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Koester et al.

[11] **3,870,424**

[45] **Mar. 11, 1975**

[54] **EXPANSION GAP SEALING DEVICE**

[75] Inventors: **Waldemar Koester**, Forsbach, Germany; **Reinhold Huber**, Rorbas, Switzerland

[73] Assignee: **Kober AG**, Glarus, Switzerland

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

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

[58] **Field of Search** 404/64, 65, 66, 67, 68, 404/69, 43; 14/16

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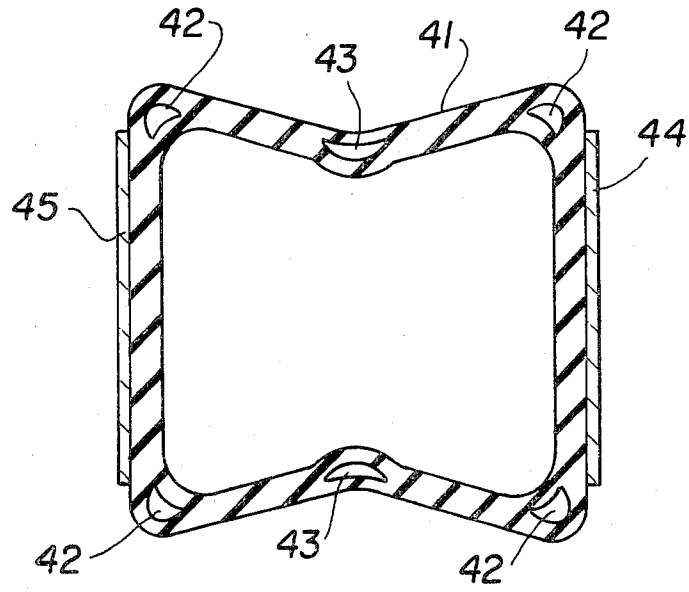
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Primary Examiner—Roy D. Frazier
Assistant Examiner—Thomas J. Holko
Attorney, Agent, or Firm—Wolfgang G. Fasse

[57] **ABSTRACT**

The present sealing device for expansion gaps in highway surfaces, race tracks, building components or the like, includes an elastomeric body having cross walls for bridging the gap and side walls for connection to the gap forming surfaces. The cross walls are foldable for adjustment to variations of the width of the gaps. The side walls of said body are provided with connecting elements for securing the sealing device to the opposite inner walls of the gap. The connecting elements are made of a material which on the one hand enters into a bond with the elastomeric body when the latter is vulcanized and which on the other hand are compatible for forming a glued connection with the gap walls. Hinge means may be provided for facilitating the folding of the elastomeric body.

20 Claims, 12 Drawing Figures



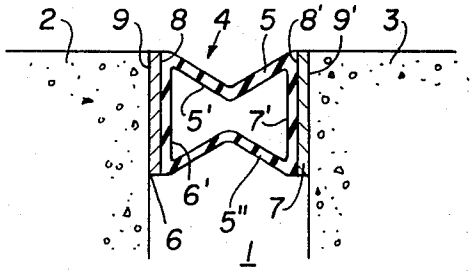


FIG. 1

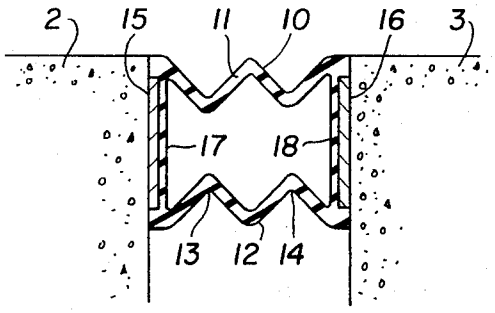


FIG. 2

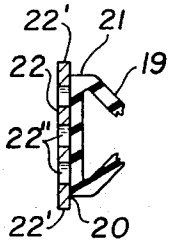


FIG. 3

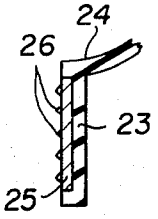


FIG. 4

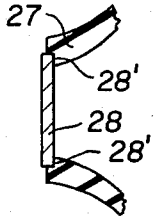


FIG. 5

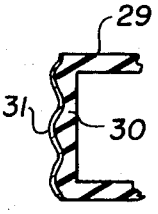


FIG. 6

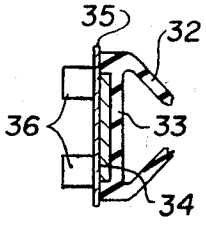


FIG. 7

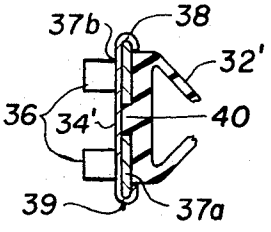


FIG. 8

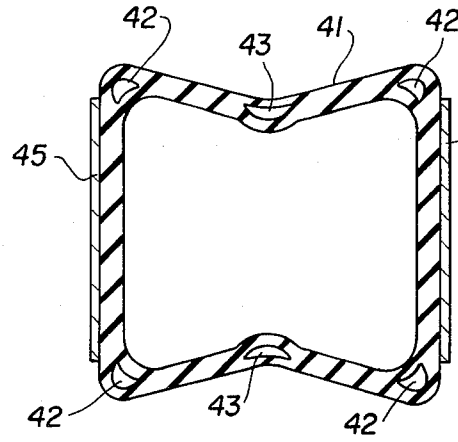


FIG.9

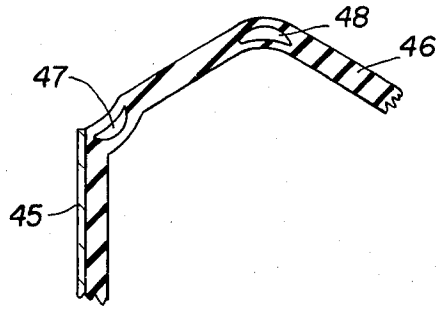


FIG.10

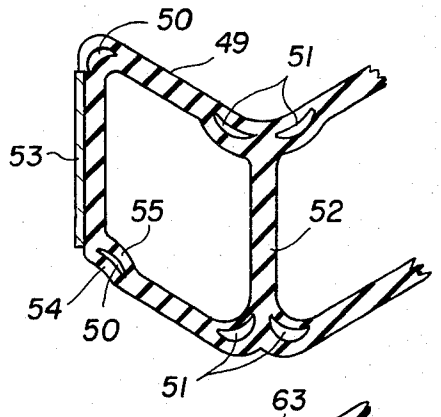


FIG.11

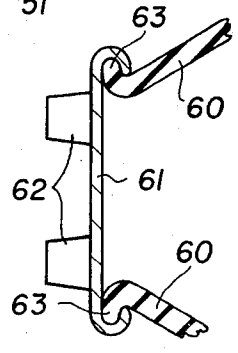


FIG.12

EXPANSION GAP SEALING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to expansion gap sealing devices, especially for gaps between adjacent structural members of road surfaces, race tracks, building components or the like. These gaps are provided to accommodate temperature expansions and contractions of said structural members.

Prior art expansion gap sealing devices are usually placed into the gap in a pre-stressed or biased condition. Where these sealing devices are placed into the finished joint, the sealing between the device and the walls defining the gap is accomplished in different ways by different sealing devices.

There are, for instance, sealing devices which have lateral sealing lips (U.S. Pat. No. 2,156,681). By means of an appropriate pressure such sealing devices are supposed to provide a water tight connection. However, since elastomers tend to creep the pre-stress or bias force decreases in such sealing devices with respect to time and the sealing becomes ineffective. Other known sealing devices improve the sealing action relative to the gap walls by embedding steel springs into the elastomeric sealing body (U.S. Pat. No. 3,479,333, German Pat. No. 1,658,468). Such steel springs may increase the sealing pressure whereby the disadvantageous creeping of the elastomeric sealing body is partially compensated. However, also steel springs are subject to fatigue after some time. Moreover, steel springs have the disadvantage that their pressure decreases with an increasing gap width.

The expansion properties of the known elastomeric gap sealing devices are particularly disadvantageous in cold weather, that is, when the gap width is large. In this case any remaining biasing force is still further decreased. In addition, the sealing device itself looses its elastic properties with falling temperatures. It freezes so to speak and it is not able to follow the opening of the gap. The same effect may arise by the so called crystallization of an elastomeric material when the sealing device is subjected to a definite deformation over a long period of time. The result is in this case also a detachment of the elastomeric sealing body from the walls or surfaces defining the gap.

In order to avoid such a detachment the elastomeric sealing devices have been glued to the walls of the gap as disclosed in U.S. Pat. No. 3,276,336 and in Swiss Pat. No. 433,418. In these prior art cases it is expected that the tension force of the gap edges should be used to assure a tight seal or connection if necessary. Thus, the elastomeric sealing body or profile is forced to follow the movement of the gap edges when the prestress or bias in the sealing profile has been decreased due to any one of the above described conditions. However, so far no durable adhesive connection between an elastomeric sealing, which mostly is a rubber sealing, and the gap walls has become known. The adhesive connections are not durable, since all rubber-like materials comprise softeners and other materials which continuously travel to the surface and disrupt any adhesive film after some time.

It is conventional in known gap sealing devices to construct at least the side of the elastomeric body which covers the gap at the top, as a trough section which hangs or is bent downwardly; this is done to assure the folding of the upper side in a downward direction. Moreover, it is already known from said Swiss Pat. No. 433,418 to notch the upper or cover wall near the side edges in order to avoid an excess stress in the wall due to deformations of the sealing body.

Finally, there is known a gap sealing device suitable for installation in fresh concrete as disclosed in German Pat. No. 1,259,077. The sealing device according to this reference has laterally extending ribs of dove tailed cross section. These ribs form a teeth intermeshing between the gap sealing device and the concrete of the gap walls. However, this sealing device connection can be realized only by pouring concrete around the sealing profile which is being held in a certain position inside the gap. This procedure is not possible for the most frequent cases where the sealing device must be installed in an expansion gap after a layer of concrete has been completed.

OBJECTS OF THE INVENTION

In view of the foregoing, the invention aims at overcoming the above drawbacks of the prior art and to achieve the following objects:

to provide a gap sealing device which may be easily installed in a finished gap and by means of which it is possible to obtain a solid and permanent adhesive bond between the walls of the gap and the sealing device proper, whereby to assure a definite sealing of the gap;

to make is possible to use sealing bodies of a rubber like material;

to avoid a glued bond directly between a sealing body of elastomeric material and the adjacent walls of the gap; and

to provide a combination of different types of bonds in order to improve the sealing characteristics as well as the useful service life of the present sealing devices.

SUMMARY OF THE INVENTION

According to the invention it has been found that an adhesive connection or glued bond directly between the elastomeric sealing body and the walls of the expansion gap, especially if it is produced at the construction site, is not satisfactory with regard to the quality of the bond nor with regard to its durability. Furthermore, it has been recognized that there are available excellent adhesive materials which provide permanent adhesive bonds between a great number of synthetic materials or metals on the one hand, and concrete on the other hand.

According to the invention there is provided an expansion gap sealing device which comprises connecting strip means made of a material other than natural or synthetic rubber but bondable to a sealing body of elastomeric material to be secured during the vulcanization of the latter. Said strip may partially or completely replace the side walls of the sealing body.

A further connection of the pre-fabricated sealing device having connecting strips vulcanized to the sealing body proper to the side walls of the gap may be made by using conventional adhesives directly at the construction site.

Numerous materials may be used for the connecting strip means, particularly stiff materials such as metal, synthetics or a fabric of natural fibers but excepting synthetic or natural rubber.

According to the invention there is further provided a combination of the connecting strip means vulcanized on the side walls of the elastomeric sealing body

with easily movable joints in the edges, bends and branches between wall portions of the elastomeric sealing body which move relative to each other when folds formed by these wall portions are opened or closed due to widening or narrowing of the expansion gap.

The above combination has the surprising effect that the easily movable joints reduce the wear and tear or stress to a minimum so that the adhesive bond is relieved advantageously from said stress. The invention departs completely from the prior art which uses continuously pre-stressed sealing bodies which have been obviated by the invention and thus the useful life and quality of the bond has been improved. Thus, the invention avoids all substantial stresses in the adhesive connection. Further, the invention renders it possible to manufacture expansion gap sealing bodies having a wide operational range which nevertheless minimizes the reactive forces. The provision of easily movable and freely deformable joints as taught by the invention is, surprisingly, compatible with the use of relatively strong cross or cover walls which are resistant, for example, to the dirt of the road.

In order to effect a folding of the wall portions of the sealing body practically without any resistance, the invention suggests that the elastomeric body has double walls at the areas of the joints so that a cavity is located in each double wall. It is especially advantageous that such cavity is of substantially sickle-shaped cross section having a convex outer curvature facing toward an outer face of the joint.

BRIEF FIGURE DESCRIPTION

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

FIG. 1 is a cross section through a concrete expansion gap with a sealing body having cross walls foldable at the center thereof;

FIG. 2 is a cross section through a concrete sealing gap with a double fold in the sealing body;

FIGS. 3 to 6 show different variations of connecting strip means for the elastomeric sealing body;

FIGS. 7 and 8 show each a section through a gap sealing device with anchor means attached to the connecting strip means;

FIG. 9 shows a cross section through a box shaped gap sealing device easily movable with joints in the edges or corners where the body well portions merge to form a fold;

FIG. 10 is a cross section through a portion of a sealing body having a honeycombed or hexoganal shape;

FIG. 11 shows a cross section through a portion of a sealing body with easily movable joints and having a so called butterfly shape; and

FIG. 12 is a partial sectional view through a further modification of the connecting strip means according to the invention.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

In FIG. 1 the expansion gap 1 is located between the edges or opposite surfaces of concrete structural members 2 and 3. The gap is sealed by means of a sealing device 4 comprising a sealing body 5 of elastomeric material and having a somewhat box shaped cross section. The body 5 has cross walls 5' and 5'' as well as side walls 6' and 7'. The cross walls 5' and 5'' are inwardly bent along a center vertical plane to form a fold. The side walls 6' and 7' carry connecting strip means 6 and 7 on their outward surfaces facing said opposite surfaces. The strip means 6 and 7 are vulcanized to the side walls 6' and 7' during the manufacture of the elastomeric sealing body 5. The strip means 6 and 7 hereafter referred to as strips are preferably made of steel or of a synthetic material such as epoxy resin; they may be made as thin foils or as plates. The strips are connected to the opposite surfaces of the gap 3 by means of adhesive layers in the planes 9 and 9'. Such adhesives are well known in the art and the connection may be made at the construction site. The vulcanized bond is located in the planes 8 and 8'.

The sealing body 5 may preferably be a hose with quite different cross sections. Hose type bodies with one or multiple folds in the cross walls are particularly suitable whereby in wider gaps intermediate walls may be provided. There may also be used sealing bodies which are open at the bottom.

In FIG. 2 there is illustrated a sealing body 10 with double folds. The cross walls or covers 11 and 12 of the sealing body 10 are inwardly bent at 13 and 14. The strips 15 and 16 are located in respective recesses in the side walls 17 and 18 of the sealing body 10. As in FIG. 1 and in all further embodiments of the invention, the strips 15 and 16 are vulcanized to the sealing body and are connected to the side walls 2 and 3 of the joint by means of adhesives or the like. The opposite surfaces forming the gap 1 may be made of concrete, metal or synthetic materials.

FIG. 3 shows a section of an elastomeric sealing body 19 which is connected with a strip 22 which has a lateral dimension larger than that of the adjacent side walls of the body 19 whereby edges 22' of the strip 22 extend beyond the opposite cross walls or covers 20 and 21. The strip 22 may comprise apertures 22'' which enhance an adhesive bond.

According to FIG. 4 there is inserted in a recess in the side wall 23 of a substantially U-shaped sealing body 24, a strip 25 which has small proturbances 26 whereby the adhesive surface is also enlarged just as by the apertures 22''.

In the embodiment shown in FIG. 5 the side wall of the sealing body 27 is directly formed by the strip 28, whereby the vulcanized bonds 28' are provided directly between the strip 28 and the cross walls.

The sealing body 29 in FIG. 6 has a corrugated side wall 30 to which is vulcanized a strip 31 of a correspondingly corrugated foil. The corrugated structure improves the contact with the respective opposite surface of the gap and increases the adhesive surface.

The joint sealings illustrated in FIGS. 7 and 8 are suitable for being poured in by fresh concrete. In the sealing device 32 of FIG. 7 the strip 34 which is inserted in a recess in the side wall 33, is glued to an anchoring means 35. This sealing device including the anchoring means is delivered to the construction site in preassembled form and is there arranged in the gap location whereupon concrete or synthetic resin is poured around the sealing device. The anchoring means 35 carry anchoring flaps 36 which may be punched and bent out of sheet metal. The strip 34 and the anchoring means 35 may also be formed as a one piece integral structure.

In FIG. 8 the strip is divided into stripes 37a and 37b the outer edges of which extend upwardly and down-

wardly relative to the installed position of the sealing body beyond the extremities of the sealing body 32'. The extending edges of the stripes 37*a*, 37*b* are received and clamped in channels 38, 39 formed at the lateral edges of the anchoring means 34' by bending these lateral edges inwardly and toward each other. The anchoring means 34' may be made of sheet metal. In this embodiment the adhesive connection between the stripes 37*a* and 37*b* and the anchoring means 34' may be omitted because the described clamping of the stripe edges by the channels 38 and 39 of the anchoring means provide a sufficiently strong and tight connection between the sealing body and the anchoring means.

This connection can still be improved by making the inner distance between the bottoms of the channels 38 and 39 somewhat smaller than the distance between the outer edges of the stripes 37*a* and 37*b*. By this feature a biasing force is provided when the two stripes 37*a* and 37*b* are inserted into the channels and thereby slightly moved towards each other whereby the land 40 of the elastomeric sealing body 32 is compressed.

FIGS. 9 to 11 show particularly advantageous embodiments of the elastomeric sealing body. FIG. 9 shows a sealing body 41 in the shape of a box with rubber joints or hinges at the edges and at the intermediate folds. The joints comprise sickle-shaped cavities 42 and 43 located between double wall portions. These cavities extend longitudinally inside said double walls and have preferably a length corresponding to the length of the sealing body. Each sickle shape is so arranged so that its curvature points in the direction of the hinging movement of the respective wall portions forming the joint. The more the profile is compressed the smaller becomes the cross section of the cavities 42, 43. On the other hand, the cross section of the cavities widens the more the side walls of the sealing bodies 41 are pulled apart. These so called rubber joints 42, 43 result in a particularly effortless folding of the sealing bodies 41, whereby the inner tensions in the walls of the sealing body in the area of the joints are substantially reduced. This reduction relieves the tensional forces in the bonds especially to the gap surfaces because the deforming forces inside the sealing body 41 have been reduced.

Substantially the same considerations are valid with regard to the embodiments shown in FIGS. 10 and 11. FIG. 10 shows a partial section of a sealing body 46 which has a substantially honeycombed or hexagonal shape. This body 46 is also provided with sickle-shaped joints 47 and 48 at its corners and in the central folding plane resulting in a practically effortless folding of the sealing body. FIG. 11 shows one half of a cross section through a sealing body 49 which is butterfly shaped and which likewise has rubber joints or hinges 50 in its corners and further rubber joints 51 whereby two joints 51 together facilitate the folding in the area of the dividing wall 52.

FIG. 12 shows an embodiment wherein the cross walls 60 of the sealing body are connected by a strip means 61 forming simultaneously and as an integral structure the side wall of the sealing body and an anchoring means with lugs 62. Vulcanized bonds 63 are provided between the cross walls 60 and the strip means 61. An adhesive bond may be obviated due to the lugs 62.

Although the invention has been described with reference to specific example embodiments, it is intended to cover all modifications and equivalents within the scope of the appended claims.

What is claimed is:

1. A sealing device for an expansion gap between opposite surfaces of structural members, comprising a body of elastomeric material having cross wall means, side wall means, and joint means between said side wall means and said cross wall means to define a substantially closed body, a pair of stiff non-rubber connecting strips, only one surface of each connecting strip being vulcanized to a separate side wall means, whereby the other sides of said connecting strips are free of said body and connectable to said opposite surfaces, said cross wall means having foldably inclided wall portions, said joint means having cavities therein providing reduced joint wall thicknesses as compared with the wall thickness of said body outside of said joint means for facilitating the movement of said wall means relative to each other, said cavities having curvatures arranged so that cavities at diametrically opposite joints of said body are oppositely directed relative to each other, and wherein said joint means have double walls defining said cavities therebetween, said cavities having sickle-shaped cross sections, whereby the walls at each of said joint means may move relative to each other.

2. The sealing device of claim 1, in which said cavities have sickle-shaped cross sections formed of a concave wall and a convex wall at the respective joint, the concave walls being on the sides of the cavities toward the surface of said body at the respective joint that has an increasing angle upon compression of said body.

3. The sealing device of claim 1, wherein said cross walls have folds intermediate therein, further comprising sickle-shaped cavities at said folds.

4. The sealing device of claim 1, wherein said cavities have sickle-shaped cross sections, each formed of a concave wall and a convex wall, at least one joint means between a side wall means and a cross wall means forming an acute angle at the inside of said body, the concave wall of the cavity at the respective joint facing toward the outer surface of said body.

5. The sealing device of claim 1, in which said cavities have sickle-shaped cross sections, each formed of a concave wall and a convex wall, at least one of said joint means between a cross wall means and a side wall means having an obtuse angle toward the inside of said body, the concave wall of the cavity at said one joint means facing toward the inner surface of said body.

6. The sealing device of claim 1, wherein said body further comprises a dividing wall joining said cross wall means, the joints between said dividing and said cross wall means having reduced thickness as compared with the wall thickness of the body outside said joint means for facilitating the movement of said wall means relative to each other.

7. The sealing device of claim 6, wherein the joint means between said dividing wall and cross wall means have double walls defining a free space therebetween, whereby a free space is provided at each joint means between said dividing wall and said cross wall means.

8. The sealing device of claim 7, wherein said free spaces are sickle-shaped, each having a concave wall and a convex wall, wherein an acute angle is formed between one cross wall means and an adjoining side wall means, the concave surfaces of said free surfaces of

said one cross wall means being on the sides of said cross wall means toward the inside of said body.

9. The sealing device of claim **7**, wherein said free spaces are sickle-shaped and each formed of a concave wall and a convex wall, wherein an obtuse angle is formed at the inside of said body between one cross wall means and an adjoining side wall means, the concave walls of said free spaces in said one cross wall means facing toward the outer surface of said one cross wall means.

10. A sealing device for an expansion gap defined between opposite surfaces of structural members, comprising a body of elastomeric material including cross wall means, connecting strip means for securing said cross wall means to said opposite surfaces, and a vulcanized bond between said body of elastomeric material and a region of one side of said connecting strip means, said connecting strip means comprising a material, other than natural and synthetic rubber, which is compatible with said vulcanized bond, the region of the other side of said strip means opposite said region on said one side thereof being free of elastomeric material and being connectable to said opposite surfaces, and wherein said body of elastomeric material comprises folds formed by oppositely inclined wall portions in said cross wall means, side wall means, and junction means for interconnecting said side wall means with said cross wall means and adjacent ones of said wall portions to each other to form a substantially closed body, said junction means comprising joint means with cavities therein having sickle-shaped cross sections including a convex and a concave curvature for facilitating the movement of said wall means and wall portions relative to each other, said cavities reducing the wall thickness at the junction means as compared to the wall thickness outside said joint means, said cavities having curvatures arranged so that the curvatures of cavities at diametrically opposite points of said body are oppositely directed.

11. The sealing device according to claim **10**, wherein said vulcanized bond is provided between said side wall means and said connecting strip means.

12. The sealing device according to claim **10**, wherein said material of said connecting strip means is a substantially stiff material.

13. The sealing device according to claim **10**, wherein said joint means comprise double walls defining said cavity means between adjacent double walls.

14. The sealing device according to claim **13**, wherein said cavity means have a length corresponding substantially to that of the sealing device.

15. The sealing device according to claim **13**, wherein each of said joint means has an inner and an outer joint face, said convex curvature facing toward said outer joint face.

16. The sealing device of claim **10**, wherein the material of said connecting strip means is a metal.

17. The sealing device of claim **10**, wherein the material of said connecting strip means is a synthetic material.

18. The sealing device of claim **10**, wherein the material of said connecting strip means comprises a fabric of natural fibers.

19. The sealing device of claim **10**, wherein said cavities are formed with a concave wall and a convex wall, the concave walls being on the sides of the cavities toward the surface of said body at the respective joint that has an increasing angle upon compression of said body.

20. The sealing device of claim **10**, further comprising sickle-shaped cavities extending in said folds of said cross wall means.

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