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(54) A DEVICE AND METHOD FOR INHIBITING RAIL CORROSION

VORRICHTUNG UND VERFAHREN ZUR VERHINDERUNG DER KORROSION VON SCHIENEN

DISPOSITIF ET PROCÉDÉ D'INHIBITION DE LA CORROSION DES RAILS

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Description

[0001] The invention relates to a device and method for inhibiting rail corrosion.

[0002] Rails are made of steel and so are susceptible to corrosion. It is known to inhibit rail corrosion by coating all but the running surface of the rail with a barrier coating or an active coating in order to prevent water or other corrosive substances from coming into contact with the rail. The coatings may be made of an organic material, or of a material which is more anodic than steel, and so corrodes in preference to the steel rail.

[0003] There are a number of problems associated with such barrier or active coatings. Firstly, they are easily damaged. Secondly, they require good preparation of the substrate, particularly the sharp edges of the foot tip, to ensure lasting adhesion of the coating to the steel surface. Thirdly, they are expensive and therefore rails with barrier or active coatings can only be deployed in areas of high corrosion susceptibility such as coastal stretches, tunnels and level crossings. However, rail foot failures, for which corrosion is one of the primary causes, can occur in a very wide range of locations within any railway network.

[0004] It is an object of the present invention to seek to mitigate the above problems.

[0005] Accordingly, the invention provides a device for inhibiting rail corrosion, the device comprising means for galvanically protecting only those parts of the rail which are most susceptible to failure caused by corrosion.

[0006] Using galvanic protection helps overcome the problem of damage on installation as galvanic protection will continue to be effective even in the event of damage. Protecting only those parts of the rail which are most susceptible to failure caused by corrosion ensures that protection is provided where it is most important, whilst reducing costs.

[0007] A conventional rail comprises a head which provides a running surface for the train, a narrower web which extends downwardly from the head and a foot which supports the web.

[0008] The device may comprise means for galvanically protecting the foot of the rail. Stresses are highest at the foot of the rail, and so this is where failure caused by corrosion is most likely.

[0009] The device may comprise a member which, in use, is in contact with the foot of the rail, the galvanic protection means being applied to said member.

[0010] The foot of the rail is supported on a bearer. The bearer may be made of wood, composites, concrete, or steel. A thin, resilient rail pad is positioned between the underside of the foot and the bearer. This rail pad is usually made of a resilient rubber-type material.

[0011] In the preferred embodiment of the invention, the device comprises a rail pad having galvanic protection means. These galvanic protection means are intended to protect the rails that sit above the pad against corrosion.

[0012] Applying the galvanic protection to a rail pad rather than to the rail means that the present invention can be applied to rails already in track. It also means that there is no need to prepare the rail prior to application of the galvanic protection. The only thing which needs to be ensured is that there is electrical contact between the foot of the rail and the pad, meaning that there may be no isolating layers between the foot of the rail and the pad such as thick oxide layers, paint layers etc.

[0013] The whole of the rail pad may have galvanic protection means. The galvanic protection offered by the pad may cover the entire rail.

[0014] Alternatively, only part of the rail pad may have galvanic protection means. The part of the rail foot which is most susceptible to corrosion is the underside of the rail foot. There are a number of factors which are responsible for this.

[0015] The bending of the rail as a consequence of the passage of wheels over the rail introduces tensile stresses in the rail foot the magnitude of which is a function of a number of factors such as the axle load of passing vehicles, the section modulus of the rail, and the spacing between sleepers. However, although these stresses are fully accounted for in the design of the track, they can become critical in the presence of defects or features that act as stress raisers. Two such features are corrosion pits, particularly those that have a sharp point at their base and the very front and back edges of the sleepers in contact with the rail and pad (i.e. in the direction of traffic). The edges in contact with the insulators and the fastening can also act as stress raisers. The weight of the rail and the effect of fastening ensure close electrical contact between the rail and the galvanic coating on the pad.

[0016] Under static conditions, the underside of the rail foot is in contact with the upper surface of the pad. However, the approaching wheel lifts the rail slightly creating a gap between the rail and the pad and thereby enabling the ingress of water, moisture or corrosive fluids from the atmosphere. The pad and rail are in intimate contact when the wheel is on top of the pad. This can squeeze out some of the water, moisture or corrosive fluid, but some will still remain attached to the underside of the rail foot. The passage of the wheel away from the pad again creates a gap between the rail and the pad allowing ingress of water, moisture and corrosive fluid, thereby creating the environment for rail corrosion.

[0017] Another factor that influences corrosion of the underside of the rail foot is the type of pad surface. Some pads have a relatively flat surface in contact with the rail while some others have discrete dimples and hence the areas between the dimples permit accumulation of water, moisture and corrosive fluid.

[0018] The above environments can be conducive to corrosion the magnitude of which is dependent upon the severity of the water, moisture, or corrosive fluid ingress between the pad and rail ranging from complete immersion of the rail underside and pad in water or corrosive

fluid to moisture laden air or droplets of water or corrosive fluid. Complete or near complete immersion of the underside of the rail leads to general corrosion of the whole area and hence thinning of the rail foot and eventual fracture. Alternatively, droplets of water or corrosive fluid can lead to the formation of corrosion pits on the underside of the rail foot and, depending on the sharpness of the bottom of the corrosion pit, can lead to fatigue and premature fracture leading to a transverse rail break.

[0019] Accordingly, the entire upper surface of the rail pad may have galvanic protection means. This ensures that the entire underside of the rail foot, which is the part of the rail foot which is most susceptible to corrosion, has galvanic protection. In other words, the whole of the top surface of the pad to a shallow depth may have galvanic protection means and the galvanic protection offered by the pad may therefore cover the whole of the underside of the rail foot. Indeed, because of the "throw power" from anodic protection, the corrosion protection coverage is extended by up to about 15mm beyond the front and back sleeper edges, providing galvanic protection to the edges that are regarded as potential stress raisers. Applying galvanic protection means to the entire upper surface of the rail pad also facilitates application of the galvanic protection means.

[0020] Only part of the upper surface of the rail pad may have galvanic protection means. Thus, the edges of the upper surface of the rail pad may have galvanic protection means. The central area of the upper surface of the rail pad may also have galvanic protection means. This ensures that those parts of the rail seat area which are most susceptible to the effects of corrosion have galvanic protection. However, such selective application may not always be cost effective because of the additional processes required in applying the galvanic protection means.

[0021] The galvanic protection means may comprise a tape, the tape comprising a layer of a metal to act as a sacrificial anode, and a layer of adhesive.

[0022] Zinc, magnesium or aluminium can be used as sacrificial metals for the galvanic protection of steel rails. Galvanic protection of steel rails can also be provided by using alloys of the said metals as sacrificial metals.

[0023] Preferably zinc is used as the metal to act as a sacrificial anode. The tape may be an adhesive tape to facilitate application of the tape to the rail.

[0024] Using a tape as the galvanic protection means allows existing rail pads to be adapted for use in the present invention.

[0025] In an embodiment of the invention an adhesive metal coated tape to provide the galvanic protection is used. However, other methods are also suitable. For example, the galvanic protection means may comprise particles of a metal which acts as a sacrificial anode. Thus, the rail pad may be embedded or impregnated with metal particles, such as zinc particles, or may be sprayed using metal particles, such as zinc particles suspended in a suitable fluid to adhere the particles to the pad. The metal

particles, such as zinc particles need to be electrically connected to each other. This electrical connectivity may be achieved by the steel rail to which it is mounted. Alternatively, to ensure a conductive path between individual anodic metal particles, an embodiment of the invention incorporates a conductive material such as carbon or graphite powder within the manufactured coating. The conductive material is preferably inert to the surroundings. Instead of carbon it is also possible to use conductive polymers, conductive rubbers or conductive ceramics. The metal particles may be zinc, aluminium or magnesium particles or alloys thereof.

[0026] Alternatively, the galvanic protection means may comprise a paint of a metal which acts as a sacrificial anode. Thus, the rail pad may be painted using zinc paint. Indeed, it is not even necessary to apply the galvanic protection means to the rail pad. For example, metal tape or metal coated adhesive tape may be applied to the whole underside area of the rail foot in contact with the pad or on part of this area concentrating on the small central area which experiences the highest tensile stresses and that part of the rail which is in contact with the four edges of the pad which can act as potential stress raisers.

[0027] The invention further provides a method of inhibiting rail corrosion, the method comprising the step of galvanically protecting only those parts of the rail which are most susceptible to failure caused by corrosion.

[0028] The method may comprise the step of galvanically protecting the foot of the rail.

[0029] The method may comprise the step of protecting the underside of the foot of the rail.

[0030] The method may comprise the step of protecting part of the underside of the foot of the rail.

[0031] The method may comprise the step of applying galvanic protection means to the foot of the rail.

[0032] Alternatively, the method may comprise the step of applying galvanic protection means to a member which, in use, is in contact with the foot of the rail such as a rail pad.

[0033] The invention will now be illustrated by way of example with reference to the following schematic drawings of which:

Figure 1 shows a plan view of a first embodiment of a device according to the invention;

Figure 2 shows a side view of the device shown in Figure 1;

Figure 3 shows a side cross-sectional view of the device shown in Figure 1, in use, taken along line X - X; and

Figure 4 shows a plan view of a second embodiment of a device according to the invention.

Figure 5 shows a side view of an embodiment of the

device shown in Figure 1.

[0034] The device shown in Figures 1 to 3 is a rail pad 1. The rail pad 1 is made of a rubber-type or PTFE-type material, and comprises two side edges 2a, 2b a front edge 2c and a back edge 2d. The rail pad 1 is H-shaped in plan view, two opposed recesses 3 being formed in the two side edges 2a,2b. The entire upper surface of the rail pad 1 is covered by zinc tape 4. The zinc tape 4 consists of an upper layer of zinc 5 and a lower layer of an adhesive 6.

[0035] In use, the rail pad 1 is positioned on a bearer 7 such that the two recesses 2 are received in two up-standing shoulders 8 of the bearer 7. A rail 9 is positioned on top of the rail pad 1 and held in place by clips 10. The rail 9 consists of a head 11 which provides a running surface for the train, a narrower web 12 which extends downwardly from the head 11 and a foot 13 which supports the web 12.

[0036] As can be seen from Figure 3, the zinc tape extends all across the leading front edge 2c of the pad 1 and the bearer 7. This ensures that corrosion protection is provided in all locations that are susceptible to ingress of moisture, water or corrosive fluids. Furthermore, the corrosion protection extends to up to about 15 mm away from the front 2c and back 2d edges into the bare rail foot 13. This is achieved as a result of the "throw power" protection provided by anodic zinc tape. Consequently, the stress raising effect of the bearer edge is effectively countered by ensuring that no sharp corrosion pits are formed in this area.

[0037] The device shown in Figure 4 is similar to the device shown in Figure 1, but zinc tape 4 has been applied only to part of the upper surface of the rail pad 1. Thus, zinc tape 4 has been applied to the central area 14 and to each of the four edges 2a,2b,2c,2d. This ensures that all four edges of 2a,2b,2c,2d of the rail pad 1, which, in use, are in contact with the two side edges of the rail foot 13 and are in line with the front and back edges of the bearer 7, have galvanic protection.

[0038] The device shown in Figure 5 shows a rail pad 1 made from a resilient material comprising a top layer 15 comprising metal particles 16 and a conductive material 17 between the metal particles providing the electrical connection between the metal particles.

[0039] The above embodiments are described by way of example only. A number of possible variations will be apparent to the skilled person without departing from the scope of the claims.

Claims

1. A device for inhibiting corrosion of a rail (9), the device comprising means for galvanically protecting the foot (13) of the rail (9) wherein the device comprises a member which, in use, is in contact with the foot of the rail, wherein the member is a rail pad and

the galvanic protection means being applied to said member, wherein

- the galvanic protection means comprise a tape (4) applied to the rail pad, the tape comprising a layer of a metal (5) and a layer of adhesive (6), or
- the galvanic protection means comprise metal particles (16) embedded or impregnated in the rail pad, or
- the galvanic protection means comprise metal particles provided to the rail pad by spraying metal particles suspended in a suitable fluid to adhere the particles to the pad, or
- the galvanic protection means comprise a rail pad painted with a paint of a metal; and wherein the metal in the tape, the metal particles in the rail pad, the metal particles in the fluid or the metal in the paint acts as a sacrificial anode.

2. A device according to claim 1, wherein only part of the rail pad has galvanic protection means.
3. A device according to claim 1 or 2, wherein the entire upper surface or only part of the upper surface of the rail pad has galvanic protection means.
4. A device according to claim 3, wherein the edges of the upper surface of the rail pad have galvanic protection means.
5. A device according to claim 3 or claim 4, wherein the central area of the upper surface of the rail pad has galvanic protection means.
6. A device according to any one of claims 1 to 5, wherein the galvanic protection means comprises particles of a metal which acts as a sacrificial anode and a conductive material such as carbon, graphite powder, conductive polymers, conductive rubbers or conductive ceramics to provide electrical conductivity between the particles of the metal acting as a sacrificial anode.
7. A device according to any of claims 1 to 6, wherein the layer of metal or the metal in the metal paint is zinc, aluminium, magnesium or alloys of zinc, aluminium or magnesium or wherein the metal particles are zinc, aluminium or magnesium particles or alloys thereof.
8. A method of inhibiting rail corrosion, the method comprising the step of galvanically protecting the foot of the rail by applying galvanic protection means to the foot of the rail, by applying galvanic protection means to a member which, in use, is in contact with the foot of the rail, wherein the member is a rail pad and the galvanic protection means being applied to

said member, wherein

- the galvanic protection means comprise a tape applied to the rail pad, the tape comprising a layer of a metal and a layer of adhesive, or
 - the galvanic protection means comprise metal particles embedded or impregnated in the rail pad, or
 - the galvanic protection means comprise metal particles provided to the rail pad by spraying metal particles suspended in a suitable fluid to adhere the particles to the pad, or
 - the galvanic protection means comprise a rail pad painted with a paint of a metal; and wherein the metal in the tape, the metal particles in the rail pad, the metal particles in the fluid or the metal in the paint acts as a sacrificial anode.
9. A method according to claim 8, wherein the layer of metal is zinc, aluminium, magnesium or alloys of zinc, aluminium or magnesium or wherein the metal particles are zinc, aluminium or magnesium particles or alloys thereof.
10. A method according to claim 9, wherein a conductive material provides electrical connectivity by providing a conductive path between individual anodic metal particles.
11. A method according to claim 10, wherein the conductive material is carbon or graphite powder, conductive polymers, conductive rubbers or conductive ceramics.
12. A method according to claim 8 to 11, the method comprising the step of galvanically protecting part of the underside of the foot of the rail.
- Patentansprüche**
1. Vorrichtung zur Verhinderung der Korrosion einer Schiene (9), wobei die Vorrichtung ein Mittel umfasst, um den Fuß (13) der Schiene (9) galvanisch zu schützen, wobei die Vorrichtung ein Element umfasst, welches bei der Verwendung den Fuß der Schiene berührt, wobei das Element eine Schienenunterlage ist und wobei das Mittel für den galvanischen Schutz auf dieses Element aufgetragen wird, wobei
- das Mittel für den galvanischen Schutz ein Band (4) umfasst, das auf die Schienenunterlage aufgetragen wird, wobei das Band eine Schicht aus einem Metall (5) und eine Schicht aus einem Klebstoff (6) umfasst, oder
 - das Mittel für den galvanischen Schutz Metallpartikel (16) umfasst, die in der Schienenunterlage eingebettet oder imprägniert sind, oder
 - das Mittel für den galvanischen Schutz Metallpartikel umfasst, die an die Schienenunterlage durch Aufsprühen von Metallpartikeln, die in einer geeigneten Flüssigkeit suspendiert sind, geliefert werden, damit die Partikel an der Unterlage haften, oder
 - das Mittel für den galvanischen Schutz eine Schienenunterlage umfasst, die mit einer Farbe aus einem Metall bestrichen ist; und wobei das Metall in dem Band, die Metallpartikel in der Schienenunterlage, die Metallpartikel in der Flüssigkeit oder das Metall in der Farbe als Opferanode agiert bzw. agieren.
2. Vorrichtung nach Anspruch 1, wobei nur ein Teil der Schienenunterlage ein Mittel für den galvanischen Schutz aufweist.
3. Vorrichtung nach Anspruch 1 oder 2, wobei die gesamte obere Fläche oder nur ein Teil der oberen Fläche der Schienenunterlage ein Mittel für den galvanischen Schutz aufweist.
4. Vorrichtung nach Anspruch 3, wobei die Ränder der oberen Fläche der Schienenunterlage ein Mittel für den galvanischen Schutz aufweisen.
5. Vorrichtung nach Anspruch 3 oder Anspruch 4, wobei der zentrale Bereich der oberen Fläche der Schienenunterlage ein Mittel für den galvanischen Schutz aufweist.
6. Vorrichtung nach einem beliebigen der Ansprüche 1 bis 5, wobei das Mittel für den galvanischen Schutz Partikel eines Metalls, das als eine Opferanode agiert und ein leitfähiges Material wie Kohlenstoff, Graphitpulver, leitfähige Polymere, Leitgummi oder leitfähige Keramik umfasst, um zwischen den Partikeln des Metalls, das als eine Opferanode agiert, eine elektrische Leitfähigkeit bereitzustellen.
7. Vorrichtung nach einem beliebigen der Ansprüche 1 bis 6, wobei die Schicht aus Metall oder das Metall in der Metallfarbe Folgendes ist: Zink, Aluminium, Magnesium oder Legierungen von Zink, Aluminium oder Magnesium oder wobei die Metallpartikel Zink-, Aluminium- oder Magnesiumpartikel oder Legierungen davon sind.
8. Verfahren zur Verhinderung der Korrosion einer Schiene, wobei das Verfahren den Schritt des galvanischen Schützens des Fußes der Schiene durch Auftragen eines Mittels für den galvanischen Schutz auf den Fuß der Schiene umfasst, indem ein Mittel für den galvanischen Schutz auf ein Element aufgetragen wird, welches bei der Verwendung den Fuß der Schiene berührt, wobei das Element eine Schie-

nenunterlage ist und wobei das Mittel für den galvanischen Schutz auf dieses Element aufgetragen wird, wobei

- das Mittel für den galvanischen Schutz ein Band umfasst, das auf die Schienenunterlage aufgetragen wird, wobei das Band eine Schicht aus einem Metall und eine Schicht aus einem Klebstoff umfasst, oder
 - das Mittel für den galvanischen Schutz Metallpartikel umfasst, die in der Schienenunterlage eingebettet oder imprägniert sind, oder
 - das Mittel für den galvanischen Schutz Metallpartikel umfasst, die an die Schienenunterlage durch Aufsprühen der Metallpartikel, die in einer geeigneten Flüssigkeit suspendiert sind, geliefert werden, damit die Partikel an der Unterlage haften, oder
 - das Mittel für den galvanischen Schutz eine Schienenunterlage umfasst, die mit einer Farbe aus einem Metall bestrichen ist; und wobei das Metall in dem Band, die Metallpartikel in der Schienenunterlage, die Metallpartikel in der Flüssigkeit oder das Metall in der Farbe als Opferanode agiert bzw. agieren.
9. Verfahren nach Anspruch 8, wobei die Schicht aus Metall Folgendes ist: Zink, Aluminium, Magnesium oder Legierungen von Zink, Aluminium oder Magnesium oder wobei die Metallpartikel Zink-, Aluminium- oder Magnesiumpartikel oder Legierungen davon sind.
10. Verfahren nach Anspruch 9, wobei ein leitfähiges Material eine elektrische Verbindung bereitstellt, indem eine leitfähige Bahn zwischen einzelnen anodischen Metallpartikeln bereitgestellt wird.
11. Verfahren nach Anspruch 10, wobei das leitfähige Material Folgendes ist: Kohlenstoff oder Graphitpulver, leitfähige Polymere, Leitgummi oder leitfähige Keramik.
12. Verfahren nach Anspruch 8 bis 11, wobei das Verfahren den Schritt des galvanischen Schützens eines Teils der Unterseite des Fußes der Schiene umfasst.

Revendications

1. Un dispositif pour l'inhibition de la corrosion d'un rail (9), le dispositif comprenant un dispositif de protection galvanique du patin (13) du rail (9), le dispositif comprenant un élément qui, en cours d'usage, entre en contact avec le patin du rail, l'élément étant un tampon de rail, et le dispositif de protection galvanique étant appliqué sur ledit élément, dans lequel

- le dispositif de protection galvanique comprend un ruban (4) appliqué sur le tampon de rail, le ruban comprenant une couche d'un métal (5) et une couche d'adhésif (6), ou
- le dispositif de protection galvanique comprend des particules métalliques (16) encastrées ou imprégnées dans le tampon de rail, ou
- le dispositif de protection galvanique comprend des particules métalliques appliquées sur le tampon de rail par pulvérisation de particules métalliques suspendues dans un fluide approprié pour assurer l'adhérence des particules au tampon, ou
- le dispositif de protection galvanique comprend un tampon de rail peint avec une peinture d'un métal ; et le métal du ruban, les particules métalliques dans le tampon de rail, les particules métalliques en suspension dans le fluide, ou le métal dans la peinture jouent un rôle d'anode sacrificielle.

2. Un dispositif selon la revendication 1, dans lequel seule une partie du tampon de rail est dotée d'un dispositif de protection galvanique.
3. Un dispositif selon la revendication 1 ou 2 dans lequel la surface supérieure entière, ou une partie seulement de la surface du tampon de rail est dotée d'un dispositif de protection galvanique.
4. Un dispositif selon la revendication 3, dans lequel les bords de la surface supérieure du tampon de rail sont dotés d'un dispositif de protection galvanique.
5. Un dispositif selon la revendication 3 ou la revendication 4, dans lequel la zone centrale de la surface supérieure du tampon de rail est dotée d'un dispositif de protection galvanique.
6. Un dispositif selon une quelconque des revendications 1 à 5, dans lequel le dispositif de protection galvanique comprend des particules d'un métal jouant le rôle d'une anode réactive, et une matière conductrice, par exemple du carbone, de la poudre de graphite, des polymères conducteurs, des caoutchoucs conducteurs ou des céramiques conductrices, pour assurer la conductivité électrique entre les particules de métal jouant un rôle d'anode sacrificielle.
7. Un dispositif selon une quelconque des revendications 1 à 6, dans lequel la couche de métal ou le métal contenu dans la peinture métallique est du zinc, de l'aluminium, du magnésium ou des alliages de zinc, d'aluminium ou de magnésium, ou les particules métalliques sont des particules de zinc, d'aluminium, ou de magnésium ou des alliages de ces derniers.

8. Une méthode pour l'inhibition des rails, cette méthode comprenant la protection galvanique du patin de rail par l'application d'un dispositif de protection galvanique sur le patin de rail, par l'application d'un dispositif de protection galvanique sur un élément en contact, en cours d'usage, avec le patin du rail, cet élément étant un tampon de rail et le dispositif de protection galvanique étant appliqué sur ledit élément, 5
- 10
- le dispositif de protection galvanique comprenant un ruban appliqué sur le tampon de rail, le ruban comprenant une couche d'un métal et une couche d'adhésif, ou
 - le dispositif de protection galvanique comprenant des particules métalliques encastrées ou imprégnées dans le tampon de rail, ou
 - le dispositif de protection galvanique comprenant des particules métalliques appliquées sur le tampon de rail par pulvérisation de particules métalliques suspendues dans un fluide approprié pour assurer l'adhérence des particules sur le tampon, ou
 - le dispositif de protection galvanique comprenant un tampon de rail peint avec une peinture d'un métal ; 25
- et le métal du ruban, les particules métalliques dans le tampon de rail, les particules métalliques en suspension dans le fluide, ou le métal dans la peinture jouant un rôle d'anode sacrificielle. 30
9. Une méthode selon la revendication 8, la couche de métal étant du zinc, de l'aluminium, du magnésium ou des alliages de zinc, d'aluminium ou de magnésium, ou les particules métalliques sont des particules de zinc, d'aluminium, ou de magnésium ou des alliages de ces derniers. 35
10. Une méthode selon la revendication 9, dans laquelle un matériau conducteur assure une connectivité électrique en fournissant un chemin conducteur entre des particules métalliques anodiques individuelles. 40
11. Une méthode selon la revendication 10, le matériau conducteur étant de la poudre de carbone ou de graphite, des polymères conducteurs, des caoutchoucs conducteurs, ou des céramiques conductrices. 45
12. Une méthode selon les revendications 8 à 11, la méthode comprenant l'opération de protection galvanique d'une partie du dessous du patin de rail. 50

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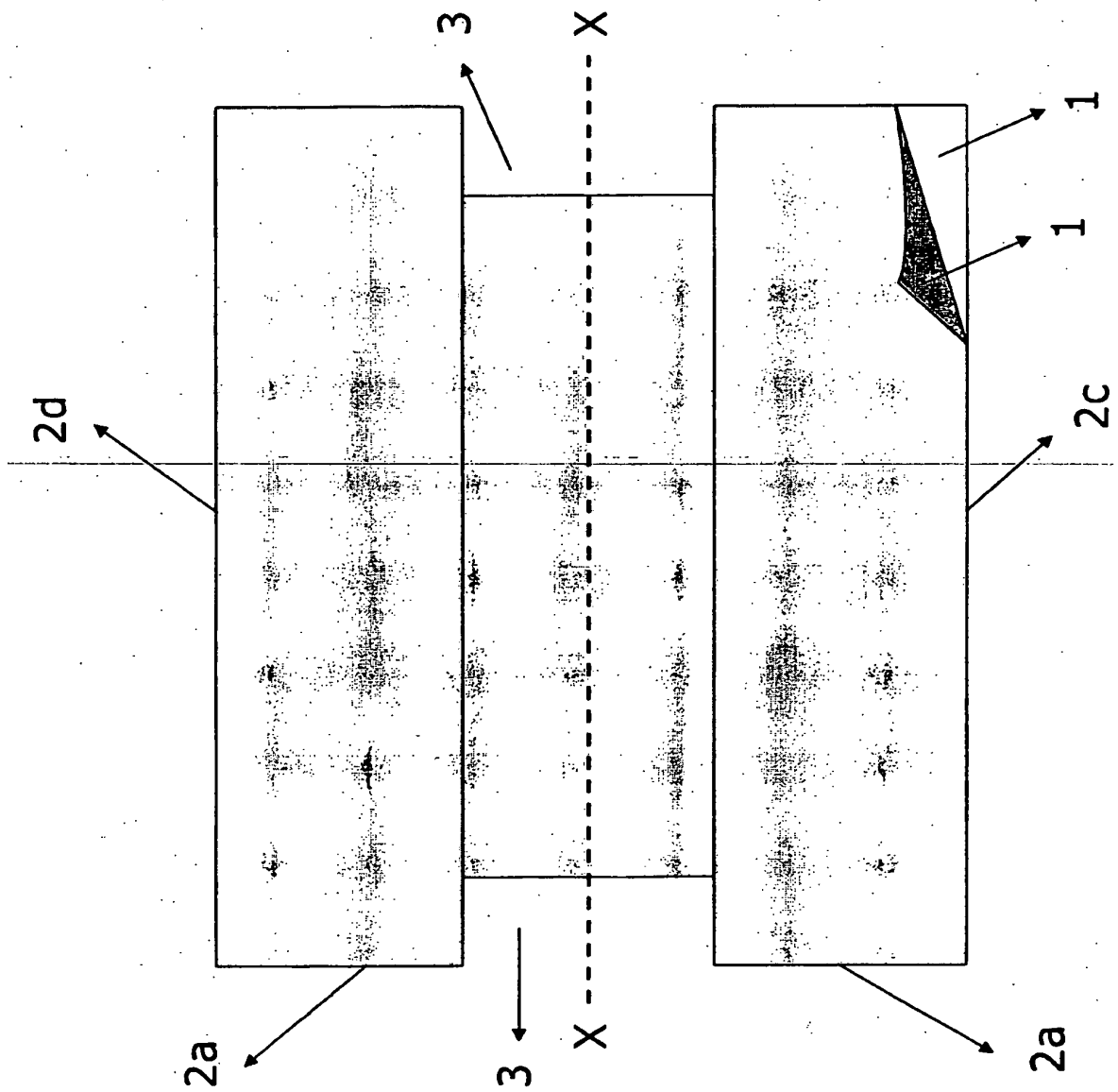


Figure 1

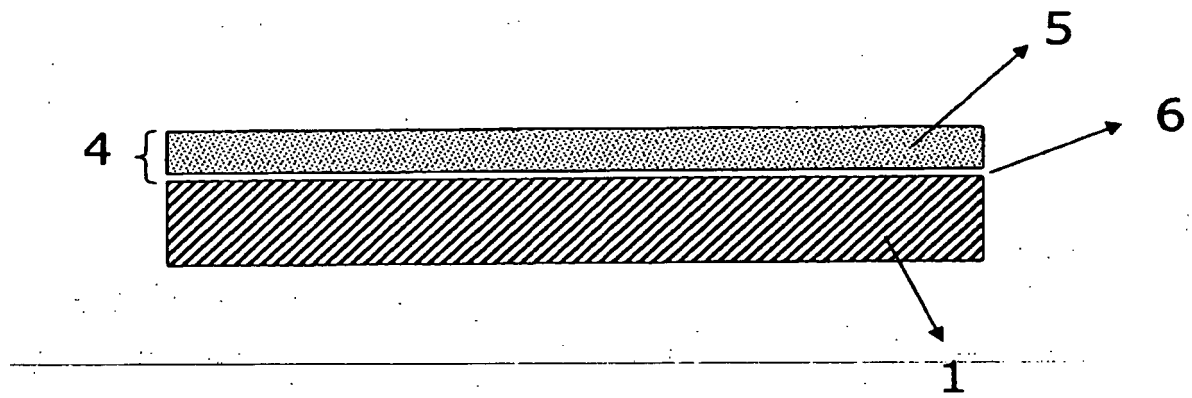


Figure 2

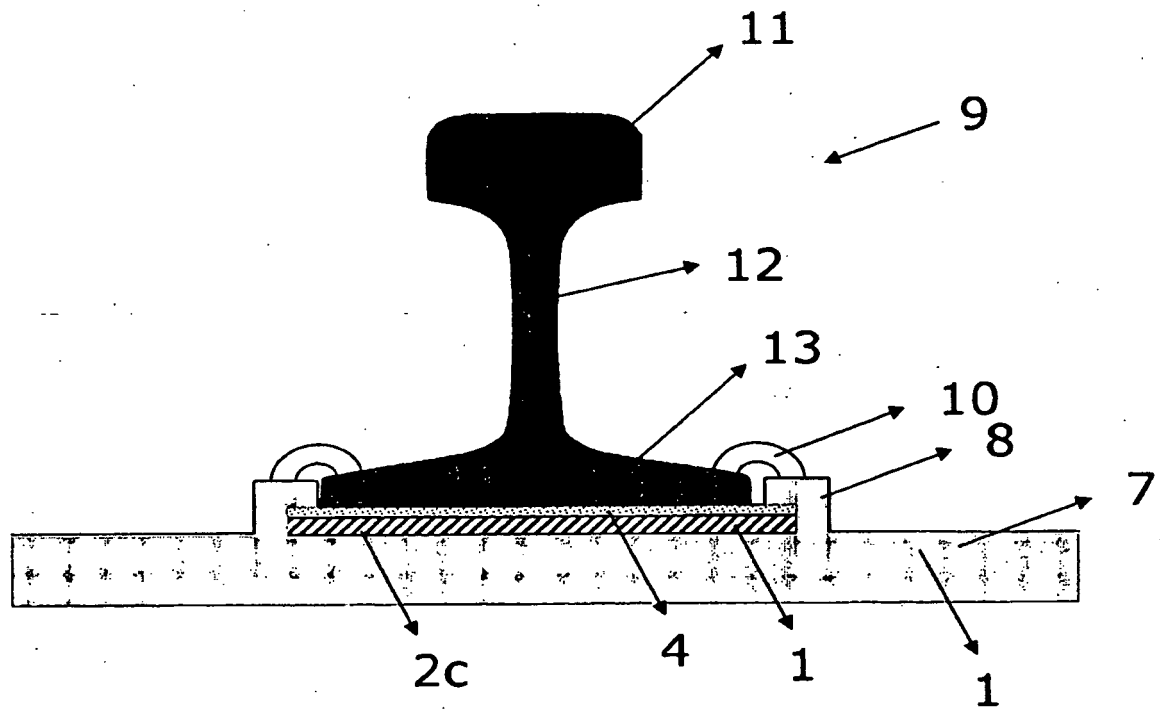


Figure 3

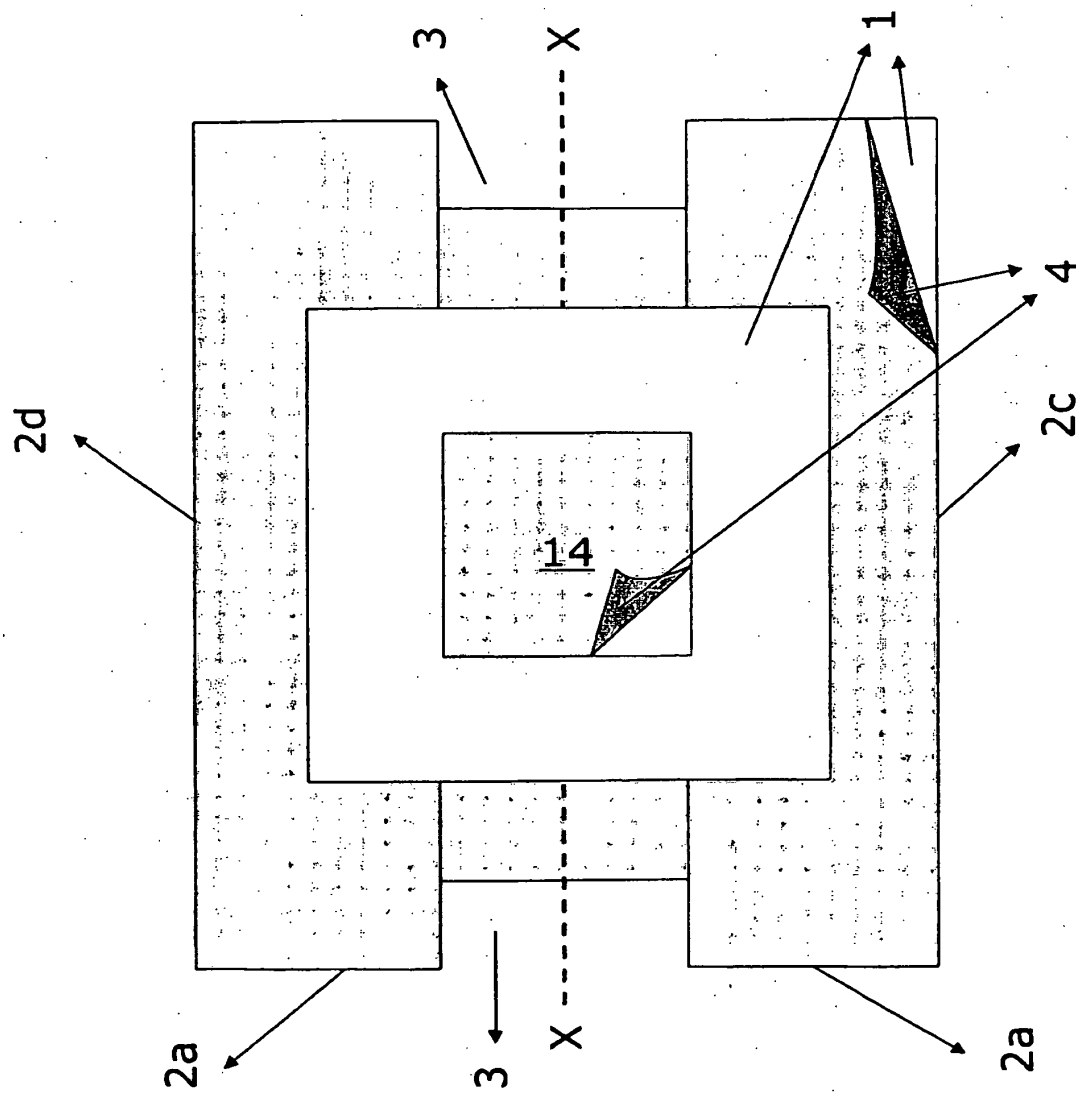


Figure 4

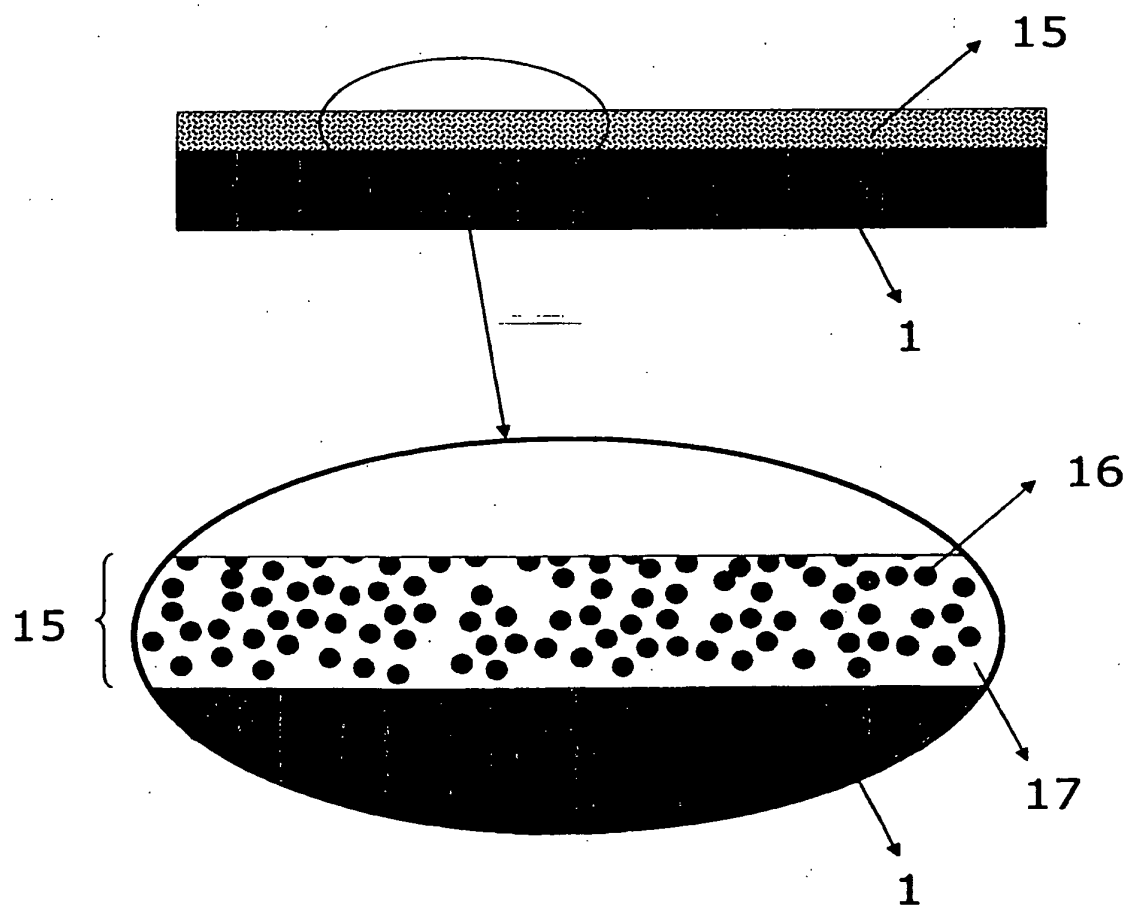


Figure 5