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DeMunck

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[54] **ELASTIC SEALING STRIP**

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[63] Continuation-in-part of Ser. No. 617,185, Feb. 20, 1967.

[52] **U.S. Cl.** **52/403,** 52/396, 161/124

[51] **Int. Cl.** **E04b 1/36**

[58] **Field of Search** ..52/396, 403; 49/484, 496, 497; 161/120, 124

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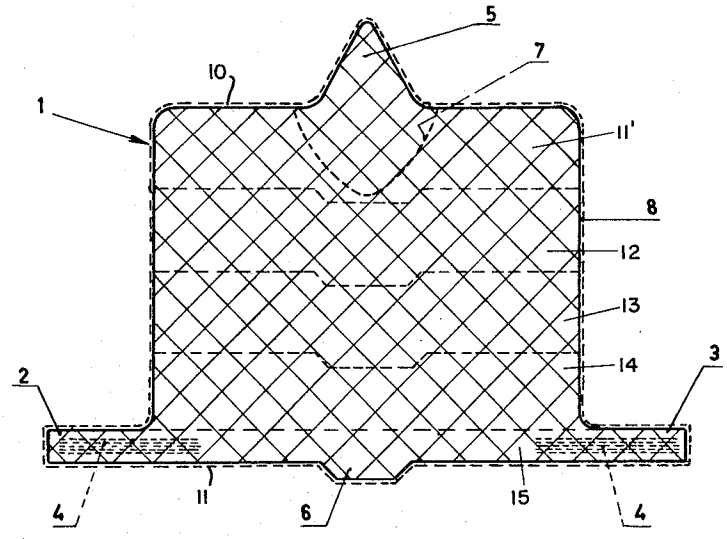
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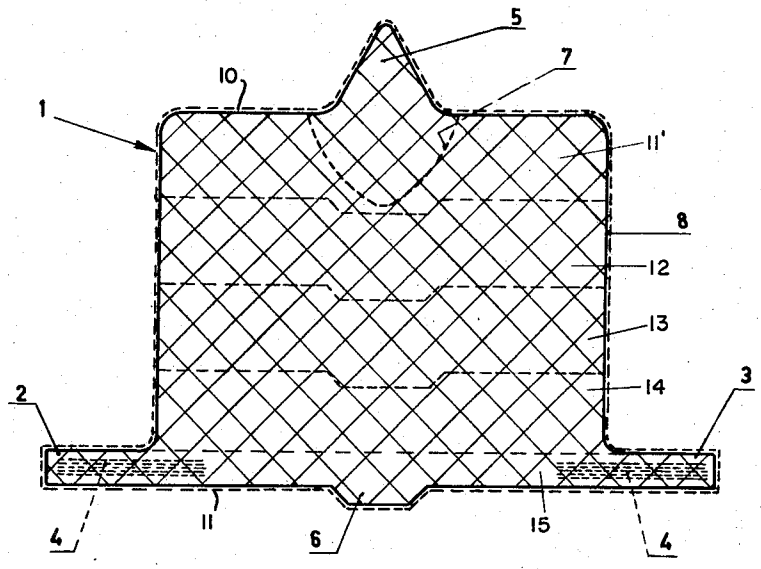
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A sealing strip of elastic material for tunnel and building joints and including a projecting portion compressible into the main body of the strip. The projecting portion is of a different modulus of elasticity from that of said main body.

3 Claims, 1 Drawing Figure





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ELASTIC SEALING STRIP

This is a continuation-in-part application of Ser. No. 617,185 filed Feb. 20, 1967 and now abandoned.

This invention relates to a sealing strip of rubber, synthetic rubber or similar material for joints of tunnels and buildings and for similar purposes and is in particular suitable for sealing abutting joints between tunnel elements.

When building tunnels according to the so-called sinking method tunnel, elements are manufactured in a building dock and are provided with front plates. Such tunnel elements may be towed in floating condition to their definite location and be sunk there by ballast and drawn by means of winches against the tunnel elements previously sunk or against the abutment constructed on dry land. In this case the pull which is required to compress the sealing strip, in order to bridge the irregularities in the end of the tunnel elements, is limited to that pulling force which the winches may produce. When the water between the front plates is removed, the total hydrostatic pressure acts on the sealing strip. This pressure depends on the depth of the joint to be sealed below the water surface and on the ratio of the surface and the circumference of the tunnel element. If the provided tunnel element does not lie in the correct position, it must be swung with the aid of winches. In order to render this swinging possible, it is preferable to provide for a flexible connection between the tunnel elements.

The invention aims at providing a sealing strip offering such a flexible connection for which not only this adjustment is possible but, moreover, this adjustment may be effected with the smallest possible transverse forces so that the bending moment in the tunnel wall is prevented from becoming too great. For this purpose, according to the invention, the sealing strip comprises a projecting portion having a smaller cross-section than the other portion of the sealing strip. Since the sealing strip should not only seal, but should also absorb the hydrostatic pressure, as mentioned above, it is preferred to give the projecting part a substantially triangularly cross-section. Consequently, the projection is given a greater rigidity against flexures as a result of forces exerted in a direction perpendicular thereto.

According to the invention, the projecting part may consist of a material having a smaller modulus of elasticity than the other part of the sealing strip.

Below the projecting portion of the sealing strip, there may be located a portion having such a modulus of elasticity and such dimensions as to allow the projecting portion to be pressed into said portion located below the projecting portion. Consequently, when the tunnel elements have been placed in their definite location, the sealing strip contributes to the sealing along its entire surface.

The projecting portion is preferably situated in the middle of the sealing strip.

A preferred embodiment of the sealing strip according to the invention is characterized in that it consists of a number of layers which are pre-vulcanized and subsequently interconnected. For this purpose there may be provided between said vulcanized layers so-called cushion layers. The number of these layers depends on the thickness of the sealing strip and, according to this thickness, it may amount to two or more. It is preferred

to provide these layers with one or more raised portions and/or recesses which interlock. The layers may consist of material having different moduli of elasticity. If desired the sealing strip may be provided at the side remote from the side having the projection with a rib of trapezium-shaped cross-section so that water is prevented from leaking between the sealing strip and the front face of the tunnel element with which said rib is in contact. The material of this rib has preferably substantially the same modulus of elasticity as the material of the projection of the sealing strip.

For the purpose of fastening the sealing strip, the latter may be provided with fastening flanges reinforced with canvass or some other material.

In order to protect the sealing strip against influences of the weather and of air and light, said strip may be provided, according to the invention, with a thin coating of neoprene which may be applied in the form of a solution adhesive. It has been found that a sealing strip provided with a neoprene coating of a thickness of 0.3 mm did not show any corrosion after having been exposed to wind and weather.

The invention will be further explained below with reference to the accompanying drawing showing by way of example a cross-section of an embodiment of the sealing strip according to the invention.

The sealing strip **1** shown in the drawing comprises two side flanges **2** and **3** which serve to fasten the sealing strip. These side flanges are provided with a reinforcement **4** of canvass or some other suitable material.

At the face **10** of the sealing strip **1** which in the drawing is facing upwards, there is provided a projecting portion **5** extending in the middle along the entire length of this upper face. Said portion **5** consists of rubber having a smaller modulus of elasticity than that of the remainder of the sealing strip. The projecting portion **5** has an approximately triangular cross-section. At the under face **11** of the sealing strip **1**, there is provided a rib **6** of trapezium-shaped cross-section.

As shown in dotted lines, the sealing strip may be composed of layers **11'** to **15** of rubber or similar material. These layers may have different moduli of elasticity relative to each other.

Below the projecting portion **5**, there may be a portion **7** shown in dotted lines having such a modulus of elasticity and such dimensions as to allow the projecting portion **5** to be pressed thereinto.

It is of course true that rubber and materials similar thereto are essentially incompressible so that the pressing of portion **5** into the underlying portion of the strip will result in a flowing away of the material in said underlying portion in order to make way for said portion **5**. In fact, the side walls **9** of the strip will bulge outwardly to some extent as the result of portion **5** being pressed into the underlying portion of the strip. Such bulging, however, is not detrimental to the effectiveness of the strip since the bulging is in a radial direction, that is, essentially perpendicular to the direction along which the compression is applied and there usually is plenty of room in that direction between the structural elements to accommodate such bulging. This is clear when one considers that the respective opposite faces **10** and **11** of the strip **1** fit essentially parallelly against the respective confronting faces of the two structural elements between which a seal is to be effected.

Following is an example of a sealing strip constructed according to this invention.

COMPOSITION OF MATERIALS

1. Soft rubber compound of the triangular-shaped projection **5**

Material	Parts by Weight
smoked sheet	100
zinc oxide	5
HAF black	5
stearic acid	1
softener BP-21	8
phenyl beta naphtylamine	1.5
sulfur	1.5
vulkacit F	1

properties: elasticity modulus E = 10 kg/cm² (at **100%** elongation)
G = 3 kg/cm² shear modulus

2. Harder rubber compound of the body of the underlying portion of the sealing strip

Material	Parts by Weight
smoked sheets	100
zinc oxide	5
HAF black	30
SRF black	20
stearic acid	1
softener dutrex **55**	5
phenyl beta naphtylamine	1.5
sulfur	2
santocure	1

elasticity modulus E = 40 kg/cm² (at **100%** elongation)
shear modulus G = 13 kg/cm²

It is obvious that the invention is not restricted to the embodiment described above and shown in the drawing but that it may be modified in many ways without departing from the scope of the invention. This applies for the cross-sectional shape of the body of the sealing strip as well as for the side flanges, the projecting portion **5** and the rib **6** of said sealing strip. If desired the sealing strip may be provided with a coating **8** of neoprene which is applied in the form of a solution adhesive.

What is claimed is:

1. A solid sealing strip of elastic material, such as rubber, synthetic rubber and similar elastic material, especially for joints of tunnels, said sealing strip having two opposite sealing surfaces, the main portions of said sealing surfaces being parallel to one another, one of said opposite sides being provided with a projecting portion, having a substantially triangular cross section, the base and the sides of said projecting portion being small as compared with the width of the sealing strip, said projecting portion consisting of an elastic material having a smaller modulus of elasticity than at least a part of said sealing strip located directly below said projection, the height of the last-mentioned part and its modulus of elasticity on the one side and the dimensions and the modulus of elasticity of the projecting portion on the other side being selected in such a way as to allow the projecting portion to be substantially pressed into said part of the sealing strip located below said projecting portion.

2. A sealing strip according to claim **1**, characterized in that it consists of a plurality of prevulcanized substantially flat solid layers being connected to one another, one of the faces of each pair of two adjacent layers being provided with at least one projection gripping in a recess arranged in the other face of said pair of faces.

3. A solid sealing strip of elastic material, such as rubber, synthetic rubber and similar elastic material, especially for joints of tunnels, said sealing strip having two opposite sealing surfaces, the main portions of said sealing surfaces being parallel to one another, one of said opposite sides being provided with a projecting portion having a substantially triangular cross section, the base and the sides of said projecting portion being small as compared with the width of the sealing strip, said projecting portion consisting of an elastic material having a smaller modulus of elasticity than at least a part of said sealing strip located directly below said projection, the height of the last-mentioned part and its modulus of elasticity on the one side and the dimensions and the modulus of elasticity of the projecting portion on the other side being selected in such a way as to allow the projecting portion to be substantially pressed into said part of the sealing strip located below said projecting portion, the sealing strip comprising a plurality of layers consisting of elastic material, such as rubber, synthetic rubber and similar elastic material, having different moduli of elasticity, a rib being provided at the side of said strip opposite to the side provided with the projection having a small triangular cross section, said rib having a substantially trapezium-shaped cross section, the sealing strip being provided with fastening flanges having their bottom flush with the sealing strip side provided with said rib.

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