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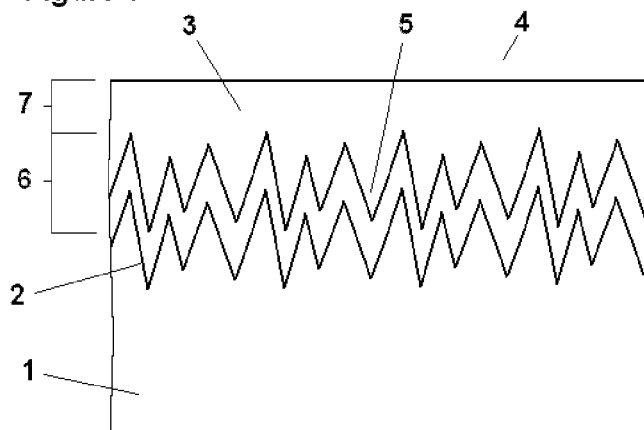
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[Suite sur la page suivante]

(54) **Title** : LUBRICATION-FREE RAILWAY SHUNTING DEVICE

(54) **Titre** : DISPOSITIF DE MANOEUVRE FERROVIAIRE SANS GRAISSAGE

Figure 1



(57) **Abstract** : The present invention relates to a part including one surface (4) rubbing against a second surface, said part including at least one steel structure (1, 2) comprising an amorphous phase totalling more than 70%, characterised in that the outer surface (4) of said structure is covered with at least one layer (3) of lubricating thermoplastic polymers.

(57) **Abrégé** : Pièce comprenant une surface de frottement (4) contre une seconde surface, cette pièce comprenant au moins une structure (1) en acier. La surface externe (4) de cette structure est recouverte d'au moins une couche (3) de polymères thermoplastiques lubrifiants. Une couche (2) d'acier amorphe est disposée entre la structure (1) et la couche (3) de polymères thermoplastiques lubrifiants.



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Lubrication-free railway shunting device

The present invention relates to the field of railway switches and crossings and more specifically to the field of rubbing steel on steel surfaces of said
5 devices and in particular to the field of rubbing surfaces which maintain their lubricating properties over a long period.

Currently, in railway systems such as shunting devices, points or frogs with movable points, the devices which involve sliding or a displacement be-
10 tween two parts of steel rubbing against one another have the problem that they wear rapidly and the rubbing surfaces overheat.

To overcome these problems it is usual to lubricate the surfaces intended to bear the rubbing of different steel parts together. However, a lubrication of
15 this kind has certain limitations, in particular that of restricted durability. The lubricant applied to the contacting surfaces is quickly eliminated during the use of the device with said surfaces. In addition to its simple elimination, the lubricant also has the disadvantage of reacting with or fixing dust and particles from its operating environment. The lubricating proper-
20 ties of the lubricant are then altered which has a detrimental effect on the low sliding resistance of the surfaces against one another.

An alternative solution to lubrication, which is currently used to limit the pressure on said rubbing surfaces, is to install rollers for displacing the
25 parts which support the surfaces. This solution is translated by separating the contacting surfaces by means of rollers which displace the parts relative to one another. In addition to the significant cost of equipping the rubbing surfaces with such a mechanism, this solution also has the disadvantage of

involving a significant modification of the geometric shape of some of the elements which support the rubbing surfaces.

Object of the invention

It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages, or to provide a useful alternative.

Summary

In a first aspect, the present invention provides a part comprising an external first surface rubbing against a second surface, said part comprising at least one structure made of steel, the first surface of said steel structure being covered by at least one layer of lubricating thermoplastic polymers,

wherein the steel structure is not made from amorphous steel, the part comprises a layer of amorphous steel arranged between the steel structure and the layer of lubricating thermoplastic polymers.

In a second aspect, the present invention provides a method for treating a surface of a steel structure in order to reduce a resistance to friction and to obtain a part as described above, wherein the method comprises the following steps:

smoothing the surface to be treated,

cleaning the smoothed surface,

impregnating a liquid thermoplastic polymer onto the smoothed-cleaned surface; and

polymerisation by heating.

An objective of the preferred embodiment is to provide a surface which is adapted to enable in a lasting manner the rubbing of steel on steel and operates with restrictions of resistance to movements of a minimal size.

The subject matter of the preferred embodiment is also an articulation comprising at least one part supporting a rubbing surface as described above.

The preferred embodiment is explained in more detail in the following description, which relates to at least one preferred embodiment, given as a non-

restrictive example, and explained with reference to the attached schematic drawings in which:

- figure 1 is a schematic representation of an exemplary embodiment of the thickness of a part bearing a rubbing surface according to the invention,
- 5 - figure 2 is a schematic representation of a diagram of the resistance to rubbing supported by the rubbing surface over time.

The invention relates to a duplex surface coating which makes it possible to facilitate primarily the rubbing of steel on steel in a sequential or random
10 type of translatory cycle movement between two opposing parts, one fixed and one moving, under stress, in all types of weather and in severe atmospheric conditions. However, as explained in the present document, the invention is also adapted to facilitate the rubbing between opposing parts arranged according to other embodiments.

15

The invention relates to a part comprising a surface 4 on which rubbing occurs. Said rubbing surface 4 thus interacts with the surface of a second part. The interaction between two parts can be performed, for example, in the manner of an articulation between two elements inside a device or be-
20 tween two elements belonging to different devices respectively. The first part comprises at least one steel structure 1, characterised in that the external surface of this steel structure 1 is covered by at least one layer of lubricating thermoplastic polymers 3.

25 Within the scope of the invention the layer of polymers can be supported by the external surface of one of the parts intended to form the articulation or by each of the articulation parts. Moreover, the invention can be applied equally well to planar articulation surfaces and to circular or curved surfaces.

The purpose of the layer of polymers 3, within the scope of the invention, is to provide lubrication by making it possible to reduce significantly the resistance to the rubbing of the surfaces 4 of each part during the displacement of one relative to the other. The thermoplastic layer 3 makes it possible to reduce the coefficient of friction by obtaining a value of in the order of 0.2, preferably in the order of 0.15 and ideally 0.09.

According to a particular and non-restrictive embodiment of the invention, at least one of the thermoplastic polymers used is a semi-crystalline thermoplastic. According to a particular example, the thermoplastic used is a polyether ether ketone also referred to as PEEK.

The lubricating properties of the layer of thermoplastic polymers 3 can be altered when the articulation operates in conditions where the temperature varies or in extreme weather conditions and/or in an environment which encourages deterioration, such as for example the presence of dust.

According to a preferred embodiment, which is not restrictive for the invention, the durability of the rubbing surface 4 and in particular the resistance of the rubbing surface 4 to corrosion is improved by integrating a layer 2 of amorphous steel which is arranged between on the one hand the steel structure 1 and on the other hand the layer of lubricating thermoplastic polymers 3.

According to a particular embodiment of the invention, the steel structure 1 is made from amorphous steel such that the steel structure 1 and the layer 2 of amorphous steel form one single layer of steel.

According to a particular embodiment the layer 2 of steel has a composition which integrates at least 70%, preferably at least 80% and ideally at least 90% amorphous phase.

- 5 A special feature of the invention is also to improve the durability of the lubricating properties of the layer of polymers 3 by restricting the wear of the layer of polymers 3 by interlacing the layer of polymers 3 and the external steel surface, making it possible to combine the properties of each of these layers, so that said surface is formed directly by the structure 1 of
10 steel or amorphous steel of the part or by an intermediate layer of amorphous steel 2.

- Said interlacing is performed by forming a relief on the external steel surface. The cavities of this relief are then, at least partly, filled by the layer of
15 lubricating polymers 3. The layer of polymers 3 covering the relief thus levels the rubbing surface of the part.

- The layer of polymers 3 thus forms an external layer formed by a first thickness 6, at depth, which fills at least partly the relief cavities of the surface of the steel structure 1 and/or the intermediate layer of amorphous
20 steel 2, and by a second thickness 7, on the surface, which forms the contact surface where the rubbing of the part is performed.

- The formation of a rubbing surface according to the invention thus involves
25 several steps of a method of treatment which enables the formation of a layer 3 of lubricating thermoplastic polymers. These different steps correspond at least to:

- a step of smoothing the surface to be treated,
- a step of cleaning the smoothed surface,

- a step of impregnating a liquid thermoplastic polymer onto the smoothed cleaned surface,
- a step of polymerisation by heating the deposited thermoplastic.

- 5 According to a non-restrictive embodiment of the invention, the thermoplastic polymer is impregnated on the rubbing surface by spray-coating using an air-pressure gun.

10 According to an exemplary embodiment, after polymerisation the thermoplastic layer 3 has a thickness of greater than 10 μm , preferably greater than 15 μm and ideally greater than 20 μm . The thermoplastic layer 3 then has a Koenig microhardness of more than 100, preferably more than 110 and ideally more than 120 or a Shore hardness of more than 65D, preferably more than 75D and ideally more than 85D.

15 According to a preferred embodiment, the thermoplastic layer 3 deposited in this way has an adhesive strength greater than 80 MPa, preferably greater than 90 MPa and ideally greater than 100 MPa. Likewise, the thermoplastic layer 3 has a compressive strength greater than 100 MPa, preferably
20 greater than 110 MPa and ideally greater than 118 MPa. The thermoplastic layer 3 makes it possible to reduce the coefficient of friction by obtaining a value in the order of 0.2, preferably in the order of 0.15 and ideally 0.09.

25 According to a non-restrictive special feature of the invention, prior to this application of a layer of polymerised thermoplastic, the method comprises different steps enabling an improvement of the corrosiveness of the rubbing surface with the formation of a layer 2 of amorphous steel on which the layer 3 of polymerised thermoplastic is deposited. Said different steps also correspond to:

- a step of smoothing the steel surface,
- a step of degreasing the steel surface,
- a step of thermal spray coating at least one substrate selected from a list comprising in particular chromium (Cr), silicon (Si), manganese (Mn), boron (B) and iron (Fe).

After these preliminary steps a layer 2 of amorphous steel is formed on the rubbing surface. The resistance of the rubbing surface to corrosion is proportional to the percentage of amorphous steel formed on the surface.

10

According to one exemplary embodiment, the layer 2 formed has a thickness greater than 100 μm , preferably greater than 200 μm and ideally greater than 250 μm . The layer 2 of amorphous steel has a porosity of less than 2%, preferably less than 1.5% and ideally less than 1%. Said steel layer 2, by means of the thermal spray coating of a substrate, also has the feature of having a level of oxide of less than 8%, preferably less than 6% and ideally less than 4%.

15

According to a preferred embodiment the layer 2 of amorphous steel formed in this way has an adhesive strength greater than 35 MPa, preferably greater than 40 MPa and ideally greater than 45 MPa. Likewise, the layer 2 of amorphous steel enables a resistance of the rubbing surface to shearing of more than 90 MPa, preferably more than 110 MPa and ideally more than 130 MPa.

25

According to a preferred but non-restrictive embodiment of the method for obtaining a surface of the invention, the method comprises a plurality of steps which make it possible to join together more closely the layer 3 of

polymerised thermoplastic and the upper surface of steel which bears said thermoplastic layer 3. The formation of this close connection thus involves:

- a step of abrasion of the surface by spray coating corundum until a predetermined relief surface has been obtained,

5 - a step of cleaning the abraded steel surface.

These abrasion steps are performed prior to a step of depositing the layer of 3 polymerised thermoplastic and a step of forming a layer 2 of amorphous steel by thermal spray coating a substrate.

10

According to one embodiment, the abrasion of the surface is performed by a corundum of the Cristalba F40-F60 type or any other type guaranteeing the absence of iron oxide. The corundum makes it possible to obtain a roughness with an Ra of less than 8 μm , preferably less than 6 μm and ideally between 4.5 μm and 6 μm . After abrasion, the surface has a Vickers microhardness of more than 900 HV 0.3, preferably more than 1000 HV 0.3 and ideally more than 1150 HV 0.3.

15

The formation of a relief on the external steel surface forms a plurality of cavities 5 distributed on the steel surface. During the deposit of the layer of thermoplastic polymers and in particular during the impregnation step of the liquid polymer, said polymer fills and bridges in particular the various cavities in the relief of the steel surface.

20

The rubbing surface thus has, in its thickness, below the layer of thermoplastic polymers 3 as such, a portion of thickness 6 at which the steel surface and the thermoplastic polymer are interlaced. Said particular thickness portion 6 of the rubbing surface participates in particular in improving the durability of the rubbing surface and the resistance of this surface to wear.

25

In fact, during the use of the rubbing surface, the layer formed by the single thickness 7 of the polymerised thermoplastic 3 has insufficient hardness and resistance to wear to guarantee a sufficiently adequate durability.

However, after a period t1 during which the rubbing surface is subject to

5 progressive wear, said external layer of single thermoplastic polymer 7 disappears. The surface which is subject to rubbing is then formed by the external surface of the thickness 6 where the steel and thermoplastic polymer 3 are interlaced. The external surface on which rubbing occurs is then formed by an alternation of steel surface and thermoplastic polymer surface
10 3. This alternation thus enables a combination of the hardness of steel, possibly amorphous steel, with the lubricating properties of the thermoplastic polymer 3. The rubbing surface thus enables a combination of the hardness and the lubrication making it possible to maintain continuously over time t2 the lubricating properties of the thermoplastic polymer 3. The association
15 tion of the layer 3 of thermoplastic polymer with the layer 2 of amorphous steel thus makes it possible to reduce the coefficient of friction by obtaining a value of in the order of 0.2, preferably in the order of 0.15 and ideally 0.09. The rubbing surface of the invention thus makes it possible to ensure the durability of the low resistance met by the rubbing surface.

20

Of course, the invention is not restricted to the embodiment described and represented in the attached drawings. Modifications remain possible, in particular from the point of view of the structure of the various elements or by substituting equivalent techniques, without departing as such from the
25 field of protection of the invention.

Claims

1. A part comprising an external, first surface rubbing against a second surface, said part comprising at least one structure made of steel, the first surface of said steel structure being covered by at least one layer of lubricating thermoplastic polymer,
wherein the steel structure is not made from amorphous steel, the part comprises a layer of amorphous steel arranged between the steel structure and the layer of lubricating thermoplastic polymer.
2. The part according to claim 1, wherein the steel structure comprises at least 70% amorphous phase.
3. The part according to one of claims 1 or 2, wherein the surface on which the layer of thermoplastic polymer is applied forms a relief at least partly filled by the layer of thermoplastic polymer.
4. The part according to claim 3, wherein the external layer of polymer is formed by a first thickness which fills the relief of the external surface and a second thickness which forms the rubbing surface of the part.
5. The part according to any one of claims 1 to 4, wherein at the least one thermoplastic polymer is a semi-crystalline thermostable thermoplastic.
6. An articulation forming a sliding assembly, comprising at least one part bearing a rubbing surface according to any one of claims 1 to 5.
7. A method for treating a surface of a steel structure in order to reduce a resistance to friction and to obtain a part according to any one of claims 1 to 5, wherein the method comprises the following steps:
smoothing the surface to be treated,
cleaning the smoothed surface,
impregnating a liquid thermoplastic polymer onto the smoothed-cleaned surface; and
polymerisation by heating.

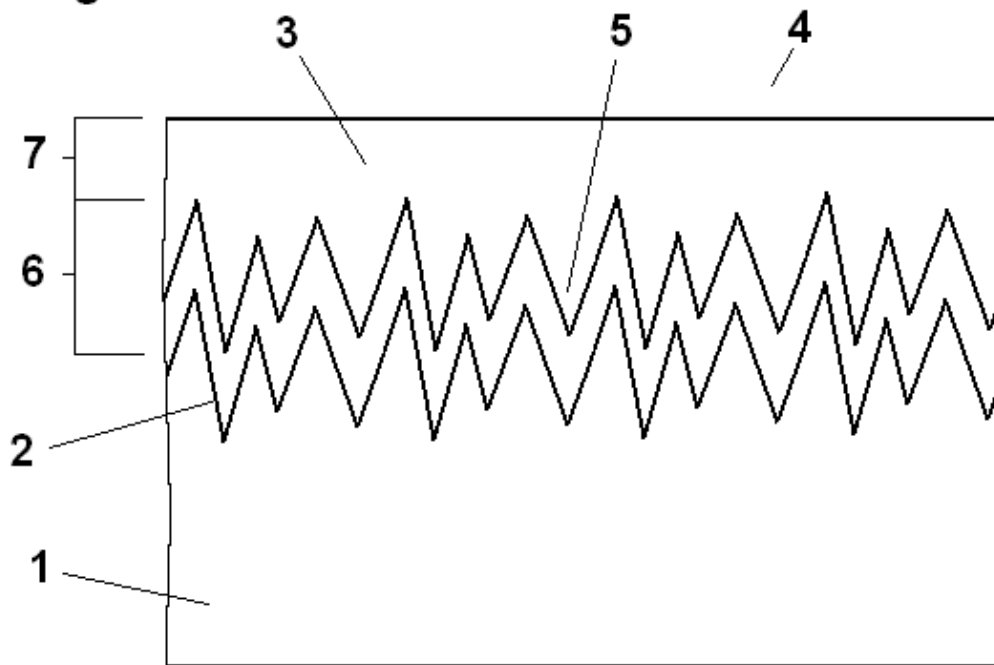
8. The method for treating a steel surface according to claim 7, wherein the method also comprises prior to the preceding steps:
- a step of smoothing the steel surface,
 - a step of degreasing the steel surface,
 - a step of thermal spray coating at least one substrate selected from a list comprising in particular chromium (Cr), silicon (Si), manganese (Mn), boron (B) and iron (Fe).
9. The method for treating a steel surface according to any one of claims 7 or 8, wherein the method comprises the following steps:
- abrasion of the surface by spray coating corundum until a predetermined relief surface is obtained, and
 - cleaning the abraded steel surface.

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Figure 1**Figure 2**