(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 September 2012 (20.09.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/122610 A2

(51) International Patent Classification:
E01B 3/46 (2006.01) *B29B 17/04* (2006.01)

(21) International Application Number:
PCT/BE2012/000015

(22) International Filing Date:
15 March 2012 (15.03.2012)

(25) Filing Language: Dutch

(26) Publication Language: English

(30) Priority Data:
BE2011/0162 15 March 2011 (15.03.2011) BE

(71) Applicant *(for all designated States except US)*: **CDM N.V.** [BE/BE]; Reutenbeek 9, B-3090 Overijse (BE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **CARELS, Patrick** [BE/BE]; CDM N.V., Reutenbeek 9-11, B-3090 Overijse (BE).

(74) Agents: **BUREAU CALLEWAERT BVBA** et al.; Brusselsesteenweg 108, B-3090 Overijse (BE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: RECYCLED ELASTIC SOLE FOR CONCRETE ELEMENTS UNDER THE RAILS OF A RAILWAY AND METHOD FOR ATTACHING THIS SOLE

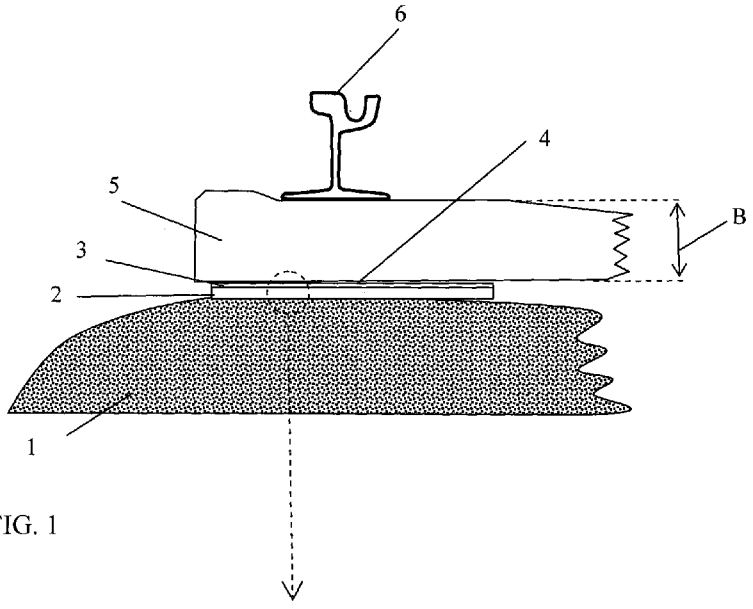

FIG. 1

(57) Abstract: Elastic sole with a concrete element (5) on which rails (6) of a railway rest, whereby this elastic sole comprises an elastic mat (2) and a tack mat (3) which are manufactured out of a pneumatic tyre, whereby the tack mat (3) is at least partly embedded in the concrete element (5) for fixing of the elastic mat (2).

WO 2012/122610 A2

Recycled elastic sole for concrete elements under the rails of a railway and method for attaching this sole

The invention concerns an elastic sole with a concrete element on which the rails of a railway rest, in particular a sleeper, whereby this elastic sole comprises a tack mat and an elastic mat which are fixed to one another. Said tack mat contains a textile structure which is at least partly embedded in the concrete element so as to anchor the elastic sole to the concrete element.

Further, the invention also concerns a method for manufacturing an elastic sole and a concrete element with an elastic sole on which this concrete element is intended to rest.

These elastic soles are used to dampen the transfer of vibrations of the rails and the sleepers to the underlying railway bed, for example to avoid any damage to the ballast bed. Thus, the life of the ballast stones on which the sleepers rest is extended. The elastic soles must thereby resist relatively high horizontal shear resistances. A firm attachment of the sole to the concrete element is hereby very important.

According to the present state of the art, elastic soles are fixed to the concrete elements by embedding these soles at least partly in the concrete. Such elastic soles are described for example in patents EP1186709B1 and EP1298252B1.

European patent EP1186709B1 describes an elastic sole which is provided with upright parts which have hooks in the shape of a harpoon. These parts are embedded in the bottom side of the concrete sleeper. These upright parts are disadvantageous in that they penetrate rather deeply in the concrete and consequently have an adverse effect on the strength of the concrete sleepers.

European patent EP1298252B1 describes a method for connecting a concrete sleeper to a railway bed by means of an elastic mat whereby this elastic mat is fixed to the concrete by means of a geotextile. To this end, the geotextile is embedded in the wet concrete of the concrete sleeper on the one hand, and it is either embedded in the elastic mat or welded to the

latter on the other hand. Said geotextile is disadvantageous, however, in that its fibres become detached under the influence of shear resistances, as a result of which the sleeper comes off the elastic mat.

Further, it is also difficult to attach such existing elastic soles in the concrete when the concrete is too dry or if any chippings are present in the concrete.

The invention aims to remedy these disadvantages by providing an elastic sole and a method which make it possible to provide the bottom side of a concrete element, in particular a sleeper, with an elastic sole in a simple manner.

The present invention also aims to provide a solution which make it possible to attach the elastic sole in such a manner that it will resist much higher shearing forces than the present solutions without compromising the strength of the concrete element.

Moreover, the invention aims to propose a solution that is more environmentally friendly and cost-effective compared to current solutions.

To this aim, at least a part of a rubber layer of a pneumatic tyre is removed, which part forms an elastic mat, whereby this part is removed from said pneumatic tyre together with at least a part of a textile layer, such that an elastic sole is obtained with the above-mentioned part of a textile layer on one side, which forms a tack mat. This tack mat is hereby at least partly embedded in the elastic mat and it has at least partially free textile parts. These free textile parts of the tack mat are at least partly embedded in the concrete element by providing the tack mat against wet concrete of the concrete element, such that the free textile parts penetrate in an outer layer of the concrete element, after which this wet concrete hardens and the tack mat is anchored in the concrete element, such that finally the elastic mat is attached to the concrete element by means of the tack mat.

The concrete element forms a sleeper, for example, on which the rails of a railway rest.

Practically, the part of the rubber layer forming the elastic mat and the part of the textile layer are removed together from said pneumatic tyre,

such that the textile parts of the textile layer extend above the elastic mat up to a height which amounts to 0.1 to 3 mm, in particular 0.2 to 2 mm, and preferably 0.2 to 1 mm.

Advantageously, the rubber layer and/or the textile layer are provided with at least a longitudinal and/or a diagonal incision.

The invention also concerns an elastic sole with a concrete element on which the rails of a railway rest, in particular a sleeper, whereby this elastic sole comprises an elastic mat and a tack mat which are fixed to one another, whereby this tack mat is provided with textile parts which are embedded at least partly in the concrete element and, preferably, also at least partly in the elastic mat, whereby the textile parts consist at least partly of cords extending practically parallel to the elastic mat. In particular, the invention also concerns a method for manufacturing an elastic sole with a tack mat derived from a pneumatic tyre.

Other particularities and advantages of the invention will become clear from the following description of practical embodiments of the method and device according to the invention; this description is given by way of example only and does not limit the scope of the claimed protection in any way; the figures of reference used hereafter refer to the accompanying drawings.

Figure 1 schematically represents a cross section of an elastic sole with a concrete element according to an embodiment of the invention.

Figure 2 schematically represents a detail of figure 1 displaying a tack mat with an elastic mat.

Figure 3 schematically represents the construction of a rubber pneumatic tyre, in particular a schematic cross section of a radial tyre.

The invention generally concerns an elastic sole for a concrete element 5. In particular, the invention concerns an elastic sole for a sleeper on which the rails 6 of a railway rest, as is schematically represented in figure 1. This elastic sole is situated in a railway between the concrete element 5 and the ballast 1 of the railway bed. Such soles protect the ballast stones and extend their life. Further, the invention also concerns a method for manufacturing a concrete element 5 with an elastic sole attached to it.

According to the invention, the elastic sole consists of an elastic mat 2 and a tack mat 3, whereby the tack mat 3 is used to fix the elastic mat 2 to the concrete element.

The elastic sole is obtained from a pneumatic tyre, in particular a car tyre or the like. Thus, material from a worn tyre can be at least partly used for this purpose. Said car tyre may consist for example of a radial tyre or a cross-ply tyre and it contains mainly an elastic material such as synthetic rubber.

In general, a pneumatic tyre is built as represented in figure 3. The outside 10 has a rubber tread 7, possibly embossed. Said tread 7 is the upper side of a rubber top layer 13. Under this rubber top layer 13 is situated what is called a carcass or textile layer 14 with a rubber underlay 12 underneath. Also several other layers may be provided and/or an additional reinforcement in steel. The inside 11 of such a tyre is usually provided with a rubber airtight layer.

According to a method of the invention, the rubber top layer 13 and the textile layer 14 lying against it are removed together from the tyre in the circumferential direction of the latter. To this end, the top part of the tyre is cut off, preferably practically parallel to the tread 7 and the textile layer 14, right under the textile layer 14. A strip is hereby obtained comprising at least a part of the textile layer 14 and a part of the rubber layer 13. The strip hereby has a width, for example, corresponding more or less to the width of the tread 7. This width may amount for example to some 180 mm and it depends on the dimensions of the recycled car tyre.

Said strip may also be obtained by making use of a plane or grater so as to remove material from the inside of the pneumatic tyre. It is also possible to remove material from the outside of the pneumatic tyre in this way.

Consequently, according to the invention, at least a part of the thickness D of the textile layer 14, together with at least a part of the thickness E of a rubber layer 13 lying against it are removed from the pneumatic tyre.

The total thickness C of the strip also depends on the nature of the car tyre and the wear of its tread 7. Said thickness C may amount for

example to some 5 mm to 15 mm. Preferably, the thickness amounts to some 6 mm to 10 mm, in particular some 8 mm, or in particular some 6 mm to 7 mm.

If desired, several strips can be combined. Thus, these strips can be placed next to one another and stiffened via what is called a 'temperature/pressure/time' process (TPT) in a press oven. The strips are hereby rigidly fixed to each other by subjecting the elastomeric rubber to an elevated temperature and pressure for a certain period of time. Thus can be obtained a strip that is wider than the tread 7 of a pneumatic tyre.

The textile layer 14 contains textile threads and/or cords 4 which, for example in a radial tyre, run mainly parallel to the surface of the tyre and crosswise in relation to the driving direction. The driving direction is in this case the direction in which the tyre moves when rolling over the tread 7. These textile threads and/or cords 4 can be made for example of synthetic fibres such as rayon, polyester, polyamide and/or aramid. Said textile layer 14 may also contain steel wires. Consequently, depending on the application of the elastic sole, it is possible to select a specific type of car tyre to be recycled.

As a result, the textile layer 14 consists of a structure with textile parts such as textile threads and/or cords 4. Thus, the textile layer 14 may consist of a woven structure, parallel cords 4 and/or intersecting cords 4. Thus, this structure may consist of parallel cords 4 which are joined and are possibly interwoven. Said structure has a certain thickness which may amount for example to 1 mm to 3 mm, preferably some 2 mm. These textile threads and/or cords 4 are at least partly embedded in the rubber top layer 13. Further, these textile threads and/or cords 4 are at least partly free on a side opposite the rubber top layer 13.

When the textile layer 14 is already at least partly embedded in the rubber layer 13, usually no additional provisions have to be made for fixing the tack mat 3 to the elastic mat 2.

The textile parts 4 preferably extend above the elastic mat 2 up to a height which amounts to 0.1 to 3 mm, in particular 0.2 to 2 mm, and preferably 0.2 to 1 mm.

The textile layer 14 may be processed such that textile parts 4 raise themselves at least partly better. The textile layer 14 may be processed for example by means of a comb, a plane or a sanding element such as sanding paper, a scourer or a sanding block. Thus are obtained erected textile parts 4 which will be more able to integrate in the concrete. These textile parts 4 may also at least partly consist of fine erected hairs of the textile layer 14.

It is possible to provide incisions in the rubber top layer 13 and/or the textile layer 14 to thus make the elastic mat 2 with the tack mat 3 more flexible and also flatter. Said incision can be provided for example longitudinally and/or diagonally in relation to the driving direction of the tyre.

Further, if necessary, the strip can be punched or sawn to a desired size. Thus can be obtained a strip with dimensions that are suitable to be put under a sleeper.

According to the method of the invention, the concrete element 5 and the tack mat 3 are put together when the concrete of the concrete element 5 is still wet and has not cured yet. The tack mat 3 has a surface with a three-dimensional structure which penetrates in the wet concrete. This structure consists of the textile threads and/or cords 4 of the textile layer 14 which are at least partly embedded in the rubber layer and extend at least partly further in the concrete, as shown in figure 2.

After the concrete has dried and cured, the tack mat 3, as a result, is at least partly embedded in the concrete element 5. The tack mat 3 hereby merely extends in a thin layer of concrete 8 up to a certain depth A. Thus, the tack mat 3 preferably merely extends in what is called the laitance, such that it does not adversely affect the firmness of the concrete element 5. Further, any chippings 9 that are present in the concrete will not hinder the anchoring of the tack mat 3.

When the elastic sole fits closely against the concrete element, the textile structure will extend in the concrete element up to a depth A which preferably maximally amounts to 0.2 to 4.0 mm.

In order to evaluate the strength of the connection between the tack mat and the concrete element, a pull-out force may be determined. This

pull-out force is in this case the force needed to pull the tack mat out of the concrete element, such that the elastic sole comes off the concrete element.

By means of the above-described method can be obtained a concrete element with an elastic sole whereby the pull-out force amounts to at least 0.6 to 1.0 MPa, even to at least 1.7 MPa.

It is of course important that the textile structure as such is sufficiently strong and that the different textile threads and/or cords are sufficiently attached to each other. This is achieved in that these textile threads and/or cords are situated in a woven structure and/or are at least partly embedded in the rubber layer 13 of the elastic mat 2.

Further, it is also important to distribute the stresses in the concrete resulting from the fastening of the elastic sole. A good distribution of said tensions is obtained when the textile layer 14, and thus also the tack mat 3, is homogenously built.

The anchoring depth of the tack mat 3 is preferably very small, such that it has practically no impact on the structure and strength of the concrete element. Said depth is preferably very small as well, such that any chippings present in the concrete element have no impact on the anchoring of the tack mat. Consequently, according to the invention, the textile parts 4 merely extend in the outer layer 8 of the concrete element 5.

Thanks to the restricted anchoring depth, it is also possible to embed the tack mat in rather dry concrete and/or in concrete with a low fluidity.

When manufacturing the concrete element with the tack mat according to the invention, use can be made of a vibrating or a non-vibrating lid.

The concrete which is poured in a formwork for manufacturing the concrete element can be compacted by means of a vibrating plate.

The elastic sole can also be applied on the concrete element 5 by providing said sole beforehand in a formwork, after which the concrete is poured in the formwork in order to manufacture the concrete element.

Naturally, the invention is not restricted to the above-described method and device according to the invention. Thus, the different elements of the described embodiments can be mutually combined, and different types of

pneumatic tyres can be used depending on the desired qualities of the elastic sole.

For example, an underlying rubber layer 12 can be used together with the textile layer 14 instead of the rubber top layer 13. Also part of the tread can be removed to thus obtain a thinner elastic sole, for example. The textile layer can be partly removed to obtain erected free far ends of the textile threads and/or cords, which can provide for a better adhesion in the concrete element.

The term rubber according to the invention includes natural and synthetic rubber and any other equivalent suitable elastomeric materials which can be used to replace natural and synthetic rubber.

According to the invention, also a rubber strip with an adhering textile layer consisting of for example parallel cords can be made, analogous to those in a pneumatic tyre. Thus, it is possible to make an elastic sole without stripping an existing pneumatic tyre. The elastic mat can then be made for example of resin-bound rubber granules and the textile layer could be made of polyamide, polyester, polypropylene and/or polyethylene.

According to an alternative method of the invention, an elastic sole can be made by gluing a textile layer on an elastic mat formed of an elastomeric material. The elastomeric layer and/or the textile layer can for example be obtained from a pneumatic tyre.

The elastic sole according to the invention can also be obtained by stripping a strip of elastomeric rubber from a pneumatic tyre, after which a textile layer is glued on this strip.

In order to manufacture the elastic sole according to the invention, at least a part of a textile layer can be obtained from a pneumatic tyre, after which this part of the textile layer is glued on an elastic mat or an elastomeric strip which was not necessarily obtained from a pneumatic tyre.

Claims

1. Method for manufacturing a concrete element provided with an elastic sole on which said concrete element is intended to rest, whereby this concrete element is made by pouring concrete in a formwork and whereby a strip is removed from one or several pneumatic tyres according to the circumferential direction of the latter, whereby these pneumatic tyres have a rubber layer (13) which mainly consists of rubber and which is confined by a tread (7) of the pneumatic tyres on the one hand and by a textile layer (14) having a thickness D on the other hand, characterised in that said strip is obtained by removing at least a part of said rubber layer (13) together with at least a part of the thickness D of the textile layer (14) from the pneumatic tyres, such that said strip has free textile parts (4) which are not surrounded by rubber, whereby said part of the rubber layer (13) forms an elastic mat (2) and whereby said free textile parts (4) and the adjacent textile layer of said strip form a tack mat (3) which is at least partly embedded together with the free textile parts (4) in the concrete of said concrete element (5) before it has cured by bringing said tack mat (3) into contact with a surface of the concrete element (5), such that said free textile parts (4) penetrate at least partly in an outer layer (8) of the concrete, whereby the concrete is subsequently cured, such that said tack mat (3) is anchored in the concrete and said elastic mat (2) is thus attached to the concrete element (5) via the tack mat (3).

2. Method according to claim 1, whereby said strip is put against a wall of said formwork together with said rubber layer (13), and concrete is subsequently poured in this formwork so as to form the concrete element (5), such that said free textile parts (4) extend in the concrete of the latter.

3. Method according to claim 1, whereby concrete is poured in said formwork so as to form the concrete element (5) and said strip is subsequently pressed together with said free textile parts (4) against the surface of the cast concrete, whereby the concrete subsequently cures, such that said tack mat (3) is anchored in the concrete.

4. Method according to any one of the preceding claims, whereby said concrete element (5) forms a sleeper on which the rails (6) of a railway are intended to rest.

5. Method according to any one of the preceding claims, whereby said strip is removed from said one or several pneumatic tyres, such that the free textile parts (4) extend above the elastic mat (2) up to a height which amounts to 0.1 to 3 mm, in particular 0.2 to 2 mm, and preferably 0.2 to 1 mm.

6. Method according to any one of the preceding claims, whereby said textile layer (14) consists of steel wires, textile cords and/or synthetic fibres such as rayon, polyester, polyamide or aramid.

7. Method according to any one of the preceding claims, whereby said pneumatic tyre is a radial tyre.

8. Method according to any one of the preceding claims, whereby said elastic mat (2) and/or the tack mat (3) is/are provided with at least an incision running longitudinally and/or diagonally in relation to the driving direction of the pneumatic tyre.

9. Method according to any one of the preceding claims, whereby said strip is cut from the pneumatic tyre, such that the latter has a width of some 180 mm.

10. Method according to any one of the preceding claims, whereby the side of the elastic mat (2) turned away from the tack mat (3) is levelled up to a certain thickness (C) of the strip.

11. Method according to any one of the preceding claims, whereby the tack mat (3) is processed by sanding, scraping and/or combing it.

12. Elastic sole with a concrete element (5) on which the rails (6) of a railway are intended to rest, in particular a sleeper, whereby this elastic sole comprises an elastic mat (2) and a tack mat (3) which are fixed to one another, whereby this tack mat (3) is provided with textile parts (4) which are embedded at least partly in the concrete element (5) and preferably also at least partly in the elastic mat (2), characterised in that the tack mat (3) comprises at

least a part of the textile layer (14) of a pneumatic tyre and the elastic mat (2) comprises at least a part of a rubber layer (12, 13) of the pneumatic tyre.

13. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the elastic mat (2) comprises at least a part of a rubber layer (12, 13) of the pneumatic tyre.

14. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) are at least partly embedded in the elastic mat (2).

15. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the elastic mat (2) comprises at least a part of a rubber layer (13) between the tread (7) of the pneumatic tyre and the textile layer (14).

16. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the rubber layer (13) comprises at least a part of the tread (7) of the pneumatic tyre.

17. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) of the tack mat (3) extend in the concrete element (5) up to a depth (A) which amounts to maximally 5% of the height (B) of the concrete element (5), in particular maximally 1%, preferably maximally 0.5%.

18. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) of the tack mat (3) extend in the concrete element (5) up to a depth (A) which amounts to 0.1 to 4 mm, in particular 0.2 to 3 mm, and preferably 0.2 to 2 mm.

19. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) extend above the elastic mat (2) up to a height (A) which amounts to 0.1 to 3 mm, in particular 0.2 to 2 mm, and preferably 0.2 to 1 mm.

20. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the elastic mat (2) consists at least partly of rubber and/or resin-bound rubber granules.

21. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the elastic sole is anchored with the concrete element (5), such that the pull-out force amounts to at least 0.6 to 1.7 MPa, preferably at least 1.0 MPa.

22. Elastic sole with a concrete element (5) on which the rails (6) of a railway are intended to rest, in particular a sleeper, whereby this elastic sole comprises an elastic mat (2) and a tack mat (3) which are fixed to one another, whereby this tack mat (3) is provided with textile parts (4) which are embedded at least partly in the elastic mat (2) and at least partly in the concrete element (5), characterised in that the textile parts (4) consist at least partly of cords which are practically parallel to the elastic mat (3).

23. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) consist at least partly of cords which are practically parallel to the elastic mat (3) and which are interwoven in a textile structure such that they join.

24. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) are at least partly embedded in the elastic mat (2).

25. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) are at least partly glued onto the elastic mat.

26. Elastic sole with a concrete element (5) according to any one of the preceding claims, whereby the textile parts (4) are at least partly derived from a pneumatic tyre.

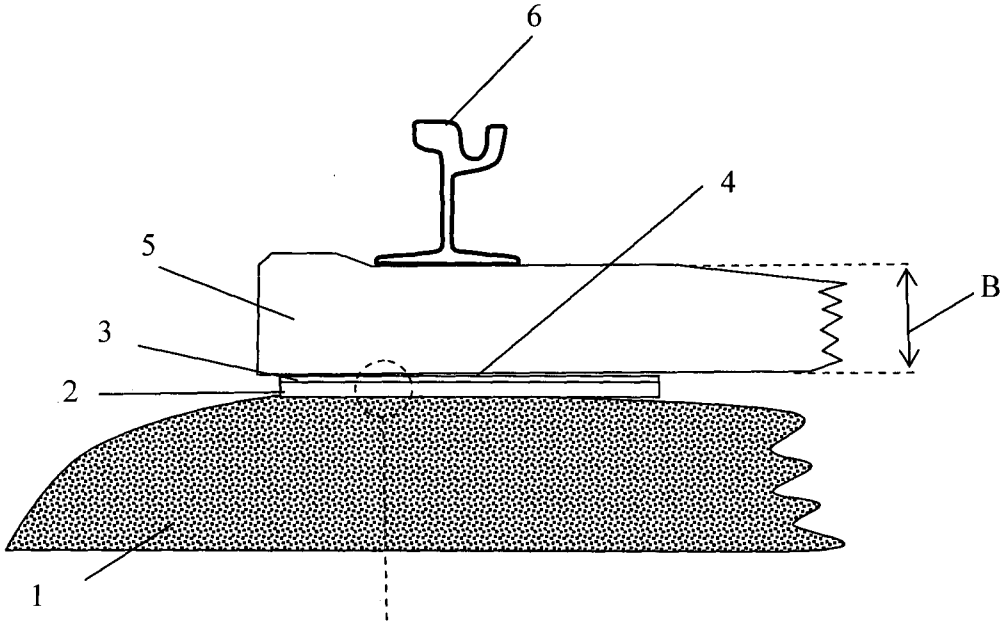

FIG. 1

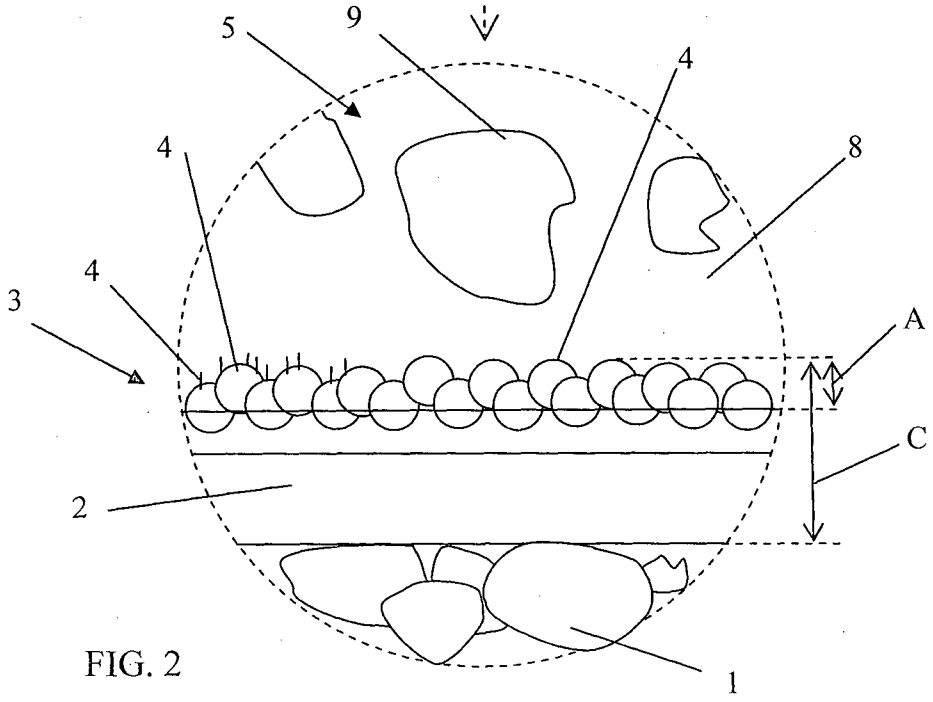

FIG. 2

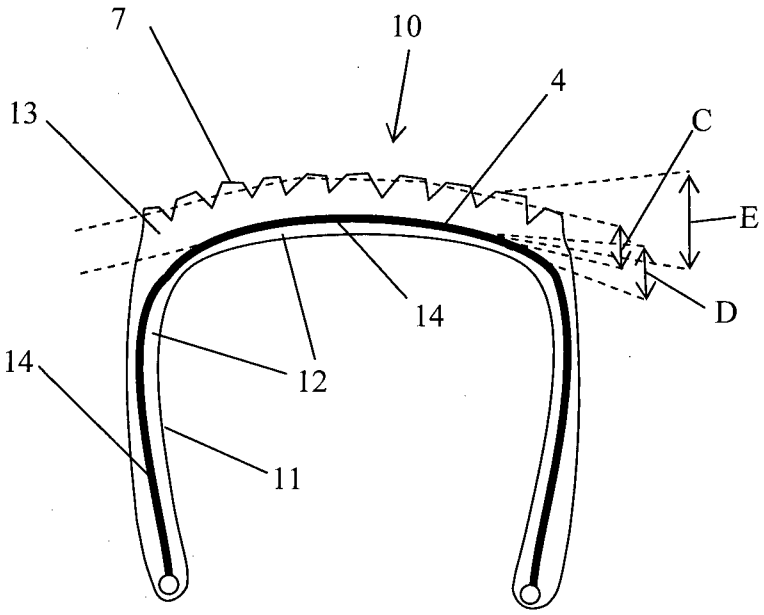

FIG. 3