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(54) **Method for sealing the joint between two road parts which are movable relative to each other and are provided with an asphalt road surface, in particular the joint between two bridge roadway parts or between a bridge roadway part and a land-abutment part.**

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Description

The invention relates to a method for sealing the joint between two road parts which are movable relative to each other and are provided with, or are to be provided with an asphalt road surface, in particular the joint between two bridge roadway parts or between a bridge roadway part and a land-abutment part, comprising:

- making a recess at the site of the joint in at least a hot-rolled asphalt covering said parts, at least the bottom of the recess being covered with an elastic sealing membrane layer and a hard strip, for example of metal, being placed above the joint, the membrane layer extending over the strip, and placing in the recess, above the membrane layer, a material with elastic properties.

Such a method is known from EP-A-0296377. The metal strip prevents material from sinking in the joint; the elastic sealing membrane provides the water seal and ensures the spread of the movement in the joint with the result that stress concentrations in the layer lying above are prevented due to small diffferences in elongations between said covered parts and the layer lying above. For larger differences in elongations problems of stress concentrations are expected, due to too high shear stresses. The elastic material in the recess can absorb movements in the ground below, without giving way. Use of the filling of the recess known from the above mentioned European patent application in water permeable road surfaces could lead to an unsafe situation, in which, when it rained, the motorist could suddenly be faced with a pool of water on the road surface before, after and above the joint. There could also be increased tire noise when passing over the joint.

The object of the invention is to solve this problem and to provide a water-permeable or water draining and low-noise filling of the recess at the site of the joint, without the elasticity and flexibility of said filling which is necessary in order to avoid cracks forming, being adversely effected.

According to the invention, the method is to this end characterized in that the recess above the membrane layer is filled with elastic hot-rolled asphalt of which at least the top layer is made of very open-textured elastic hot-rolled asphalt.

The metal strip prevents material from sinking in the joint. The elastic sealing membrane provides the water seal and ensures the spread of the movement in the joint, with the result that stress concentrations in the layers lying above are prevented. The elastic hot-rolled asphalt can absorb movements in the ground below, without giving way. This elastic material is preferably composed of a bottom layer of dense hot-rolled asphalt and a top layer of very open-textured hot-rolled asphalt. The elastic very open-textured hot-rolled asphalt of the joint seal abuts the very open-textured hot-rolled asphalt of the connecting road, so that there is no difference in sound production, and the horizontal water conveyance through the open-textured layer, viewed in the lengthwise direction of the road, is not interrupted. The elastic dense hot-rolled asphalt ensures that water is retained and can be drained through the elastic very open-textured hot-rolled asphalt.

If the vertical distance between the top surface of the road and the top surface of the bridge roadway part corresponds to the thickness of the very open-textured hot-rolled asphalt, the recess can be made right into the material of the road parts which are movable relative to each other. Space is then produced for a layer of elastic dense hot-rolled asphalt. If movements are very small, such a layer of dense hot-rolled asphalt is not necessary.

Securing means projecting into the joint are used to prevent shifting of the hard strip, without said strip being fixed.

The elastic sealing membrane can be made of a 3 to 30 mm thick layer of a bitumen emulsion or a plastic modified bitumen emulsion mixed with fine stone grit. Another possibility is for the elastic sealing membrane to be made up of a 3 to 30 mm thick layer of an emulsion based on polyurethane alone or mixed with a fine stone grit.

It is also possible for the elastic sealing membrane to be composed of several layers, in which case little or none of said emulsion is applied in the stone grit between the layers. This produces a very low shear strength between the two layers, with the result that the stresses in the elastic very open-textured hot-rolled asphalt lying above will be minimal.

Another embodiment is to apply a one to five millimetre thick emulsion layer between the above-mentioned two layers, which also achieves a low shear strength.

There are practical advantages if the recess narrows stepwise from top to bottom. This step form is not necessary.

The elastic, very open-textured hot-rolled asphalt can have the following composition:
stone chippings: 65-90 mass per cent, particle size 8-16 mm
sand: 0-20 mass per cent, granule size 0-3 mm
filler: 0-10 mass per cent, size < 63 µm
binder: 4-25 mass per cent
additions: 0-1 mass per cent,
the binder being composed of a mixture of bitumen and a natural rubber or elastomer, or a thermoplastic.

The admixture to the bitumen can be styrene butadiene styrene polymer (SBS), styrene butadiene rubber (SBR) or ethyl vinyl acetate (EVA), or ethylene propylene dimonomer (EPDM).

The above-mentioned additions (0-1 mass per cent) can contain glass fibres, mineral fibres, rubber particles, adhesion improvers, latex emulsions and bitumen emulsions.

The invention will now be explained in greater detail with reference to the figures.

Figure 1 shows a longitudinal section through two bridge roadway parts which are movable relative to each other.

Figure 2 shows a cross-section along the line II - II in Figure 1.

Figure 3 shows a longitudinal section through two bridge roadway parts which are movable relative to each other, in which the joint seal is of a different type.

The figures show two bridge roadway parts 1, 2 which are separated from each other by a joint 3. The normal road surface on the bridge roadway parts in Figure 1 comprises a bottom layer 4 of dense hot-rolled asphalt and a top layer 5 of very open-textured hot-rolled asphalt. The layer 4 is not present in Figure 3. In both cases the road surface on the bridge roadway parts abuts the ordinary road surface composed of a bottom layer of dense hot-rolled asphalt and a top layer of very open-textured hot-rolled asphalt. In Figure 3 the dense hot-rolled asphalt of the ordinary road surface is not continued on the bridge roadway parts, but lies with the end face against the vertical boundary of a bridge roadway part.

In Figure 1 a recess 6 is made in the asphalt above the joint 3. In Figure 2 this recess 6 continues over the hot-rolled asphalt of the bridge roadway parts.

An elastic sealing membrane layer 7 covers the bottom of the recess, and a metal strip 8 is placed in said membrane layer above the joint 3, which strip is connected to securing means such as a cord 8a, which prevents shifting of the strip. The membrane extends over the top surface of the strip.

The recess 6 is also filled with a bottom layer 9 of elastic dense hot-rolled asphalt and a top layer 10 of elastic very open-textured hot-rolled asphalt.

The open-textured layers 5 and 10 are the same thickness and abut each other accurately, so that the water seeping through said layers can flow away in the lengthwise direction of the road. It can be seen from the cross-section of Figure 2 that water which has collected on the top surface of the elastic dense hot-rolled asphalt layer can flow away in the crosswise direction through the elastic very open-textured hot-rolled asphalt to a channel 11 formed through the layer 10 not running through to the side boundary of said bridge roadway part 2.

Depending on the circumstances, it is also possible for layer 5 to have the composition of layer 10, and for these layers 5 and 10 to be applied in one go over the whole or part of the bridge roadway.

The membrane layer 7 runs through at the ends to the transition between the elastic dense hot-rolled asphalt and the elastic very open-textured hot-rolled asphalt.

It is possible in the absence of the dense hot-rolled asphalt on the bridge for the layer of elastic very open-textured hot-rolled asphalt to be placed directly on the membrane layer 7. In other words, in certain circumstances (very small changes in the width of the joint) the layer 9 in Figure 3 can be omitted.

The watertight membrane layer 7 can be a stress-absorbing membrane interlayer (SAMI) which is characterised not only by its watertightness, but also by a great elasticity, even at low temperatures.

The membrane is composed of at least one layer of a bitumen emulsion mixed with fine stone grit, in order to create a layer thickness. The layer thickness varies between 3 and 30 mm. If the membrane is made of at least two of these layers, a very low shear strength can be created between the two layers by applying the stone grit in a suitable manner, with the result that lower stresses in the very open-textured hot-rolled asphalt lying above this will be produced. In the zone of low shear strength hardly any bitumen emulsion is present between the stone grit, or an emulsion layer one to five millimetres thick is applied. The bitumen emulsion can be composed of a mixture of bitumen with SBS or bitumen with EVA, SBR or EPDM.

Another possibility is to replace the bitumen emulsion by polyurethane-based mixtures.

The elastic very open-textured hot-rolled asphalt has the following composition:

stone chippings: 65-90 mass per cent, particle size 8-16 mm

sand: 5-20 mass per cent, granule size 0-3 mm

filler: 4-10 mass per cent, size < 63 μm

binder: 4-10 mass per cent

additions: 0-1 mass per cent.

The binder can be composed of a mixture of bitumen with natural rubber or elastomer, or a thermoplastic, in particular with styrene butadiene styrene polymer (SBS) or with styrene butadiene rubber (SBR) or with ethyl vinyl acetate (EVA), or with ethylene propylene dimonomer (EPDM). The additions can contain glass fibres, mineral fibres, rubber particles, adhesion improvers, latex emulsions and bitumen emulsions. What is essential is that the mixture after compacting should have hol-

low spaces between 15 and 35 volume per cent.

The elastic dense hot-rolled asphalt differs from the elastic very open-textured hot-rolled asphalt in that the spaces between the larger pieces of chippings are filled with smaller pieces and sand. The mixture will therefore contain more sand and more smaller stone chipping parts than is the case with the elastic very open-textured hot-rolled asphalt.

The main advantage of the joint seal described is that the very open hot-rolled asphalt runs over the joint in such a way that the water drainage through this open-textured hot-rolled asphalt layer in the lengthwise direction of the road is uninterrupted and no noise peak is produced on passing over the joint. This advantage is obtained without detriment to the resistance to crack formation at the site of the joint.

Claims

1. Method for sealing the joint (3) between two road parts (1, 2) which are movable relative to each other and are provided with, or are to be provided with, an asphalt road surface, in particular the joint between two bridge roadway parts or between a bridge roadway part and a land-abutment part, comprising:
   - making a recess (6) at the site of the join in at least a hot-rolled asphalt (5) covering said parts, at least the bottom of the recess being covered with an elastic sealing membrane layer (7) and a hard strip (8), for example of metal, being placed above the joint, the membrane layer extending over the strip, and placing in the recess, above the membrane layer, a material with elastic properties, characterized in that the recess above the membrane layer is filled with elastic hot-rolled asphalt (9, 10) of which at least the top layer (10) is made of very open-textured elastic hot-rolled asphalt.

2. Method according to claim 1, characterized in that the elastic hot-rolled asphalt in the recess has a bottom layer (9) of dense hot-rolled asphalt or a dense joint structure.

3. Method according to claim 1 or 2, characterized in that the recess is made right into the material of the road parts which are movable relative to each other.

4. Method according to one of the preceding claims, characterized by securing means (8a) projecting into the joint to prevent shifting of the hard strip without fixing the strip.

5. Method according to one of the preceding claims, characterized in that the elastic sealing membrane is composed of a one to thirty mm thick layer of a bitumen emulsion or modified bitumen emulsion mixed with stone.

6. Method according to claims 1 to 4, characterized in that the elastic sealing membrane is composed of a one to thirty mm thick layer of an emulsion based on polyurethane mixed with a stone.

7. Method according to claim 5 or 6, characterized in that the elastic sealing membrane is composed of several layers, and little or none of said emulsion is applied in the stones between the layers.

8. Method according to claim 7, characterized in that a one to five mm thick layer of said emulsion is applied between the layers.

9. Method according to one of the preceding claims, characterised in that the recess is narrowed stepwise from top to bottom.

10. Method according to one of the preceding claims, characterized in that the elastic very open-textured hot-rolled asphalt has the following composition:
    stone chippings: 65-90 mass per cent, particle size 8-16 mm
    sand: 0-20 mass per cent, granule size 0-3 mm
    filler: 0-10 mass per cent, size < 63 μm
    binder: 4-25 mass per cent
    additions: 0-1 mass per cent,
    the binder being composed of a mixture of bitumen and a natural rubber or elastomer, or a thermoplastic material.

11. Method according to claim 10, characterized in that the binder is composed of a mixture of bitumen and styrene butadiene styrene polymer (SBS).

12. Method according to claim 10, characterized in that the binder is composed of a mixture of bitumen and styrene butadiene rubber (SBR).

13. Method according to claim 10, characterized in that the binder is composed of a mixture of bitumen with ethyl vinyl acetate (EVA).

14. Method according to claim 10, characterized in that the additions are composed of glass fibres and/or mineral fibres and/or rubber particles and/or adhesion improvers and/or latex emul-

sions and/or bitumen emulsions.

Patentansprüche

1. Verfahren zum Dichten der Fuge (3) zwischen zwei relativ zueinander beweglichen Fahrbahnteilen (1, 2), die mit einer Asphalt-Fahrbahndecke versehen sind oder versehen werden, insbesondere der Fuge zwischen zwei Brükkenfahrbahnteilen oder einem Brücken- und einem Landfahrbahnteil, bei dem: am Ort der Fuge in mindestens einem die Teile bedeckenden Heißwalzasphalt (5) eine Aussparung (6) gemacht wird, mindestens der Boden der Aussparung mit einer elastischen Dichtmembranschicht (7) bedeckt wird und ein harter Streifen (8), beispielsweise aus Metall, über die Fuge gelegt wird, wobei sich die Membranschicht über den Streifen erstreckt, und ein Material mit elastischen Eigenschaften in der Aussparung über der Membranschicht angeordnet wird, **dadurch gekennzeichnet,** daß die Aussparung über der Membranschicht mit elastischem Heißwalzasphalt (9, 10) gefüllt wird, wobei mindestens die obere Schicht (10) aus einem elastischem Heißwalzasphalt (10) mit sehr offenem Gefüge hergestellt ist.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet,** daß der elastische Heißwalzasphalt in der Aussparung eine untere Schicht (9) aus dichtem Heißwalzasphalt oder einer dichten Fugenstruktur aufweist.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet,** daß die Aussparung direkt in dem Material der relativ zueinander beweglichen Fahrbahnteile gemacht wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** Sicherungseinrichtungen (8a), die in die Fuge hineinragen, um ein Verschieben des harten Streifens zu verhindern, ohne den Streifen zu fixieren.

5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet,** daß die elastische Dichtmembran aus einer 1 bis 30 mm dicken Schicht einer mit Stein gemischten Bitumenemulsion oder modifizierten Bitumenemulsion zusammengesetzt ist.

6. Verfahren nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet,** daß die elastische Membran aus einer 1 bis 30 mm dicken Schicht einer mit Stein gemischten Emulsion auf Polyurethanbasis zusammengesetzt ist.

7. Verfahren nach einem der Ansprüche 5 oder 6, **dadurch gekennzeichnet,** daß die elastische Dichtmembran aus mehreren Schichten zusammengesetzt ist, und das wenig oder keine Emulsion in die Steine zwischen den Schichten eingebracht wird.

8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet,** daß eine 1 bis 7 mm dicke Schicht der Emulsion zwischen die Schichten eingebracht wird.

9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet,** daß die Aussparung von der oberen Seite bis zum Boden stufenweise enger wird.

10. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet,** daß der elastische Heißwalzasphalt mit sehr offenem Gefüge folgende Zusammensetzung aufweist:
Steinsplitter: 65 bis 90 Massen-%, Teilchengröße 8 bis 16 mm
Sand: 0 bis 20 Massen-%, Granulatgröße 0 bis 3 mm
Füllmaterial: 0 bis 10 Massen-%, Größe < 63 µm
Bindemittel: 4 bis 25 Massen-%
Zusätze: 0 bis 1 Massen-%,
wobei das Bindemittel aus einer Mischung aus Bitumen und Naturkautschuk oder Elastomer oder aus einem thermoplastischem Material zusammengesetzt ist.

11. Verfahren nach Anspruch 10, **dadurch gekennzeichnet,** daß das Bindemittel aus einer Mischung aus Bitumen und Styrol-Butadien-Styrol-Polymer (SBS) zusammengesetzt ist.

12. Verfahren nach Anspruch 10, **dadurch gekennzeichnet,** daß das Bindemittel aus einer Mischung aus Bitumen und Styrol-Butadien-Kautschuk (SBR) zusammengesetzt ist.

13. Verfahren nach Anspruch 10, **dadurch gekennzeichnet,** daß das Bindemittel aus einer Mischung aus Bitumen und Ethyl-Vinylacetat (EVA) zusammengesetzt ist.

14. Verfahren nach Anspruch 10, **dadurch gekennzeichnet,** daß die Zusätze aus Glasfasern und/oder Mineralfasern und/oder Kautschukteilchen und/oder Adhäsionsverbesserern und/oder Latex-Emulsionen und/oder Bitumen-Emulsionen zusammengesetzt sind.

Revendications

1. Procédé pour étanchéifier le joint (3) entre deux parties de route (1, 2) qui sont mobiles l'une par rapport à l'autre et qui sont munies, ou qui doivent être munies, d'une surface de route en asphalte, en particulier le joint entre deux parties de tablier de pont ou entre une partie de tablier de pont et une partie de butée du terrain, comprenant :
   - la réalisation d'une cavité (6) au site du joint dans au moins de l'asphalte préparé à chaud (5) recouvrant lesdites parties, au moins la base de la cavité étant recouverte d'une couche de membrane d'étanchéité élastique (7) et d'une bande dure (8), par temple en métal, disposée au-dessus du joint, la couche de membrane s'étendant au-dessus de la bande, et la mise en place dans la cavité, au-dessus de la couche de membrane, d'un matériau gant des propriétés élastiques, caractérisé en ce que la cavité au-dessus de la couche de membrane est remplie d'asphalte préparé à chaud élastique (9, 10) dont au moins la couche supérieure (10) est constituée d'asphalte préparé à chaud élastique de texture très ouverte.

2. Procédé selon la revendication 1, caractérisé en ce que l'asphalte préparé à chaud élastique dans la cavité comporte une couche inférieure (9) d'asphalte préparé à chaud dense ou une structure de joint dense.

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que la cavité est réalisée entièrement à l'intérieur du matériau des parties de route qui sont mobiles l'une par rapport à l'autre.

4. Procédé selon l'une des revendications précédentes, caractérisé par des moyens de fixation (8a) faisant saillie à l'intérieur du joint pour empêcher le déplacement de la bande dure sans fixer la bande.

5. Procédé selon l'une des revendications précédentes, caractérisé en ce que la membrane d'étanchéité élastique se compose d'une couche d'un à trente millimètres d'épaisseur d'une émulsion de bitume ou d'une émulsion de bitume modifiée mélangée avec du gravier.

6. Procédé selon les revendications 1 à 4, caractérisé en ce que la membrane d'étanchéité élastique se compose d'une couche d'un à trente millimètres d'épaisseur d'une émulsion à base de polyuréthane mélangée avec du gravier.

7. Procédé selon la revendication 5 ou 6, caractérisé en ce que la membrane d'étanchéité élastique se compose de plusieurs couches, et en ce que peu ou pas du tout de ladite émulsion est appliquée aux graviers entre les couches.

8. Procédé selon la revendication 7, caractérisé en ce qu'une couche d'un à cinq milimètres d'épaisseur de ladite émulsion est appliquée entre les couches.

9. Procédé selon l'une des revendications précédentes, caractérisé en ce que la cavité est rétrécie pas à pas du haut en bas.

10. Procédé selon l'une des revendications précédentes, caractérisé en ce que l'asphalte préparé à chaud élastique à texture très ouverte a la composition suivante :

    gravillons : de 65 à 90 pour cent en masse, taille des particules comprise entre 8 et 16 mm

    sable : de 0 à 20 pour cent en masse, taille des granules comprise entre 0 et 3 mm

    charge : de 0 à 10 pour cent en masse, taille < 63 μm

    liant : de 4 à 25 pour cent en masse

    compléments : de 0 à 1 pour cent en masse,

    le liant étant composé d'un mélange de bitume et d'un caoutchouc naturel ou d'un élastomère, ou d'une matière thermoplastique.

11. Procédé selon la revendication 10, caractérisé en ce que le liant se compose d'un mélange de bitume et de polymère styrène-butadiène-styrène (SBS).

12. Procédé selon la revendication 10, caractérisé en ce que le liant se compose d'un mélange de bitume et de caoutchouc styrène-butadiène (styrène butadien rubber ou SBR).

13. Procédé selon la revendication 10, caractérisé en ce que le liant se compose d'un mélange de bitume et d'acétate d'éthyle-vinyle (ethyl-vinyl acétate ou EVA).

14. Procédé selon la revendication 10, caractérisé en ce les compléments se composent de fibres de verre et/ou de fibres minérales et/ou de particules de caoutchouc et/ou de promoteurs d'adhérence et/ou d'émulsions de latex et/ou d'émulsions de bitume.

fig - 1

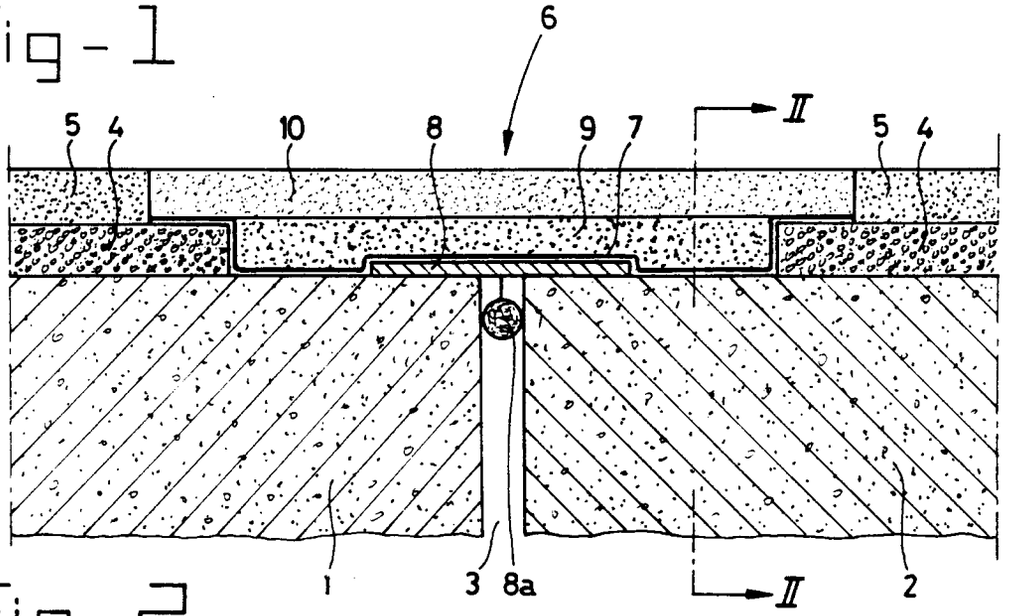

fig - 2

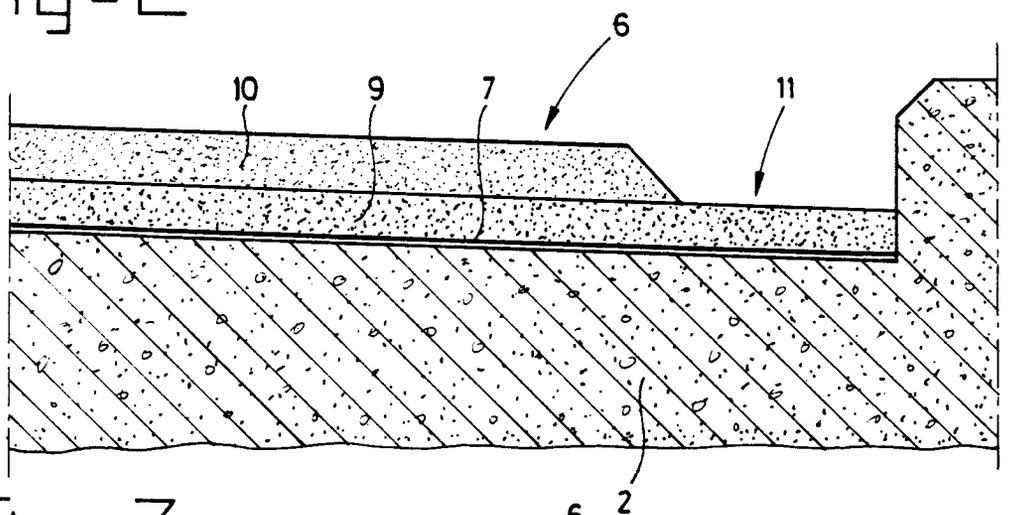

fig - 3