have, with regard to the expandable strips, the drawback that, especially in connection with tubular strips having a box-shaped cross-sectional area, peaks of tensional forces occur along the edges of the strips which forces cause a peeling of the glued connection whereby such connection is destroyed. This drawback has been overcome in a different construction of the sealing strip as disclosed in West German Pat. No. 1,918,260 in such a manner that a tubular sealing strip is glued only along a center portion into grooves of the edge gripping means or of the intermediate gripping means. This known construction has, however, the drawback that the narrowing of the expansion gap forces the sealing strip upwardly and downwardly. Thus the surface of the sealing strip which is exposed directly to the traffic on the pavement is subjected to an increased tension which creates the danger that the surface may be ripped.

In another prior art pavement crossing construction as disclosed in Swiss Pat. No. 433,418, the sealing strip has the shape of a hose with a trapezoidal cross section made of a rubber elastic material. The parallel supporting walls of the hose are provided with at least one groove which extends adjacent the inclined sidewalls and which serves as a hinging gap. This hinging groove or gap due to its position adjacent to the edge of the sealing strip which is subject to the peaks of tensional forces, in effect assures that such tensional forces can be transmitted to the endangered spots only to a limited extent. However, even this construction has the drawback that the tensional forces occur to a still substantial extent at a position which is endangered with regard to said peeling. On the other hand, the hinging groove reduces the strength of the

sealing strip since it reduces the cross-sectional area of the upper supporting surface of the sealing strip or hose. Besides, it is practically impossible to achieve a complete rounding or smoothing of the hinging groove whereby it is hardly possible to avoid a notched effect.

U.S. Pat. No. 3,276,336 discloses expandable sealing strips which have a rectangular cross section whereby the upper and lower wall is provided with an inwardly directed indentation and which comprise in their inner space a rhombic grit structure. The purpose of this structure is to transmit the forces which occur when the expansion gap narrows to the sidewalls of the sealing strip and thus to the glued surfaces in order to avoid the peeling effect.

These known sealing strips have the disadvantage that their manufacture requires a substantial amount of material. On the other hand, the struts of the grit structure interfere with each other and with the remaining material of the sealing strip when the latter is being compressed whereby the expandability of the sealing strip may be utilized only to a limited extent. Besides, the edges of the rectangular sealing strip along which the glued connection begins still remain subject to the peeling effect.

OBJECTS OF THE INVENTION

In view of the above, it is the main object of the invention to overcome the above-outlined drawbacks of the prior art.

It is yet another object of the invention to provide a sealing strip which may be easily manufactured.

Yet another object of the invention is to provide a sealing strip of sturdy construction which nevertheless permits a narrowing of the expansion gap when the adjacent pavement sections expand.

It is a still further object of the invention to provide a sealing strip the sidewalls of which may be folded toward each other to the extent that the edge gripping means as well as the intermediate gripping means or the intermediate gripping means may touch each other when the pavement sections expand.

It is also an object of the invention to provide a sealing strip which will assure absolute sealing against dirt, gravel, and even water in any condition of the respective expansion gap. Stated differently, the sealing must be assured regardless of whether the gap is wide or narrow.

A still further object of the invention is to provide a method of manufacturing a sealing strip so that such strip will not sag when it is extruded from an extrusion die.

SUMMARY OF THE INVENTION

Briefly, according to the invention there is provided a sealing strip of the type described above comprising two sidewalls having upper and lower ridges which cooperate the free angled ends of the edge or intermediate gripping means, and further comprising an upper, and if desired, also a lower horizontal wall functioning as a carrying wall which along their edges toward the sidewalls extend into a substantially horizontal holding member and into a sloping supporting member to form a connection triangle for connecting the horizontal or carrier wall or walls to the sidewalls whereby the space confined by said walls is free of further struts or any other supporting means.

The provision of a supporting triangle has the advantage that without the use of glued connections it is now possible to button, so to speak, the sealing strip by means of sidewall ridges into the holding or gripping claws of the edge or intermediate gripping means whereby the mentioned connection triangle assures that the horizontally extending supporting or carrying wall of the strip which folds itself in the manner of a hinge when the gap is being narrowed, rotates about an axis located outside of that connection triangle. This has the advantage that the dangerous peaks of tensional forces have been removed from the endangered spots. When the gap is being narrowed still more the supporting member folds itself inwardly and thus presses the holding member from itself in-

wardly and thus presses the holding member from below against the claw which engages the sidewall ridges whereby the most effective sealing is maintained. When the sealing strip is not in its folded condition, the supporting member or strut affords a support for the horizontal carrying wall against vertically extending forces.

Yet another advantage of the invention is seen in the fact that the folding of the horizontal or carrying wall has a self-cleaning effect for the expansion gap because any dirt is wedged upwardly due to said folding action.

In order that the invention may be clearly understood, it will now be described, by way of example, with reference to the accompanying drawing, wherein:

FIG. 1 illustrates a sectional view through a sealing strip according to the invention held on one side by edge gripping means and on the other side by intermediate gripping means;

FIG. 1a illustrates a sectional view similar to that of FIG. 1, however, showing a sealing strip with but one horizontal, carrying wall;

FIG. 2 is a sectional view of a detail of FIG. 1 illustrating the connection triangle in a position when the gap is fully expanded;

FIG. 3 corresponds to the detailed view of FIG. 2, however, with the gap in an almost closed position;

FIG. 4 is a view on an enlarged scale similar to that of FIG. 1a illustrating the folded position of a sealing strip having but one carrying surface and positioned in a closed gap; and

FIG. 5 illustrates a sectional view through a sealing strip corresponding to that of FIG. 1, however, with a supporting member inserted into the sealing strip during its manufacture, said supporting member being removed when the manufacture of the sealing strip is completed.

Referring to FIG. 1, the sealing strip of this embodiment comprises two sidewalls 4 and 7 and an upper supporting horizontal wall 5 as well as a lower supporting horizontal wall 6. The sidewalls 4 and 7 are provided with upper and lower ridges 3. These ridges are engaged by angled claws 10 of edge gripping means 2 or of intermediate gripping means 1.

In order to form a connection triangle between each edge of the horizontally extending walls 5 and 6 and between the vertically extending sidewalls 4 and 7, the horizontally extending walls are provided along their edges with a substantially horizontally extending holding member 8 as shown in FIG. 2 and a support member or strut 9 which extends at an angle relative to the horizontal wall 5 as well as relative to the sidewalls 4 or 7.

The connection triangle according to the invention is completed by a wall section 11 of a sidewall 7 as best seen in FIG. 2. If desired, the sidewall section 11 within the connection triangle made up of members 8, 9 and 11 may be provided with an indentation 11a pointing toward the supporting member 9. These indentations 11a provide the necessary elastic forces for pressing the ridges 3 into the claws 10 of the edge gripping means 2 or of the intermediate gripping means 1. The sidewall portion 11 has a reduced cross section or a reduced thickness in the area of the triangle as compared to the remainder of the sidewalls 4 or 7.

The horizontal wall 5 comprises approximately intermediate its edges an indentation 12 pointing inwardly. The lower horizontal wall 6 is also provided with an indentation 13 again pointing inwardly relative to the sealing strip. These indentations assure that upon narrowing of the gap 17, that is, when the spacing between the intermediate gripping member 1 and the edge gripping member 2 is reduced, that the force acting upon the sealing strip is directed in such a manner that the horizontal walls are being folded inwardly.

The edge gripping means 2 may be attached to the edge of the adjacent structure, for example, to the edge 15 of a pavement section in any desirable known manner, for example, a portion of the edge gripping means 2 may be embedded in the concrete of the pavement. To the right of the intermediate gripping means 1 there may be positioned a further sealing strip 16 having the same construction as that shown between

the edge gripping means 2 and the intermediate gripping means 1. The further sealing strip 16 will also have indentations in those portions forming part of the connection triangle as shown. Further, the additional sealing strips 16 may be connected to additional intermediate gripping means (not shown) or the right-hand side of the further sealing strip 16 may be connected to a further edge gripping means (not shown) which would be a mirror symmetrical image of the edge gripping means 2 shown, for example, in FIG. 1.

FIG. 1 showing a sealing strip having a box shaped cross section positioned between the edge gripping means 2 and the intermediate gripping means 1, illustrates the maximum spacing of the gap 17. The inserting of the ridge 3 into the claw 10 results in a slight deformation of the holding member 8 so that the holding member 8 extends slightly upwardly toward the groove in the claw 10 and adjacent to the outer end 10a of the claw 10 there is a slight bend in the upper surface of the horizontally extending wall 5.

FIG. 1a illustrates a hat-shaped sealing strip having a channel-like cross section, the open end of which faces downwardly. The embodiment of FIG. 1a does not comprise a lower horizontal wall and the lower gripping claws of the intermediate gripping means as well as of the edge gripping means are slightly retracted horizontally relative to the respective upper gripping claws in order to accommodate the inclined sidewalls 4a and 7a illustrated in FIG. 1a. In this manner it is assured that there is sufficient space for the sealing strip portions when the gap 17 is being narrowed to an extent that the edge gripping means 2a and the intermediate gripping means 1a almost touch each other as shown in FIG. 4.

FIGS. 2 and 3 illustrate the change in the connection triangle comprising the holding member 8, the supporting member 9 and a portion 11 of the sidewall 7 when the gap 17 narrows due to the expansion of the pavement sections. The horizontal wall 5 is not bent except along its indentation 12 which is folded downwardly. However, the supporting member 9 is bent to form a fold as shown in FIG. 3. The inward bending of the supporting member 9 places the pivot point for the downward folding of the horizontal wall 5 approximately into the junction where the holding member 8 and the supporting member 9 are connected to each other and to the horizontal wall 5. In FIG. 3 the shape of the supporting member 9 is folded inwardly into the angle formed by the substantially horizontally extending holding member 8 and by the sidewall 7 to conform to the shape of such angle. Thus, the conforming of the supporting member 9 to the shape of the angle in the folded position of FIG. 3 affords an abutment for the folding of the horizontal wall 5 which prevents the removal of the ridge 3 from the claw 10.

The structure of FIG. 4 also affords an abutment because the supporting member 9 in its inwardly folded position as shown in FIG. 4 bears against the holding member 8 as well as against the portion of the sidewalls 4a and 7a.

From FIG. 4 it can also be seen that the approach of the gripping means 1 and 2 toward each other will wedge any dirt out of the slot between the folded wall portions 5.

FIG. 5 illustrates the insertion of a supporting structure 14 into the box-shaped sealing strip during its manufacture. This supporting structure assures that the sealing strip retains its desired shape and is removed after the material of the sealing strip has been cured.

According to the invention the support member 9 and the holding member 8 are dimensioned with regard to the horizontal wall 5 so that the moment of inertia of area relative to bending of the support member 9 and the moment of inertia of area relative to bending of the holding member 8 are together smaller than the moment of inertia of the horizontal or supporting wall 5. The sum of the cross-sectional area of the supporting member 9 and of the holding member 8 taken perpendicularly to their surface or the sum of the thickness of the holding member 8 and the supporting member 9 is larger than the cross-sectional area or the thickness of the horizontal wall 5. This feature of the invention

assures that when the gap is being narrowed, the supporting member 9 is folded as shown in FIG. 3 at a time prior to the folding of the supporting wall 5. This has the advantage that there are no obstructions in the way for the downward folding of the horizontal wall 5. A further advantage is seen in that the inwardly folded supporting member 9 assures an increased pressure against the lower surface of the holding member 8 and thus against the ridges 3 to keep them engaged with the claws 10. In addition, the folded support member 9 provides as reinforced abutment for the downward folding of the horizontal wall 5 which assures that the folding or pivoting point for the horizontal wall 5 remains outside the triangle 8, 9 and 11.

Referring again to FIG. 2, the invention assures that the junction 5a where the holding member 8 and the support member 9 are connected to the horizontal wall 5 is horizontally spaced from the edge 10a of the claw 10. Positioning the junction 5a outside the reach of the claw 10 will assure that the pivoting point will be located within the junction, or substantially within the junction, thus removing it from the connection triangle itself whereby a particularly tight connection is assured between the sealing strip and the gripping means.

Furthermore, the supporting member 8 in the position when the gripping means are widely spaced from each other as shown in FIG. 2 has a slightly upward inclination relative to the horizontal which facilitates the insertion of the ridge 3 into the gripping claw 10 and which also provides an increased pressure of the ridge 3 against the gripping claw 10. Such increased pressure improves the sealing and prevents the intrusion of gravel, dirt and/or water.

The sealing qualities are further improved by making the height of the sidewalls 4 and 7 as measured between the tip of the upper ridge 3 and the tip of the lower ridge, slightly larger than the spacing between the bottom of the groove in the upper and lower gripping claw of the gripping means. In this connection, it is desirable to provide the sidewalls 4, 7 with an indentation 11a as shown in FIG. 2 or with a section having a reduced thickness because this will facilitate the insertion of the ridges 3 into the receiving claws 10. In addition such an indentation 11a or such reduced thickness will provide elastic forces upwardly and downwardly within the plane of the sidewalls 4 and 7 so that the ridges will be pressed securely into the claws due to the bending of the indentation or the reduced-diameter section. It should be noted that the indentation 11a or the portion with reduced thickness is provided in the area of the connecting triangle so that bending of the sidewall outside the area of said connecting triangle is avoided since the sidewalls outside the triangle have a thickness larger than the sidewall portion 11 within the triangle. Thus, this feature of the invention confines positively the bending of the sidewalls to an area where it is desirable and prevents a bending in a range where it is not desired.

The invention further makes the cross-sectional area of the holding member 8 larger than the respective area of the support member 9. This feature prevents an upward bending of the holding member 8 and thus of the horizontal wall 5 into the space between adjacent gripping means. It is important to prevent the movements of portions of the sealing strip into the gap 17 above the upper surface of the horizontal wall 5 between the claws 10 of the gripping means because otherwise the sealing strip would prevent the proper narrowing of the gripping means and the sealing strip might be damaged due to its being pinched between the gripping claws moving toward each other. The invention has removed this drawback.

According to the invention, it is also desirable to dimension the width of the gripping claws so that they will overlap the portion of the folded sealing strip which is constituted by the thickness of the sidewall portion 11, by the thickness of the supporting member 9 and by the thickness of the holding member 8 as seen in FIG. 3 so that the folded sealing strip will be accommodated completely underneath the two claws as the claws approach each other whereby the claws may move toward each other until they contact each other.

In certain instances it may be desirable to provide the lower horizontal wall 6 with an indentation which points downwardly in the same manner as the indentation 12 of the upper horizontal wall 5 rather than inwardly as the indentation 13 shown in FIG. 1. In order to accommodate such a sealing strip with an upper and a lower horizontal wall, both of which have an indentation pointing downwardly, the lower claws will be spaced vertically outwardly relative to the upper claws and the sidewalls will be slanted as shown, for example, in FIG. 4. This arrangement will assure that the downwardly folding lower horizontal surface will not interfere with the narrowing of the gap. This particular construction is desirable where a relatively wide sealing strip is desired to seal broad gaps, but which sealing strip must have a relatively narrow width in the vertical direction.

Where in the production of the sealing strips according to the invention difficulties should be encountered due to very long sealing strips, the invention teaches to maintain the desired cross-sectional configuration even for such long strip by means of a supporting structure which is inserted into the sealing strip as it emerges from the extrusion tool. Such supporting structure is shown at 14 in FIG. 5 and will prevent the collapse of the sealing strip, especially during the time when it is not yet cured. Preferably the supporting structure is inserted approximately intermediate between the indentations of the upper and the lower horizontal wall and the supporting structure is removed after the curing has been completed. The use of the supporting structure is especially advantageous where the sealing strip has an upper horizontal wall with a downwardly pointing indentation and a lower horizontal wall with an upwardly pointing indentation as shown in FIG. 5. Advantageously, the supporting structure is also made of an extrudable material but which is not compatible with the material of the sealing strip so that it will not connect itself with the material of the sealing strip as it emerges from the extruding die. This feature facilitates the removal of the supporting structure after the curing or vulcanizing of the sealing strip.

The shape of the supporting structure 14 is not critical, for example, it may be hollow and thus may subsequently be used as a hose.

What I claim is:

1. A sealing strip for an expansion gap with a pair of superposed strip gripping means located in said gap, facing each other and defining a vertical gripping space, the strip comprising sidewalls, at least one horizontal wall, and, for connecting said horizontal wall to each sidewall, a holding member extending substantially in the direction of said horizontal wall and a supporting member extending at an angle relative to said horizontal and sidewalls to form with a portion of the sidewall a connection triangle, the space confined by said walls being substantially free of other holding and supporting elements, and said sidewalls having a height exceeding said gripping space.

2. The sealing strip according to claim 1, wherein the connection triangle portion of the strip sidewall has an indentation pointing toward the adjacent supporting member.

3. The sealing strip according to claim 1, wherein the connection triangle portion of the strip sidewall has along its length a section opposite said supporting member, which section has a reduced cross-sectional area as compared to the sidewall cross-sectional area outside said connection triangle.

4. The sealing strip according to claim 1, for an expansion gap with strip gripping claws extending into the gap and then downwardly to form recesses in the gap structure, upper and lower ridges of the strip sidewalls fitting elastically into the recesses.

5. A sealing strip for an expansion gap, especially in road pavements with strip gripping means located in said gap and facing each other, comprising strip sidewalls having upper and lower ridges adapted to fit into said gripping means, at least one horizontal wall, and means for connecting said horizontal wall to said strip sidewalls, said connecting means consisting of a holding member and a supporting member for each con-

nection, said holding member extending substantially in the direction of said horizontal wall and said supporting member extending at an angle relative to said horizontal wall and relative to said strip sidewalls, said holding member and said supporting member forming with a portion of the adjacent strip sidewall connection triangle, wherein the sum of the area moments of inertia of the holding and supporting members is smaller than the area moment of inertia of said horizontal wall, while the space confined by said walls is free of other holding and supporting elements.

6. The sealing strip according to claim 5, including a further horizontal wall and additional connecting means for connecting the further horizontal wall to said sidewalls, the horizontal

wall forming top and bottom walls of the sealing strip.

7. The sealing strip according to claim 5, wherein the sum of the thickness of the holding and supporting members is larger than the thickness of the horizontal wall.

8. The sealing strip according to claim 5, wherein said gripping means comprise claws, and wherein the sum of the thicknesses of the holding and supporting members and of the sidewall portion within said connection triangle is smaller than the width of the claws.

9. The sealing strip according to claim 5, wherein the cross-sectional area of said holding member is larger than the cross-sectional area of said supporting member.

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