

A PAD FOR A RAILWAY RAIL FASTENING ASSEMBLY

The present invention relates to a pad for a railway rail fastening assembly.

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Background

In railway track fastening applications, an important parameter associated with a track fastening is its vertical
10 stiffness. In some situations it is desirable to have a track fastening with a low stiffness, e.g. to reduce vibration or noise. This is particularly the case in slab track applications (i.e. those without ballast), as there is no ballast to provide additional resilience.

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Track fastening assemblies typically comprise a resilient rail pad provided between the rail and the underlying foundation (e.g. slab or sleeper). The stiffness of such a rail pad may be reduced to provide a softer track
20 fastening. However, as the pad stiffness gets lower, the amount of undesirable rail roll that is generated in response to an inclined load also increases. The problem with rail roll is that it can change the position of the critical contact between the wheel and rail and lead to
25 poor vehicle steering characteristics. As a result, the train may lurch from side to side or impart excessive forces on the track.

To obtain a lower vertical stiffness, a baseplate may be
30 introduced into the fastening system. Such a baseplate may spread the load and better resist the moment that leads to rail roll. However, introducing a baseplate adds significantly to the cost and weight of the rail fastening

system, for example due to the addition of the baseplate and the larger baseplate pad that fits beneath it. Rail fastening system with such baseplates also become more complicated, with more components.

Accordingly, a rail fastening assembly that can provide low stiffness without an expensive or heavy baseplate is desirable.

Statements of Invention

According to an aspect of the present invention there is provided a railway rail fastening assembly including: an anchoring device; a side post insulator configured to be positioned between the anchoring device and a rail foot of a rail in an installed configuration, the side post insulator extending along a width of the anchoring device; and a pad, the pad being configured for placement between the rail and an underlying foundation, wherein a cross-section of the pad includes: a rigid layer; and a first resilient layer configured to face the underlying foundation, wherein the rigid layer is integrally formed with the first resilient layer, and wherein an edge of the pad comprises a pair of spaced apart ears that extend beyond a central region of the pad, and wherein the ears are configured to extend alongside a substantial portion of the anchoring device such that the ears extend at least beyond the side post insulator between the anchoring device and the rail, and the rigid layer extends from the central region into almost an end of the ears and has a rigidity that resists bending of the rigid layer during use of the rail such that the ears are configured to limit the amount of rail roll as a lateral force is applied to the rail.

An edge of the pad may comprise (e.g. form) a pair of spaced apart ears (e.g. lug or projection) that extends beyond a central region of the pad (e.g. in substantially the same plane as the pad). The rigid layer may extend into the ear. The ear may be configured to resist rail roll.

The pad may further comprise a second resilient layer configured to face a railway rail. The rigid layer may be provided between the first and second resilient layers. The rigid layer may be integrally formed with the first and second resilient layers.

Such a pad may advantageously combine the functions of previously-proposed baseplate pads, baseplates and rail pads. Accordingly, such a pad is cheaper and simpler than a conventional baseplate assembly, which might otherwise be necessary. Furthermore, the pad according to the present invention may behave more like a baseplate, so allowing softer pads in standard assemblies. In particular, the pad according to the present invention may reduce the amount of rail roll associated with soft rail pads.

The rigid layer may be encapsulated, e.g. substantially or completely encapsulated, within the first and second resilient layers.

At least one of the first and second resilient layers may extend over one or more edges of the rigid layer. For example, in the case of the second resilient layer not being provided, the first resilient layer may extend over (e.g. alongside) one or more edges of the rigid layer, e.g. such that the rigid layer is embedded in the first resilient layer. In the case of the second resilient layer being provided, the

first and second resilient layers may be connected at said edges of the rigid layer, e.g. so as to encapsulate the rigid layer.

The first and second resilient layers may be unitary with each other. The first and second resilient layers may be made from the same material.

The first and second resilient layers may be connected at one or more cross sections at which the rigid layer is not provided, for example at the edges of the pad and/or other regions away from the edges of the pad.

The rigid layer may be embedded in the first resilient layer. The first resilient layer and the rigid layer may be moulded together. The first and second resilient layers may be moulded around the rigid layer. Additionally or alternatively, the first and/or second resilient layers may be bonded to the rigid layer.

At least the rigid layer may be sized so as to extend beyond the width of a base, e.g. foot, of the rail. For example, the rigid layer may be wider than a particular standard rail, such as those set out in European standard, EN13674. In particular, the rigid layer may be wider than standard rail profile 60E1, which has a foot width of 150mm. The rigid layer may extend between anchoring devices of the fastening assembly.

The rigid layer may comprise first and second rigid layer portions spaced apart from each other, e.g. laterally spaced apart. (The lateral spacing may be in the same direction as the longitudinal axis of the rail.) The first and second rigid layer portions may be separate from one another so as to

form discrete portions. In other words, the rigid layer may be absent in the space between the first and second rigid layer portions (where it cannot protrude out beyond the rail width because of the presence of anchoring devices that locate corresponding rail clips). Alternatively, the first and second rigid layer portions may be connected by a connecting portion. In either case, the first and second rigid layer portions may be provided at the same intermediate position across the thickness of the pad.

The first and second rigid layer portions may be elongate, e.g. forming strips. The first and second rigid layer portions may extend in substantially the same direction. The first and second rigid layer portions may extend in a longitudinal direction of the pad, e.g. in a direction perpendicular to the lateral spacing between the first and second rigid layer portions. (Accordingly, the longitudinal direction of the pad may be perpendicular to the longitudinal axis of the rail.)

The rigid layer may reduce rail roll by extending out beyond the rail foot. Therefore, the cost may be reduced and the same effect achieved by providing the first and second rigid layer portions, with no rigid layer present in the space between the first and second rigid layer portions.

The edge and an opposing edge of the pad may each comprise a pair of spaced apart ears that extends beyond the central region of the pad. For example, the edge and opposing edge may each comprise one ear. The ears may be diagonally opposite, e.g. offset from, each other.

At least one edge of the pad may have a pair of spaced apart ears (e.g. laterally spaced apart) that extend beyond the central region of the pad. In particular, opposing edges of the pad may each comprise a pair of spaced apart ears that extend beyond a central region of the pad. The ears may extend in the longitudinal direction of the pad (e.g. perpendicular to the rail longitudinal axis).

The rigid layer may extend into the ears, in particular, the first and second rigid layer portions may extend into corresponding ears. The first and second rigid layer portions may extend out almost to the ends of the ears, e.g. so that resistance to rail roll may be maximised. Each of the first and second rigid layer portions may extend between the said opposing edges.

The ears may comprise the first resilient layer. The ears may comprise the second resilient layer.

The pad may be asymmetric, e.g. about the pad's lateral axis, which may be parallel to the longitudinal axis of the rail when installed. The ear or pair of ears on one of the opposing edges may extend further from the central region than the ear or pair of ears on the other of the opposing edges. For example, longer ears may be provided on a field side of the pad and shorter ears may be provided on a gauge side of the pad.

The ear or pair of ears on one of the opposing edges may be wider (e.g. in the pad lateral direction) than the ear or pair of ears on the other of the opposing edges. For example, wider ears may be provided on the field side of the pad and narrower ears may be provided on the gauge side of the pad. The longer

and wider ears may be provided on the same side of the pad. The longer and/or wider ears may be more effective at resisting rail roll and as a result they may be provided on the field side of the pad, as this is where the maximum downward force may be directed. The length and/or width of the ears may be adjusted to suit the desired stiffness.

The central region may be trapezium shaped. For example, a width (e.g. edge) of the central region from which one of the ears or pairs of ears extends may be wider than an opposite width (e.g. edge) of the central region, e.g. from which the other ear or pair of ears may extend. The wider central region width may have the longer and/or wider ears.

The central region may be sized to be substantially the same width as the base, e.g. foot, of the rail, for example the standard rails mentioned above. The ears may extend beyond the rail base.

The or each ear may be configured to extend alongside an anchoring device forming part of the fastening assembly. One or each pair of ears may be configured to extend either side of the anchoring device forming part of the fastening assembly. The ears from one or each pair may be configured to extend alongside the anchoring device (in particular on the field side) and may extend alongside a substantial portion of the anchoring device, e.g. at least beyond an insulator between the anchoring device and the rail. The ears may be configured not to extend beneath the anchoring device.

The anchoring device may be configured to receive a fastening means, such as a clip, which bears down on the rail when in an installed configuration. The anchoring device may be fixed to

the underlying foundation, e.g. with the same or another fastening means.

The anchoring devices on either side of the rail may be independent of one another and may be independently connectable to the underlying foundation. For example, the fastening assembly, for which the pad of the present invention is intended, may not have a rigid (e.g. metal) baseplate, which engages or comprises the anchoring devices, and which extends beneath the rail.

The second resilient layer may be thicker in the central region than at the ears. The second resilient layer thickness transition may occur where the ears meet the central region of the pad. For example, the second resilient layer thickness transition may extend beneath an edge of the base of the rail intended for the pad. A chamfer may be provided in the second resilient layer where the thickness of the second resilient layer changes. The second resilient layer thickness transition may avoid the edge of the rail cutting in to the pad.

The first and second resilient layers may be configured so as to have different stiffnesses, for example the second resilient layer may be stiffer than the first resilient layer. The second resilient layer may be thinner than the first resilient layer. The first resilient layer may comprise a plurality of voids distributed across the first resilient layer so as to reduce the stiffness of the first resilient layer. For example, the first resilient layer may comprise a plurality of studs, projections, protrusions, grooves, channels, etc., which serve to reduce the area through which the loads from the rail are distributed.

The rigid layer may be formed from a metal, such as steel. The first and second resilient layers may be formed from the same or different resilient materials. At least one of the first and second resilient layers may be formed from rubber.

The underlying foundation may comprise a sleeper or a slab, e.g. as used in track slab application. The underlying foundation may be formed from concrete, cement, wood or any other suitable material.

The pad may be configured to be independent of a fastening that couples the rail to the underlying foundation and/or independent of a fastening between an anchoring device and the underlying foundation.

The rigid layer may have a rigidity that resists bending of the rigid layer during use of the rail.

The rigid layer may have a substantially flat surface facing the first resilient layer.

Brief Description of the Drawings

Reference will now be made to the accompanying drawings in which:

Figure 1 is a perspective view of a railway rail fastening assembly;

Figures 2a and 2b are perspective views of a pad for the railway rail fastening assembly according to a first

example of the present invention with Figures 2a and 2b showing top and bottom perspective views respectively;

Figures 3a, 3b and 3c show further views of the pad for the
5 railway rail fastening assembly according to the first example of the present invention where Figure 3a shows a side view, Figure 3b shows a sectional view corresponding to section A-A depicted in Figure 3a and Figure 3c shows a sectional view corresponding to section B-B depicted in
10 Figure 3a;

Figure 4 shows a partial sectional view corresponding to section C-C depicted in Figure 2a of the pad for the railway rail fastening assembly according to the first
15 example of the present invention;

Figures 5a and 5b are plan views of a pad for the railway rail fastening assembly according to a second example of the present invention with Figures 5a and 5b showing bottom
20 and top views respectively;

Figure 6 shows a plan sectional view of the pad for the railway rail fastening assembly according to the second example of the present invention and corresponds to Figure
25 3b for the first example;

Figures 7a, 7b and 7c show a pad for the railway rail fastening assembly according to a third first example of the present invention with Figure 7a showing a bottom plan
30 view, Figure 7b showing a top plan view and Figure 7c showing a sectional view; and

Figure 8 shows a graph comparing the response to a static inclined load for previously-proposed pads and pads according to the present invention.

5 Detailed Description

With reference to Figure 1, a railway rail fastening assembly 10, according to an example of the present invention, comprises an anchoring device 12, e.g. a shoulder, configured to receive a railway rail fastening clip 14. The anchoring device 12 is operatively connected to an underlying foundation (shown schematically in Figure 1), such as a railway sleeper or slab. Respective anchoring devices 12 are provided on either side of a railway rail 16 for retaining clips 14 which bear on a rail base or foot 17. The clip 14 secures the railway rail 16 to the underlying foundation by virtue of forces exerted by the clip on the anchoring device 12 and the rail 16.

20 The clip 14 may be configured such that it can be deflected from a non-operative configuration to at least one operative configuration in which a toe portion 15 of the clip bears indirectly on the rail via a toe insulator 22, which is described in more detail below. (In an

25 alternative arrangement, the toe insulator may be omitted such that the clip bears directly on the rail.) The clip 14 may be resilient and may be made from a rod of resilient material. The clip 14, as shown in Figure 1, may be of the type that is inserted into engagement with the anchoring

30 device 12 and rail 16 in a substantially lateral direction relative to a longitudinal axis of the rail. However, other clip types are also envisaged, e.g. clips that are inserted in a direction parallel to the longitudinal axis

of the rail. Furthermore, although a particular anchoring device, which cooperates with a corresponding clip, is shown in Figure 1, it is envisaged that the present invention may apply to any other type of anchoring device, clip and/or anchoring devices without clips.

The railway rail fastening assembly 10 may further comprise one or more electrically insulating wear pieces, such as the toe insulator 22 and a side post insulator 24. The toe insulator 22 may be carried by the toe portion 15 of the clip 14 and may bear against the rail foot 17 in an installed configuration. The toe insulator 22 may electrically insulate the rail from the clip and/or limit wear between the rail and the clip. The side post insulator 24 may be positioned between the anchoring device 12 and the rail foot 17 in an installed configuration and the side post insulator 24 may extend along the width of the anchoring device. The side post insulator 24 may electrically insulate the rail from the anchoring device and/or limit wear between the rail and the anchoring device.

Referring still to Figure 1, each anchoring device 12 may comprises a protrusion 13 provided on a lower surface of the anchoring device, e.g. facing the underlying foundation when in the installed configuration. The anchoring device protrusion 13 may be configured to cooperate with a corresponding recess 36 provided in an intermediate member 38. The intermediate member 38 may extend beneath the rail 16 and may comprise a recess 36 at each end for receiving anchoring devices 12. (Alternatively, the intermediate member may not extend beneath the rail and separate intermediate member portions may be provided, each with a

recess for receiving anchoring devices 12.) The cooperation of the anchoring device protrusion 13 with the recess may permit a substantially vertical adjustment of the anchoring device 12 relative to the underlying foundation 18.

The railway rail fastening assembly 10 may further comprise a fastening means (not shown), such as a bolt, for each anchoring device. The fastening means may be configured to fasten the anchoring device 12 to the underlying foundation 18. The fastening means may be received in corresponding fastening means receiving portions 52 in the underlying foundation 18. The fastening means receiving portions 52 may cooperate with the fastening means to secure the anchoring device 12 to the underlying foundation 18. The intermediate member 38 and fastening means receiving portions 52 may be cast into the underlying foundation 18.

The railway rail fastening assembly 10 may further comprise one or more optional spacing shims 58 configured for placement between the anchoring devices 12 and the underlying foundation 18 or intermediate member 38. The shim 58 may extend beneath the rail 16. As such, a pair of anchoring devices 12 either side of the rail may be placed on the same shim 58. The thickness of the shim 58 and/or number of shims may be varied to adjust the height of the anchoring devices 12 relative to the underlying foundation 18. The shim 58 may be securely located in the installed configuration thanks to one or more openings in the shim, through which the fastening means may pass. The shim 58 may be substantially flat on both sides.

The intermediate member 38, fastening means receiving portions 52 and/or shims may be formed of a plastic, such as a high viscosity nylon or any other suitable plastic.

- 5 The railway rail fastening assembly 10 may further comprise a pad 20 according to examples of the present invention. As will be described in more detail below, the pad 20 comprises resilient material for providing cushioning between the rail foot 17 and the underlying foundation 18.
- 10 The railway pad 20 may be placed on the shim 58 in the event that a shim is provided.

With reference to Figures 2a-b, 3a-c and 4, the pad 20 according to a first example of the present invention will

15 be described.

- Referring now to Figures 2a and 2b, opposing edges 22a, 22b of the pad 20 may each have a pair of laterally spaced apart ears 24a', 24a''; 24b', 24b'' that extend beyond a
- 20 central region 26 of the pad. A first edge 22a may have ears 24a', 24a'', whilst a second edge 22b may have ears 24b', 24b''. The ears 24a', 24a'', 24b', 24b'' may extend in a longitudinal direction of the pad, which may be perpendicular to a longitudinal axis of the rail when the
- 25 pad is installed. The ears on each edge 22a, 22b may be spaced apart in a lateral direction of the pad, which is perpendicular to the longitudinal direction of the pad.

- The ears 24a', 24a'' from the first edge 22a may line up
- 30 with respective ears 24b', 24b'' from the second edge 22b. Furthermore, edges of the ears 24a', 24a'', 24b', 24b'' may be continuous with corresponding edges 22c, 22d of the pad extending in the longitudinal direction of the pad.

The central region 26 may have a length (in the longitudinal direction of the pad) substantially the same as the width of the rail foot 17. As a result, the ears
5 24a', 24a''; 24b', 24b'' may start extending from the central region 26 at the edge of the rail foot 17. The rail 16 may be a standard rail, such as those set out in European standard, EN13674. In particular, the rail 16 may have standard rail profile 60E1, which has a foot width of
10 150mm.

The pad 20 may be asymmetric, e.g. about a lateral axis of the pad. (The pad lateral axis may be parallel to the longitudinal axis of the rail when installed.) For
15 example, as depicted, the pair of ears 24a', 24a'' from the first edge 22a may extend further from the central region 26 than the pair of ears 24b', 24b'' from the second edge 22b. The longer ears 24a', 24a'' may be provided on a field side of the pad 20 and shorter ears 24b', 24b'' may
20 be provided on a gauge side of the pad. (In an alternative example, the ears on the first edge 22a may have the same length as the ears on the second edge 22b.)

As depicted in Figure 1, when the pad 20 is installed in
25 the railway rail fastening assembly 10, each pair of ears 24a', 24a''; 24b', 24b'' extends either side of a respective anchoring device 12. In other words, the lateral spacing of the ears may define a gap which receives the respective anchoring device 12. The ears 24a', 24a''
30 at the first edge 22a (e.g. those on the field side) may extend alongside a substantial portion of the anchoring device 12, e.g. at least beyond the side post insulator 24 between the anchoring device 12 and the rail 16. By

contrast, the ears 24b', 24b'' at the second edge 22b (e.g. those on the gauge side) may extend alongside a smaller portion of the anchoring device 12 or just alongside the corresponding side post insulator 24.

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The ears from each pair 24a', 24a''; 24b', 24b'' extend alongside the respective anchoring device (or side post insulator 24) and the ears 24a', 24a''; 24b', 24b'' may not extend beneath the anchoring device 12. As a result, the

10 pad 20 may be installed after the anchoring devices 12 have been secured to the underlying foundation 18. In this way, the pad 20 may be independent of (e.g. not form part of) the fastening that secures the anchoring device 12 to the underlying foundation 18.

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With reference to Figures 3a, 3b and 3c, one or more cross-sections of the pad 20 through its thickness comprises a first resilient layer 28a, a second resilient layer 28b and an intermediate rigid layer 28c provided between the first

20 and second resilient layers. At other cross-sections the rigid layer 28c may not be provided. The second resilient layer 28b may face the rail 16 and in the particular example shown may directly receive the foot 17 of the rail. By contrast, the first resilient layer 28a may face the

25 underlying foundation 18 and in the particular example shown the first resilient layer 28a may rest on the shim 58 (if provided).

The rigid layer 28c may be integrally formed with the first

30 and second resilient layers 28a, 28b. In other words, the rigid layer 28c may be encapsulated, e.g. substantially or completely encapsulated, within the first and second resilient layers 28a, 28b. For example, the first and

second resilient layers 28a, 28b may extend over one or more edges of the rigid layer 28c and the first and second resilient layers 28a, 28b may be connected at said edges of the rigid layer 28c. The first and second resilient layers
5 may also be connected at one or more cross sections at which the rigid layer 28c is not provided, for example in the middle of the central region 26 away from the edges of the pad.

10 The first and second resilient layers 28a, 28b may be unitary with each other. The first and second resilient layers 28a, 28b may be made from the same material. The first and second resilient layers 28a, 28b may be moulded around the rigid layer 28c. Additionally or alternatively,
15 the first and second resilient layers 28a, 28b may be bonded to the rigid layer 28c.

The rigid layer 28c may be formed from a metal, such as steel. The first and second resilient layers 28a, 28b may
20 be formed from the same resilient material, such as rubber.

The rigid layer 28c may extend beyond the width of the rail foot 17. For example, the rigid layer 28c may have a length greater than the width of a standard rail as
25 described above. In particular, the rigid layer 28a may extend into the ears 24a', 24a''; 24b', 24b''.

As is best depicted in Figures 3c and 4, the rigid layer 28c may have a substantially flat (e.g. flat) bottom
30 surface 28ca. The bottom surface 28ca of the rigid layer 28c may face the first resilient layer 28a. As will be mentioned below, the thickness of the first resilient layer 28a may vary locally, however, the maximum thickness of the

first resilient layer 28a may be substantially constant across the length of the pad. The rigid layer 28c may also have a substantially flat (e.g. flat) top surface 28cb that faces the second resilient layer 28b.

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The rigid layer 28c may have a rigidity (e.g. stiffness) that resists bending of the rigid layer during use of the rail 16. For example, the rigid layer 28c may have a rigidity that limits the amount of rail roll as a lateral
10 force is applied to the rail. The desired rigidity of the rigid layer 28c may be achieved by selecting the appropriate thickness, ear length, ear width and/or material for the rigid layer.

15 The rigid layer 28c may comprise first and second rigid layer portions 28c', 28c'' laterally spaced apart from each other. The first and second rigid layer portions 28c', 28c'' may be separate from one another so as to form discrete portions. In particular, the rigid layer 28c may
20 be absent in a space 27 laterally between the first and second rigid layer portions 28c', 28c'' where the rigid layer 28c may not otherwise protrude out beyond the rail width due to the presence of the anchoring devices 12 and side post insulators 24 in this region. In an alternative
25 arrangement (not shown), the first and second rigid layer portions 28c', 28c'' may be connected by a rigid connecting portion. In either case, the first and second rigid layer portions 28c', 28c'' may be provided at the same intermediate position across the thickness of the pad 20.

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As depicted in Figure 3b, the first and second rigid layer portions 28c', 28c'' may be elongate, e.g. forming strips, and extend in the longitudinal direction of the pad. In

particular, respective ends of the first rigid layer portion 28c' may extend into corresponding ears 24a', 24b' and respective ends of the second rigid layer portion 28c'' may extend into corresponding ears 24a'', 24b''. The first and second rigid layer portions 28c', 28c'' may extend out almost to the ends of the ears, e.g. so that resistance to rail roll may be maximised. As depicted, the first and second resilient layers 28a, 28b may also extend out over the ears, although in an alternative arrangement (not shown) the first and/or second resilient layers may not extend over the ears.

The rigid layer 28c may reduce rail roll by extending out beyond the rail foot 17. Therefore, the cost may be reduced and the same effect achieved by providing the first and second rigid layer portions 28c', 28c'', with no rigid layer present in the space 27 between the first and second rigid layer portions.

As depicted in Figures 2a, 3a and 4, the second resilient layer 28b may be thicker in the central region 26 than at the ears 24a', 24a'', 24b', 24b''. Transitions 29a', 29a'', 29b', 29b'' in the second resilient layer thickness may occur where the respective ears meet the central region 26 of the pad. For example, the second resilient layer thickness transition 29a', 29a'', 29b', 29b'' may extend in a direction parallel to and beneath an edge of the rail foot 17. A chamfer may be provided in the second resilient layer 28b where the thickness of the second resilient layer changes. The second resilient layer thickness transitions 29a', 29a'', 29b', 29b'' may avoid the edge of the rail foot 17 cutting in to the pad 20 as the rail rolls.

The first and second resilient layers 28a, 28b may be configured so as to have different stiffnesses, for example the second resilient layer 28b may be stiffer than the first resilient layer 28a. To achieve this the second
5 resilient layer 28b may be thinner than the first resilient layer 28a. Additionally or alternatively, as best depicted in Figure 4, the first resilient layer 28a may comprise a plurality of voids 31 distributed across the first resilient layer 28a so as to reduce the stiffness of the
10 first resilient layer. The voids 31 reduce the area through which the loads from the rail 16 are distributed and thus reduce the stiffness.

The voids 31 are provided between a plurality of
15 projections 32 which project away from the second resilient layer, e.g. in a vertical direction when the pad 20 is installed. As depicted, most of the projections 32 are circular in cross-section. The diameter of the circular cross-section may decrease with distance from the second
20 resilient layer 28b. The projections 32 may also be arranged in rows which extend in the longitudinal direction of the pad. Neighbouring rows may be offset from one another. Non-circular cross-section projections 32 may be provided at the ends of rows, e.g. to provide projections
25 up to the edges of the pad.

With reference to Figures 5a, 5b and 6, a pad 120 according to a second example of the present invention will now be described. Except for the features described below, the
30 pad 120 according to the second example is substantially the same as the pad 20 according to the first example and features described in respect of the first example may equally apply to the second example.

As depicted, the pair of ears 124a', 124a'' on edge 122a may be wider (e.g. in the pad lateral direction) than the pair of ears 124b', 124b'' on the opposite edge 122b. The wider ears 124a', 124a'' may be provided on the field side of the pad 120 with the narrower ears 124b', 124b'' being provided on the gauge side of the pad. The wider ears 124a', 124a'' may also be longer than the ears 124b', 124b'' provided on the opposite edge 122b in the same manner as that described in relation to the first example.

The longer and/or wider ears 24a', 24a''; 124a', 124a'' may be more effective at resisting rail roll and as a result they may be provided on the field side of the pad, as this is where the maximum downward force may be directed. The length and/or width of the ears may be adjusted to suit the desired stiffness.

As depicted, the central region 126 may be trapezium shaped to provide the wider ears 124a', 124a''. For example, a width of the central region from which the ears 124a', 124a'' extend may be wider than the width of the central region from which the ears 124b', 124b'' extend. The lateral spacing apart of the ears may otherwise be the same so as to accommodate the anchoring devices 12 which may be the same size.

As shown in Figure 5a, first resilient layer projections 132 may be provided along the angled edges 122c, 122d of the trapezium shaped central section 126. The diameter of the projections' 132 cross-section may change along the edge of the trapezium shaped central section 126 to fit additional projections 132 into the central region.

Figure 6 shows a cross-sectional view of the pad 120 corresponding to that shown in Figure 3b for the pad 20. As depicted, each of the first and second rigid layer portions 128c', 128c'' may be wider at one end than the other. In particular, the end of each of the first and second rigid layer portions 128c', 128c'' that extends into the wider ears 124a', 124a'' may be wider than the end that extends into the ears 124b', 124b''.

10 In a further example of the present invention (not depicted) the second resilient layer may be omitted (or may be provided as a separate component). In such an example, the rigid layer 28c, 128c may be exposed on the side

15 opposite the first resilient layer.

The pad without an integral second resilient layer may otherwise correspond to the pads described above. For example, the rigid layer may be moulded with the first resilient layer and may be embedded within the first resilient layer. The rigid layer may comprises separate rigid layer portions as described above or may comprise a single portion, e.g. with the same plan view shape as the whole pad. Any of the other features described above in relation to the pads 20, 120 may apply to the pad without an integral second resilient layer.

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In another example of the present invention (not depicted), the ears on one edge may be omitted, e.g. the ears on one edge may have zero length. For example, the pair of ears 24a', 24a''; 124a', 124a'' on edge 22a; 122a may be omitted or the pair of ears 24b', 24b''; 124b', 124b'' on the opposite edge 22b; 122b may be omitted. In either case,

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the ears may be provided on the field side of the pad (e.g. facing away from the opposite rail) as this is the side at which maximum downward force may be directed. The pad may be symmetrical about its longitudinal axis. As a result,

5 the same pad may be used on either rail with the pad simply being rotated such that ears extend in the field direction. In this way only one type of pad needs to be provided.

With reference to Figures 7a, 7b and 7c, a pad 220

10 according to a third example of the present invention will now be described. Except for the features described below, the pad 220 according to the third example is substantially the same as the pads 20, 120 according to the first and second examples and features described in respect of the

15 first and second examples may equally apply to the third example.

As depicted, the edge 222a may comprise a single ear 224a and the opposing edge 222b may also comprise a single ear

20 224b. The ears 224a, 224b may be laterally offset from each other. The ears 224a, 224b may sit alongside offset anchoring devices. Accordingly, each ear 224a, 224b may be opposite an anchoring device.

25 The ears 224a, 224b may be the same size. Accordingly, the pad 220 may possess rotational symmetry about an axis perpendicular to the longitudinal and lateral axes of the pad, but may otherwise be axisymmetric about its longitudinal and lateral axes. In an alternative example

30 (not depicted), the ears 224a, 224b may have different widths and/or lengths, e.g. in a manner similar to that described above for the first and second examples.

Referring to Figure 7c, the rigid layer 228c may extend into each of the ears 224a, 224b. As depicted, the rigid layer 228c may be unitary. However, it is also envisaged that the rigid layer may be formed from separate portions, with each portion extending into a respective ear, e.g. in the manner described above for the first and second examples.

As for the first and second examples, the first and second resilient layers 228a, 228b may extend over one or more edges of the rigid layer 228c and the first and second resilient layers 228a, 228b may be connected at said edges of the rigid layer 228c.

In a further example (not depicted), one of the ears 224a, 224b may be omitted. The remaining ear may be provided on the field side of the pad as this is the side at which maximum downward force may be directed.

Figure 8 shows a graph that illustrates the effectiveness of the pads according to the present invention. A static inclined load was applied to a rail fastening assembly with two conventional pads (C) and two pads (E) according to examples of the present invention. The load, angle, and height through which the load acts are those that would be applied dynamically in a standard European durability test on a fastening system. Measurements of the deflection of the rail foot rail on both the field (F) and gauge (G) sides of the assembly were taken. (The load is directed towards the field side, so the rail will almost inevitably deflect downwards on its field side.) Depending on the ability of the pad to resist roll, the rail may move downwards, not deflect much at all, or even move upwards on

its gauge side. The average of the field and gauge side deflections, $(F+G)/2$, represents the downward component of rail movement, so that large downward movements indicate a soft pad (good in this context). The difference between

5 the field and gauge side measurements, $(F-G)$, is indicative of rail roll, which is undesirable. Plotting one against the other indicates performance of a pad: a combination of high average deflection and low deflection difference is good. Figure 8 shows that the pads (E) according to

10 examples of the present invention perform better than the conventional pads (C). The pads (E) according to the present invention provide more vertical deflection (lower stiffness) than the conventional pads (C), but also reduce rail roll despite the lower stiffness.

CLAIMS

1. A railway rail fastening assembly comprising:
 - an anchoring device;
 - a side post insulator configured to be positioned between the anchoring device and a rail foot of a rail in an installed configuration, the side post insulator extending along a width of the anchoring device; and
 - a pad, the pad being configured for placement between the rail and an underlying foundation, wherein a cross-section of the pad comprises:
 - a rigid layer; and
 - a first resilient layer configured to face the underlying foundation,wherein the rigid layer is integrally formed with the first resilient layer, and
 - wherein an edge of the pad comprises a pair of spaced apart ears that extend beyond a central region of the pad, and
 - wherein the ears are configured to extend alongside a substantial portion of the anchoring device such that the ears extend at least beyond the side post insulator between the anchoring device and the rail, and the rigid layer extends from the central region into almost an end of the ears and has a rigidity that resists bending of the rigid layer during use of the rail such that the ears are configured to limit the amount of rail roll as a lateral force is applied to the rail.
2. The railway rail fastening assembly of claim 1, wherein the pad further comprises a second resilient layer configured to face the railway rail, wherein the rigid

layer is provided between and is integrally formed with the first and second resilient layers.

3. The railway rail fastening assembly of claim 2, wherein the rigid layer is encapsulated within the first and second resilient layers.

4. The railway rail fastening assembly of claim 2 or 3, wherein the first and second resilient layers extend over one or more edges of the rigid layer and the first and second resilient layers are connected at said edges of the rigid layer.

5. The railway rail fastening assembly of any of claims 2 to 4, wherein the first and second resilient layers are unitary with each other.

6. The railway rail fastening assembly of any of claims 2 to 5, wherein the first and second resilient layers are connected at one or more cross sections at which the rigid layer is not provided.

7. The railway rail fastening assembly of any of claims 2 to 6, wherein the first and second resilient layers are moulded around the rigid layer.

8. The railway rail fastening assembly of any of the preceding claims, wherein the first resilient layer and the rigid layer are moulded together.

9. The railway rail fastening assembly of any of the preceding claims, wherein at least the rigid layer is sized so as to extend beyond the width of a base of the rail.

10. The railway rail fastening assembly of any of the preceding claims, wherein the rigid layer comprises first and second rigid layer portions spaced apart from each other.

11. The railway rail fastening assembly of claim 10, wherein the first and second rigid layer portions are elongate and extend in substantially the same direction.

12. The railway rail fastening assembly of any of the preceding claims, wherein the edge and an opposing edge of the pad each comprise a pair of spaced apart ears that extend beyond the central region of the pad.

13. The railway rail fastening assembly of claim 12, wherein the rigid layer extends into each of the ears.

14. The railway rail fastening assembly of claim 13 when dependent on claim 10, wherein the first and second rigid layer portions extend into each of the ears.

15. The railway rail fastening assembly of any of claims 12 to 14, wherein the ears on the edge extend further from the central region than the ears on the opposing edge.

16. The railway rail fastening assembly of any of claims 12 to 15, wherein the ears on the edge are wider than the ears on the opposing edge.

17. The railway rail fastening assembly of any of the preceding claims, wherein the central region is trapezium shaped with a width of the central region from which the

ears extend being wider than an opposite width of the central region.

18. The railway rail fastening assembly of any of the preceding claims when dependent on claim 2, wherein the second resilient layer is thicker in the central region than at the ears.

19. The railway rail fastening assembly of claim 18, wherein a chamfer is provided in the second resilient layer where the thickness of the second resilient layer changes.

20. The railway rail fastening assembly of any of claims 2 to 19 when dependent on claim 2, wherein the first and second resilient layers are configured so as to have different stiffnesses.

21. The railway rail fastening assembly of claim 20, wherein the second resilient layer is stiffer than the first resilient layer.

22. The railway rail fastening assembly of any of the preceding claims, wherein the first resilient layer comprises a plurality of voids distributed across the first resilient layer so as to reduce the stiffness of the first resilient layer.

23. The railway rail fastening assembly of any of the preceding claims, wherein the rigid layer is formed from metal.

24. The railway rail fastening assembly of any of the preceding claims, wherein the first resilient layer is formed from rubber.

25. The railway rail fastening assembly of any of claims 2 to 24 when dependent on claim 2, wherein the second resilient layer is formed from rubber.

26. The railway rail fastening assembly of any of the preceding claims, wherein the pad is configured to be independent of a fastening that couples an anchoring device to the underlying foundation.

27. The railway rail fastening assembly of any of the preceding claims, wherein the rigid layer has a substantially flat surface facing the first resilient layer.