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(54) SURFACE MARKING AND METHOD OF INSTALLATION

(57) A surface marking 1 for providing marking(s) on the surface of a substrate 4 comprises a primer layer 2 and a thermoplastic layer 3. The method of installing the surface marking on a substrate comprises: forming a primer layer 2 on a surface of a substrate 4; and forming a thermoplastic layer 3 on the primer layer 2.

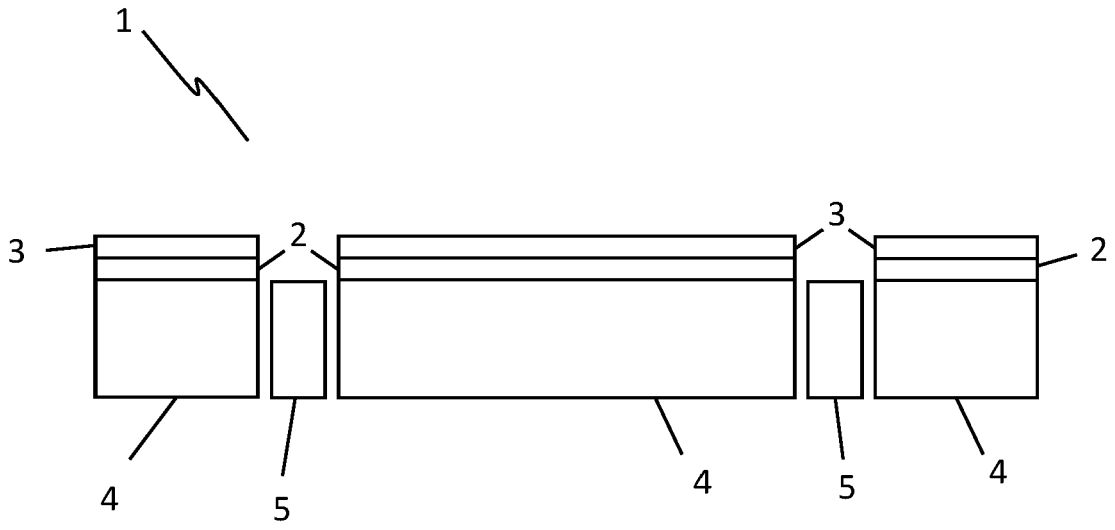

Figure 1

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Description

[0001] The present invention relates to a surface marking. In particular, a surface marking for use on rubber blocks at railway crossings.

[0002] At level crossings, blocks are installed between and around the tracks to provide a surface for carrying vehicular and pedestrian traffic. While traditional blocks are made from concrete or wood, in recent years rubber blocks or pads have come into popular use due to their durability, strength, and the advantages they provide in terms of ease of track maintenance. It is often necessary to provide surface markings on these blocks but paints and preformed thermoplastics in current use do not stick to the rubber blocks well, stripping off and wearing away quickly. This problem is exasperated by heavy traffic on the surface, as well as the expansion and contraction of the rubber during extremes of weather and temperature, leading to the separation of the surface marking and the surface of the rubber blocks. There is a need for a surface marking product that can reliably adhere to the types of surfaces found at level crossings, including rubber blocks.

[0003] It is an object of the invention to obviate or mitigate the problems outlined above. In particular, it is an object of the invention to provide a surface marking having improved adhesion properties when applied to a rubber surface.

[0004] It is a further object of the invention to provide a surface marking that provides long-lasting adhesion at level crossings.

[0005] It is a further object of the invention to provide a surface marking that can withstand sustained traffic on the surface to which the surface marking is attached.

[0006] It is a further object of the invention to provide a method of installation for a surface marking that can be used on the types of blocks found at level crossings.

[0007] It is a further object of the invention to provide a surface marking that can be applied during, and is able to withstand, a wide range of outdoor weather conditions.

[0008] It is a further object of the invention to provide a surface marking that can be applied to a surface outdoors during low temperature conditions and/or in the presence of water.

[0009] According to a first aspect of the invention there is provided a method for installing a surface marking on a substrate, the method comprising: forming a primer layer on a surface of a substrate; and forming a thermoplastic layer on the primer layer. Advantageously, the primer layer adheres well to both the substrate and the thermoplastic layer, ensuring that these two components are suitably held together in a range of weather conditions and during/after significant thermal cycling.

[0010] Preferably the method includes installing the surface marking on a road or roadway.

[0011] Preferably the method includes installing the surface marking on a surface designed to carry vehicular and/or pedestrian traffic, in use.

[0012] Preferably the method includes installing the surface marking on a block or substrate locatable between and/or adjacent to rails at a level crossing.

[0013] Preferably the method comprises forming the primer layer on a road or roadway.

[0014] Preferably the method comprises forming the primer layer on a surface designed to carry vehicular and/or pedestrian traffic, in use.

[0015] Preferably the method comprises forming the primer layer on a surface of a block or substrate located at or near a level crossing.

[0016] Ideally the method comprises forming the primer layer on a surface of an elastomeric substrate.

[0017] Preferably the method comprises forming the primer layer on a surface of a rubber substrate such as a rubber block for installation near or adjacent to a rail track at a level crossing.

[0018] Preferably the method comprises forming the primer layer on a surface of a compressed profile rubber block comprising recycled rubber crumb.

[0019] Preferably the method comprises forming the primer layer on a vulcanised rubber and/or textured surface of a substrate.

[0020] Preferably the method comprises forming the primer layer on a surface of a substrate wherein the surface of the substrate includes one or more pits and/or recesses.

[0021] Preferably the method comprises forming the primer layer on a surface of a substrate wherein the surface of the substrate includes a regular array or pattern of pits and/or recesses.

[0022] Preferably the method comprises forming the primer layer on the upper surface of a substrate. By 'upper surface' it is meant that surface which in use is exposed to air and/or the surface which in use is designed to carry vehicular and/or pedestrian traffic.

[0023] Preferably the method comprises forming the primer layer such that the primer layer has a lower surface proximal to the substrate and an upper surface opposite the lower surface. By 'lower surface' it is meant that surface which is substantially opposite the upper surface.

[0024] Ideally the method comprises preparing the surface of the substrate.

[0025] Preferably the method comprises preparing the upper surface of the substrate.

[0026] Preferably the method comprises preparing the surface of the substrate on which the primer layer is to be formed.

[0027] Preferably preparing the surface of the substrate comprises cleaning the surface of the substrate.

[0028] Preferably preparing the surface of the substrate includes removing oil, grease, dirt, particles and/or objects from the surface of the substrate.

[0029] Optionally preparing the surface of the substrate includes removing water and/or moisture from the surface of the substrate.

[0030] Ideally the method comprises preparing a primer for forming the primer layer.

[0031] Preferably preparing the primer comprises providing an epoxy.

[0032] Preferably preparing the primer comprises providing an epoxy having at least 1.5 epoxy groups per molecule and/or having an epoxy group content of 5260-5420 mmol/kg.

[0033] Preferably preparing the primer comprises providing a Bisphenol A or Bisphenol A epoxy resin.

[0034] Preferably preparing the primer comprises providing an epichlorohydrian-based epoxy, a novalac epoxy, a cycloaliphatic epoxy, an epoxy diluent or a glycidylamine epoxy

[0035] Preferably preparing the primer comprises providing a curing agent.

[0036] Preferably preparing the primer comprises providing a curing agent comprising a hardener such as a mannich base hardener. Advantageously, use of a mannich base hardener allows rapid curing at ambient and low temperatures (i.e. below 5 °C) and/or the presence of water, i.e. in moist, damp and/or wet conditions where water is present.

[0037] Optionally preparing the primer comprises providing a curing agent comprising a hardener such as an aliphatic hardener, a phenolic hardener or a polymercaptan hardener.

[0038] Preferably preparing the primer comprises providing a curing agent comprising a synthetic resin such as styrenated phenol, gum rosin, or any mixture of the two.

[0039] Preferably preparing the primer comprises mixing an epoxy and a curing agent.

[0040] Preferably preparing the primer comprises mixing an epoxy with a curing agent comprising a mannich base hardener.

[0041] Preferably preparing the primer comprises forming the curing agent by mixing the hardener with the synthetic resin in a predetermined ratio.

[0042] Preferably preparing the primer comprises forming the curing agent by mixing the hardener with the synthetic resin in a ratio of 2:3 by weight and/or by volume.

[0043] Preferably method includes providing a diluent such as benzyl alcohol.

[0044] Optionally the method includes reducing the viscosity of the primer, curing agent and/or hardener. Advantageously, altering the viscosity of the primer, curing agent and/or hardener increases the ease with which the primer, curing agent and/or hardener can be manipulated, mixed, spread and/or poured.

[0045] Optionally the method includes diluting the primer, curing agent and/or hardener.

[0046] Optionally the method includes diluting the primer, curing agent and/or hardener using a diluent such as benzyl alcohol.

[0047] Optionally the method comprises diluting the primer, curing agent and/or hardener by mixing the primer, curing agent and/or hardener with a diluent. Advantageously, diluting the primer, curing agent and/or hardener allows these to be more easily mixed and/or applied to the surface.

[0048] Optionally the method comprises diluting the primer, curing agent and/or hardener by mixing the primer, curing agent and/or hardener with a diluent in a predetermined ratio.

[0049] Optionally the method comprises diluting the primer, curing agent and/or hardener by mixing the primer, curing agent and/or hardener with a diluent in any suitable ratio to obtain the necessary viscosity, such as a ratio of 2:1, 1:1 or 1:2 by weight and/or by volume.

[0050] Preferably preparing the primer comprises mixing an epoxy and a curing agent.

[0051] Preferably preparing the primer comprises mixing an epoxy with a curing agent comprising a mannich base hardener.

[0052] Preferably the forming the primer comprises mixing the epoxy and curing agent in a predetermined ratio.

[0053] Preferably forming the primer comprises mixing the epoxy and curing agent in a predetermined ratio of epoxy to curing agent of 1:1 or 2:1 by weight and/or by volume.

[0054] Preferably the method comprises forming the primer layer by applying the primer to at least a part of a surface.

[0055] Preferably the method comprises forming the primer layer by applying the primer to at least a part of the surface of the substrate.

[0056] Preferably the method comprises forming the primer layer by applying the primer directly to at least a part of the surface of the substrate.

[0057] Preferably forming the primer layer comprises applying the primer to at least a part of the surface of an elastomeric substrate.

[0058] Preferably forming the primer layer comprises applying the primer to at least a part of the surface of a rubber block locatable between and/or adjacent to rails at a level crossing.

[0059] Preferably applying the primer to the surface of the substrate comprises pouring the primer onto the surface of the substrate.

[0060] Preferably applying the primer to the surface of the substrate comprises using an applicator means such as a brush or screed board to apply the primer to the surface of the substrate.

[0061] Preferably the method comprises forming a substrate-primer interface between the substrate and the primer.

[0062] Preferably the method comprises forming a substrate-primer interface between the surface of the substrate and the primer layer.

[0063] Preferably the method includes forming a substrate-primer interface between the upper surface of the substrate and the lower surface of the primer layer.

[0064] Preferably the method comprises forming a primer layer having a thickness of 0.1-20 mm.

[0065] Preferably the method comprises forming a

primer layer having a thickness of 2±0.2 mm.

[0066] Ideally the method comprises curing the primer layer. Advantageously, when the primer layer is sufficiently cured and hardened it will be in a solid state and ready to receive vehicular and/or pedestrian traffic.

[0067] Preferably the method comprises curing the primer in the presence of water and/or at temperatures below 5 °C. By 'in the presence of water' it is meant moist, damp and/or wet conditions where water is present, for example on a surface.

[0068] Preferably forming a thermoplastic layer on the upper surface of the primer layer comprises providing a preformed thermoplastic section.

[0069] Optionally forming a thermoplastic layer on the upper surface of the primer layer comprises providing a hot-applied thermoplastic.

[0070] Optionally the method comprises forming the thermoplastic layer using a hot-applied thermoplastic.

[0071] Optionally the method comprises pouring, rolling or screeding hot-applied thermoplastic on the primer layer.

[0072] Optionally the method comprises pouring, rolling or screeding hot-applied thermoplastic onto the upper surface of the primer layer.

[0073] Ideally the method comprises forming a thermoplastic layer having a thickness of 0.1-20 mm.

[0074] Ideally the method comprises forming a thermoplastic layer having a thickness of 2.5-3 mm.

[0075] Preferably forming a thermoplastic layer on the primer layer comprises providing a preformed thermoplastic section having a thickness of 0.1-20 mm.

[0076] Preferably the method comprises providing a preformed thermoplastic section having a thickness of 2.5-3 mm.

[0077] Ideally forming a thermoplastic layer on the primer layer is carried out after the primer has been applied to the surface of the substrate.

[0078] Ideally forming a thermoplastic layer on the primer layer is carried out before the primer layer has fully cured.

[0079] Preferably the method comprises laying, rolling or otherwise placing the preformed thermoplastic section on the primer.

[0080] Preferably forming the thermoplastic layer on the primer layer comprises laying, rolling or otherwise placing a preformed thermoplastic section on the primer layer and heating the preformed thermoplastic section.

[0081] Preferably the method comprises laying, rolling or otherwise placing the preformed thermoplastic section on the primer layer.

[0082] Preferably the method comprises laying, rolling or otherwise placing the preformed thermoplastic section on the upper surface of the primer layer.

[0083] Preferably the method comprises forming a primer-thermoplastic interface between the primer layer and the thermoplastic layer.

[0084] Preferably the method comprises forming a primer-thermoplastic interface between the upper surface of the primer and the lower surface of the thermoplastic layer.

[0085] Preferably the method comprises heating the thermoplastic.

[0086] Optionally the method comprises heating the hot-applied thermoplastic.

[0087] Preferably the method comprises heating the hot-applied thermoplastic to a predetermined temperature.

[0088] Preferably the method comprises heating the hot-applied thermoplastic to a predetermined temperature which is equal to or greater than the melting point of the thermoplastic.

[0089] Optionally the method comprises melting the hot-applied thermoplastic.

[0090] Optionally the method comprises heating the hot-applied thermoplastic before applying the hot-applied thermoplastic to the primer layer.

[0091] Optionally the method comprises applying the hot-applied thermoplastic while the hot-applied thermoplastic is in a molten state.

[0092] Preferably the method comprises heating the preformed thermoplastic section.

[0093] Preferably heating the preformed thermoplastic section comprises melting the preformed thermoplastic section onto the primer layer.

[0094] Preferably the method comprises heating the preformed thermoplastic section using a blow torch.

[0095] Preferably the method comprises heating the preformed thermoplastic section to a predetermined temperature.

[0096] Preferably the method comprises heating the preformed thermoplastic section to a predetermined temperature which is equal to or greater than the melting point of the thermoplastic.

[0097] Preferably the method comprises heating the preformed thermoplastic section after applying the preformed thermoplastic section to the primer layer.

[0098] Ideally the method includes installing reflective granular material and/or aggregate particles in the thermoplastic layer.

[0099] Ideally the method includes installing glass beads and/or particles of calcined bauxite, steel slag, sandstone, tuff, flint, basalt and/or granite in the thermoplastic layer.

[0100] Preferably installing reflective granular material and/or aggregate particles in the thermoplastic layer is carried out while the thermoplastic layer has an elevated temperature.

[0101] Preferably installing reflective granular material and/or aggregate particles in the thermoplastic layer is carried out while the thermoplastic layer is in a softened state such that reflective granular material and/or aggregate particles may be embedded in the upper surface of the thermoplastic layer.

[0102] Optionally installing reflective granular material and/or aggregate particles in the thermoplastic layer is carried out during pre-forming of the preformed thermo-

plastic section.

[0103] Ideally the method comprises allowing the thermoplastic layer to cool. Advantageously, when the thermoplastic layer is sufficiently cooled it will be in a solid state and ready to receive and/or support vehicular and/or pedestrian traffic.

[0104] According to a second aspect of the invention there is provided a surface marking for providing marking(s) on the surface of a substrate, the surface marking comprising a primer layer and a thermoplastic layer. Advantageously since the primer layer can suitably adhere to both the substrate and the thermoplastic layer the structural integrity of the surface marking system is ensured, even during inclement weather conditions and during/after severe thermal cycling.

[0105] Preferably the surface marking is located on at least a part of the surface of a substrate.

[0106] Preferably the surface marking is located on a surface of a block or substrate located at or near a level crossing

[0107] Preferably the substrate is a road or roadway.

[0108] Preferably the substrate is designed to carry vehicular and/or pedestrian traffic, in use.

[0109] Preferably the substrate is a block locatable between and/or adjacent to rails at a level crossing.

[0110] Preferably the surface is the surface of a block locatable between and/or adjacent to rails at a level crossing.

[0111] Ideally the substrate is an elastomeric substrate.

[0112] Preferably the primer layer is located on at least a part of the surface of an elastomeric substrate.

[0113] Preferably the substrate is a rubber substrate such as a rubber block for installation near or adjacent to a rail track at a level crossing.

[0114] Preferably the substrate is a compressed profile rubber block comprising recycled rubber crumb.

[0115] Preferably the surface of the substrate is a vulcanised rubber and/or textured surface.

[0116] Preferably the surface of the substrate includes one or more pits and/or recesses.

[0117] Preferably at least a part of the surface of the substrate includes a regular array or pattern of pits and/or recesses.

[0118] Preferably the surface of the substrate is an upper surface of the substrate. By 'upper surface' it is meant that surface which is uppermost in the installed position and/or which is exposed to air/weather and/or which is designed to carry vehicular and/or pedestrian traffic, in use.

[0119] Ideally the marking(s) are visible markings.

[0120] Preferably the marking(s) are high visibility markings comprising reflective granular material such as glass beads.

[0121] Preferably the marking(s) are road and/or pavement markings.

[0122] Preferably the marking(s) comprise lines, grids, numbers, letters and/or symbols.

[0123] Ideally the primer layer is located on the surface of the substrate.

[0124] Preferably the primer layer is located on at least a part of the surface of the substrate.

[0125] Preferably the primer layer is located on the upper surface of the substrate.

[0126] Preferably the primer layer includes a lower surface proximal to the substrate and an upper surface opposite the lower surface. By 'lower surface' it is meant that surface which is substantially opposite the upper surface.

[0127] Ideally the primer layer comprises a primer.

[0128] Preferably the primer layer comprises an epoxy and a curing agent.

[0129] Preferably the primer is curable in the presence of water and/or at temperatures below 5 °C. By 'in the presence of water' it is meant moist, damp and/or wet conditions where water is present, for example on a surface.

[0130] Preferably in use the primer is in a cured state. By 'cured' it is meant that the primer has gone through a curing and/or hardening process and is substantially solid.

[0131] Preferably the primer comprises an epoxy.

[0132] Ideally the epoxy has at least 1.5 epoxy groups per molecule.

[0133] Preferably the epoxy has an epoxy group content of 5260-5420 mmol/kg.

[0134] Preferably the primer comprises a Bisphenol A or Bisphenol A epoxy resin.

[0135] Optionally the epoxy is an epichlorohydrian-based epoxy, a novalac epoxy, a cycloaliphatic epoxy, an epoxy diluent or a glycidylamine epoxy.

[0136] Preferably the primer comprises a curing agent.

[0137] Preferably the curing agent comprises a hardener such as a mannich base hardener. Advantageously, use of a mannich base hardener allows rapid curing at ambient and low temperatures (i.e. below 5 °C) and/or the presence of water, i.e. in moist, damp and/or wet conditions where water is present.

[0138] Optionally the curing agent comprises an aliphatic hardener, a phenolic hardener or a polymercaptan hardener

[0139] Preferably the curing agent comprises a synthetic resin.

[0140] Preferably the synthetic resin comprises styrenated phenol, gum rosin, or any mixture of the two.

[0141] Ideally the curing agent comprises a mannich base hardener and a synthetic resin.

[0142] Preferably the curing agent comprises a predetermined ratio of hardener to synthetic resin.

[0143] Preferably the predetermined ratio of hardener to synthetic resin in the curing agent is 2:3 by weight and/or by volume.

[0144] Preferably the primer comprises a predetermined ratio of epoxy to curing agent.

[0145] Preferably the predetermined ratio of epoxy to curing agent in the primer is 1:1 or 2:1 by weight and/or

by volume.

[0146] Preferably the surface marking comprises a substrate-primer interface located between the substrate and the primer.

[0147] Preferably the substrate-primer interface is located between the surface of the substrate and the primer layer.

[0148] Preferably the substrate-primer interface is located between the upper surface of the substrate and the lower surface of the primer layer.

[0149] Preferably the primer layer has a thickness of 0.1-20 mm.

[0150] Preferably the primer layer has a thickness of 2 ± 0.2 mm.

[0151] Ideally in use the primer layer is in a substantially cured state. Advantageously, the primer layer being in a cured state means that it has hardened and is ready to receive vehicular and/or pedestrian traffic.

[0152] Preferably the primer layer, in its cured state, has a thickness of 0.1-20 mm.

[0153] Preferably the primer layer, in its cured state, has a thickness of 2 ± 0.2 mm.

[0154] Preferably the primer layer is located between the thermoplastic layer and the substrate.

[0155] Preferably the thermoplastic layer is located on the upper surface of the primer layer.

[0156] Preferably the surface marking comprises a primer-thermoplastic interface located between the primer and the thermoplastic.

[0157] Preferably the surface marking comprises a primer-thermoplastic interface located between the primer layer and the thermoplastic layer.

[0158] Preferably the primer-thermoplastic interface is located between the upper surface of the primer layer and the lower surface of the thermoplastic layer.

[0159] Preferably the thermoplastic layer comprises a solidified thermoplastic.

[0160] Ideally the thermoplastic layer is formed from a preformed thermoplastic section.

[0161] Preferably the thermoplastic layer is formed from a preformed thermoplastic section that has been thermally cycled.

[0162] Preferably the thermoplastic layer is formed from a preformed thermoplastic section that has been melted onto the primer layer.

[0163] Preferably the preformed thermoplastic section has a thickness of 0.1-20 mm.

[0164] Preferably the preformed thermoplastic section has a thickness of 2.5-3 mm.

[0165] Preferably the preformed thermoplastic layer has a thickness of 0.1-20 mm.

[0166] Preferably the preformed thermoplastic layer has a thickness of 2.5-3 mm.

[0167] Optionally the thermoplastic layer is formed from a hot-applied thermoplastic.

[0168] Optionally the thermoplastic layer is formed from a hot-applied thermoplastic that has been applied to the primer layer in a molten state and subsequently cooled.

[0169] Preferably the thermoplastic layer includes reflective granular material and/or aggregate particles.

[0170] Optionally the preformed thermoplastic section includes reflective granular material and/or aggregate particles.

[0171] Preferably the surface marking is a high visibility surface marking.

[0172] Preferably the surface marking is a high visibility surface marking comprising reflective granular material.

[0173] Preferably the reflective granular material comprises glass beads.

[0174] Preferably the surface marking is a high friction surface marking.

[0175] Preferably the surface marking is a high friction surface marking comprising aggregate particles.

[0176] Preferably the aggregate particles have a polished stone value greater than 60.

[0177] Preferably the aggregate particles are particles of calcined bauxite, steel slag, sandstone, tuff, flint, basalt and/or granite.

[0178] Preferably the aggregate particle size is 0.5-20 mm.

[0179] Preferably the aggregate particle size is 1-3 mm.

[0180] Ideally in use the surface marking is in a substantially solid state.

[0181] Ideally in use the primer layer and thermoplastic layer are in a substantially solid state.

[0182] Preferably in use the primer layer is bonded to the surface of the substrate.

[0183] Preferably in use the primer layer is bonded to the thermoplastic layer.

[0184] Preferably in use the primer layer is adhesively bonded to the surface of the substrate and the thermoplastic layer.

[0185] Optionally the surface marking comprises multiple primer layers and/or multiple thermoplastic layers.

[0186] According to a third aspect of the invention there is provided a primer for a surface marking, the primer being applicable to a surface to form a primer layer between a substrate and a thermoplastic layer. Advantageously the primer can be used to reliably adhere the thermoplastic layer to the substrate.

[0187] According to a fourth aspect of the invention there is provided a surface marking system for providing surface marking(s) on the surface of a substrate, the surface marking system comprising a primer for forming a primer layer on the surface of a substrate and a thermoplastic for forming a thermoplastic layer on the primer layer. Advantageously, the surface marking system allows surface markings to be applied to a wide range of surfaces/substrates including elastomeric surfaces/substrates typically found at level crossings.

[0188] It will be appreciated that optional features applicable to one aspect of the invention can be used in any combination, and in any number. Moreover, they can also be used with any of the other aspects of the invention

in any combination and in any number. This includes, but is not limited to, the dependent claims from any claim being used as dependent claims for any other claim in the claims of this application.

[0189] The invention will now be described with reference to the accompanying drawings which show by way of example only embodiments of an apparatus and method in accordance with the invention.

[0190] Figure 1 is a cross-sectional view of a surface marking according to an aspect of the invention.

[0191] Figure 1a is an exploded cross-sectional view of a surface marking according to an aspect of the invention.

[0192] Figure 2 is a method of installing a surface marking according to an aspect of the invention.

[0193] In Figure 1 there is shown a surface marking according to an aspect of the invention, indicated generally by the numeral 1. The surface marking 1 comprises a primer layer 2 and a thermoplastic layer 3. The primer layer 2 comprises a primer and provides an intermediate bonding layer between the thermoplastic layer 3 incorporating reflective and/or granular material (not shown) and a substrate 4. In the installed state, the primer layer 2 comprises a cured mixture of an epoxy and a curing agent and acts to reliably hold the thermoplastic layer 3 to the surface of the substrate 4. Use of the primer layer 2 to adhere the thermoplastic layer 3 to the substrate 4 overcomes the problems associated with reliably adhering thermoplastic surface markings to the above-mentioned rubber blocks typically found at level crossings.

[0194] Figure 1 shows multiple substrates 4 in the form of elastomeric rubber blocks which are used to provide a road surface for vehicular and/or pedestrian traffic at a level crossing, the blocks being installed between and either side of rails 5. The rubber blocks are compressed profiled rubber blocks comprising recycled rubber crumb and have a vulcanised rubber upper surface.

[0195] Figure 1a shows an exploded view of a surface marking 1 according to the invention. The substrate 4 has an upper surface 4a. By 'upper surface' it is meant that surface which is uppermost in the installed position and/or which is exposed to air/weather and/or which is designed to carry vehicular and/or pedestrian traffic, in use. The upper surface 4a of the substrate 4 may include one or more pits and/or recesses in e.g. a regular array. The primer layer 2 has an upper surface 2a and a lower surface 2b. By 'lower surface' it is meant that surface which is substantially opposite the upper surface. The thermoplastic layer 3 has an upper surface 3a and a lower surface 3b.

[0196] When the surface marking 1 is installed on a substrate (see figure 1), a substrate-primer interface is formed between the upper surface 4a of the substrate 4 and the lower surface 2b of the of the primer layer 2, and a primer-thermoplastic interface is formed between the upper surface 2a of the primer layer 2 and the lower surface 3b of the thermoplastic layer 3. The upper surface 3a of the thermoplastic layer 3 forms the upper surface of the surface marking 1.

[0197] In Figure 2 there is shown a method of installing a surface marking generally indicated by the numeral 100. The method 100 includes the steps of: preparing the surface of a substrate 101; preparing a primer 102; forming a primer layer on the surface of a substrate 103; applying a thermoplastic layer on the surface of the primer layer 104; heating the thermoplastic layer such that the temperature of the thermoplastic layer is raised above a predetermined temperature 105; installing reflective granular and/or aggregate material in the thermoplastic layer 106; and cooling/fully curing the thermoplastic/primer layer 107.

[0198] In step 101 the surface 4a of the substrate 4 is prepared by removing any small items such as dirt or gravel using a sweeping brush, leaf blower or any other suitable means. Removal of such articles ensures good adhesion of the primer layer 2 to the substrate 4 when the primer/primer layer 2 is in its cured state. The surface should also be free from oil and grease which may have an adverse effect on the adhesion properties of the primer.

[0199] In step 102 the primer is prepared by mixing an epoxy with a curing agent in a ratio of 1:1 or 2:1 by weight and/or by volume. The epoxy has at least 1.5 epoxy groups per molecule and/or an epoxy group content of 5260-5420 mmol/kg. Suitable epoxies for use in the present invention include: Bisphenol A epoxy resins such as Epikote 828 manufactured by Hexion; Bisphenol F epoxy resins such as Epikote 862 (RTM) manufactured by Hexion, or other resins such as Bisphenol A/F Epikote 169 manufactured by Hexion. In further optional embodiments the epoxy may be an epichlorohydrian-based epoxy, a novalac epoxy, a cycloaliphatic epoxy, an epoxy diluent or a glycidylamine epoxy.

[0200] The curing agent is formed by mixing a hardener with a synthetic resin in a ratio of 2:3 by weight and/or by volume. The curing agent includes a mannich base hardener such as KH500 manufactured by Kukdo. The mannich base is a beta-amino-ketone which is formed by the reaction of an amine, formaldehyde or aldehyde and carbon acid. Use of a mannich base hardener allows rapid curing at ambient and low temperatures (i.e. below 5 °C) as well as ensuring favourable mechanical strength, hardness and chemical resistance properties. Mannich base hardeners also allow curing of the primer in the presence of water, i.e. in moist, damp and/or wet conditions where water is present. The synthetic resin can be styrenated phenol, gum rosin, or any mixture of the two. The curing agent is mixed with the epoxy in order to form a primer having a pot life of 5-15 minutes. When mixed, the synthetic resin and KH500 Mannich base form an adduct.

[0201] Mannich base hardeners are especially useful at level crossings where the installation of surface marking(s) can be subject to significant timing constraints. Often it is not practical or possible to wait for dry, warm conditions to install surface markings at level crossings

and the ability of mannich base hardeners to allow curing of the primer at low temperatures and in the presence of water provides significant advantages.

[0202] In optional embodiments the curing agent includes a hardener only and/or does not include synthetic resin. The hardener may be an aliphatic amine hardener, such as DETA manufactured by Delamine ltd. The curing agent may comprise an aliphatic hardener, a phenolic hardener or a polymercaptan hardener. The primer, curing agent and/or epoxy may comprise a diluent such as benzyl alcohol which alters the viscosity thereof, increasing the ease with which the primer, curing agent and/or epoxy can be manipulated, mixed, spread and/or poured.

[0203] In step 103 the primer is applied to the surface 4a of substrate 4 to form the primer layer 2 on the surface 4a of the substrate 4. Since the primer is applied while in its liquid form, the primer can be brushed, rolled, poured or screeded over the surface to form a layer approximately 2 mm thick ± 10%. As will be appreciated, the primer layer 2 can have any appropriate thickness in the range 0.1-20 mm. The surface of the substrate 4 is textured with surface features and/or dimples and the primer is uniformly applied over at least those areas of the substrate surface which are to carry the surface marking(s)/thermoplastic layer 3 such that the primer layer 2 exhibits a substantially flat surface.

[0204] Since the primer prepared in step 102 is moisture-insensitive, moisture does not need to be completely removed from the surface of the substrate 4 prior to applying the primer in step 103 (i.e. during step 101). The primer can be applied and cured in the presence of wet or damp conditions and at temperatures below 5°C. This makes the surface marking quicker to apply (the step of removing moisture from the surface does not need to be performed) and suitable for installation in a wide range of geographic locations and during inclement weather conditions.

[0205] In step 104 the thermoplastic layer 3 is applied to the surface of the primer layer 2. In preferred embodiments the thermoplastic layer 3 is formed by laying or rolling a preformed thermoplastic section onto the exposed surface of the primer layer. The thermoplastic section takes the form of a preformed sheet or roll of thermoplastic material which is generally soft and deformable while in its solid state. A suitable preformed thermoplastic for use when implementing the invention is Quickline Thermoplastic Line Marking manufactured by Kestrel Thermoplastics.

[0206] The thermoplastic section is applied to the surface of the primer layer 2 after the primer has at least partially cured, and before the primer has fully cured. Prior to the primer curing completely, the surface of the primer layer 2 remains tacky such that the thermoplastic section will be slightly adhered to the primer layer 2 when laid out thereon.

[0207] Since the thermoplastic section is preformed it can be prepared off site, reducing disruption during the on-site installation. Preformed thermoplastic sections can be laid out in appropriate positions prior to being bonded to the primer in steps 105 and 107. In the example embodiment of figure 1, the preformed thermoplastic section is a generally flat or planar sheet having a thickness of 2.5-3 mm, a width of 50 mm and a length of 1-3 m. However, the preformed thermoplastic section can be of any suitable dimensions and shape and can take the form of lines, hatchings, grids, shapes, letters, numbers and/or symbols (see for example the markings in Chapter 5 of the Traffic Signs Manual). For example the preformed thermoplastic section may have any thickness in the range of 0.1-20 mm.

[0208] In step 105 the preformed thermoplastic section is heated to a predetermined temperature, in this case above the melting temperature of the thermoplastic material. Heat is applied to the thermoplastic section using a propane flame blow torch, causing the thermoplastic layer to soften and melt onto the primer layer, sinking to conform to the shape of the substrate/primer layer surface. To ensure good adhesion to the primer layer 2, the temperature of the upper surface of the thermoplastic is raised to approximately 200°C. This ensures that the thermoplastic is heated to above the melting temperature of approximately 160°C to 170°C throughout the whole layer i.e. including at that part of the thermoplastic which is in contact with the primer. The thermoplastic material should be heated uniformly over its entire surface area to ensure adequate melting and adherence to the primer layer 2. The surface temperature of the thermoplastic can be measured with an optical or infrared thermometer during heating.

[0209] Steps 104 and 105 may be repeated as many times as necessary to provide the required surface markings. For example multiple layers of thermoplastic may be butt jointed on the surface of the substrate 4 to create a hatching pattern. The thermoplastic layer 3 can be of any suitable colour such as yellow or white.

[0210] In an alternative embodiment the thermoplastic layer 3 is formed using a hot-applied thermoplastic. Hot-applied thermoplastic is a "multi component" material in powder form comprising resins, polymers, plasticizers, glass beads, pigments, fillers and/or aggregates, which becomes liquid and homogeneous when heated. Hot-applied thermoplastic can be applied to the surface of the primer layer 2 while in a liquid form by pouring, rolling, screeding and/or using a line marking machine.

[0211] In step 106 aggregate particles and/or glass beads, used to improve the slip resistance and/or reflectivity of the surface marking, are broadcast over the surface of the thermoplastic layer. This step is carried out after the thermoplastic has been heated in step 105. Applying the aggregate particles while the thermoplastic material is at an elevated temperature (e.g. above the softening temperature of approximately 125°C) ensures that the aggregate will be sufficiently bedded in and bonded to the thermoplastic layer 3. A further application of heat may be used to ensure adhesion between the thermoplastic layer and the aggregate particles and/or glass

beads after they have been broadcast over the thermoplastic layer 3. In preferred embodiments the surface marking is a high friction surface marking including aggregate particles having a polished stone value of greater than 60. For example, suitable aggregate particles include particles of calcined bauxite, steel slag, sandstone, tuff, flint, basalt and/or granite having particle sizes in the range of 0.5-20 mm or 1-3 mm.

[0212] In an alternative embodiment the preformed thermoplastic section is pre-beaded with surface-applied materials during manufacture. This means that the preformed thermoplastic section includes a concentration of glass beads and/or aggregates prior to being melted onto the primer layer 2. Pre-beading of the preformed thermoplastic section potentially removes the need to broadcast aggregate particles and/or glass beads over the surface of the thermoplastic layer 3 while said layer is in its molten state. However, in the case where the preformed thermoplastic section is pre-beaded, aggregate particles and/or glass beads can still be broadcast over the surface of the thermoplastic layer 3 in order to increase concentration thereof at the surface of the surface marking 1.

[0213] In step 107 the thermoplastic layer 3 is cooled by removing application of any extra heat thereto. The thermoplastic layer cools down by thermalizing with the surrounding environment, which has an ambient temperature below the melting point of the thermoplastic layer 3. After cooling, the thermoplastic 3 is in a hardened state in which it is bonded to the primer 3, which is in turn bonded to the rubber surface 4. Once cooled, the thermoplastic layer preferably has a thickness in the range of 0.1-20 mm, particularly 2.5-3 mm. Once the primer/primer layer 2 has fully cured and hardened, the surface and surface marking are ready to carry pedestrian and/or vehicular traffic.

[0214] A surface marking system can be used to provide surface marking(s) 1 on the surface of a substrate 4. The surface marking system comprises a primer for forming the primer layer 2 on the surface of the substrate 4 and a thermoplastic for forming a thermoplastic layer 3 on the primer layer 2. The surface marking system allows surface marking(s) 1 to be applied to a wide range of surfaces/substrates including elastomeric substrates typically found at level crossings. The primer of the surface marking system can be provided as a container of 'Part A' containing epoxy and diluent, and a container of a 'Part B' comprising curing agent and diluent. When the surface marking system is to be deployed, parts A and B are mixed to form the primer.

[0215] In the preceding discussion of the invention, unless stated to the contrary, the disclosure of alternative values for the upper or lower limit of the permitted range of a parameter, coupled with an indication that one of the values is more highly preferred than the other, is to be construed as an implied statement that each intermediate value of the parameter, lying between the more preferred and the less preferred of the alternatives, is itself preferred to the less preferred value and also to each value lying between the less preferred value and the intermediate value.

[0216] The features disclosed in the foregoing description or the following drawings, expressed in their specific forms or in terms of a means for performing a disclosed function, or a method or a process of attaining the disclosed result, as appropriate, may separately, or in any combination of such features be utilised for realising the invention in diverse forms thereof.

Claims

1. A method for installing a surface marking on a substrate, the method comprising: forming a primer layer on a surface of a substrate; and forming a thermoplastic layer on the primer layer.

2. A method according to claim 1 further comprising preparing a primer for forming the primer layer, wherein preparing the primer comprises mixing an epoxy and a curing agent.

3. A method according to claim 2 wherein preparing the primer comprises mixing an epoxy with a curing agent comprising a mannich base hardener.

4. A method according to claim 2 or claim 3 wherein forming the primer layer comprises applying the primer to at least a part of the surface of an elastomeric substrate.

5. A method according to claim 4 wherein forming the primer layer comprises applying the primer to at least a part of the surface of a rubber block locatable between and/or adjacent to rails at a level crossing.

6. A method according to any previous claim wherein forming the thermoplastic layer on the primer layer comprises laying, rolling or otherwise placing a preformed thermoplastic section on the primer layer and heating the preformed thermoplastic section.

7. A method according to claim 5 wherein heating the preformed thermoplastic section comprises melting the preformed thermoplastic section onto the primer layer.

8. A method according to any previous claim further comprising installing reflective granular material and/or aggregate particles in the thermoplastic layer.

9. A surface marking for providing marking(s) on the surface of a substrate, the surface marking comprising a primer layer and a thermoplastic layer.

10. A surface marking according to claim 9 wherein the primer layer comprises an epoxy and a curing agent.

11. A surface marking according to claim 10 wherein the curing agent comprises a mannich base hardener and a synthetic resin.

12. A surface marking according to any one of claims 9 to 11 wherein the primer layer is located on at least a part of the surface of an elastomeric substrate.

13. A surface marking according to claim 12 wherein the substrate is a rubber block locatable between and/or adjacent to rails at a level crossing.

14. A surface marking according to any one of claims 9 to 13 wherein the surface marking is a high visibility surface marking comprising reflective granular material.

15. A surface marking according to any one of claims 9 to 14 wherein the surface marking is a high friction surface marking comprising aggregate particles.

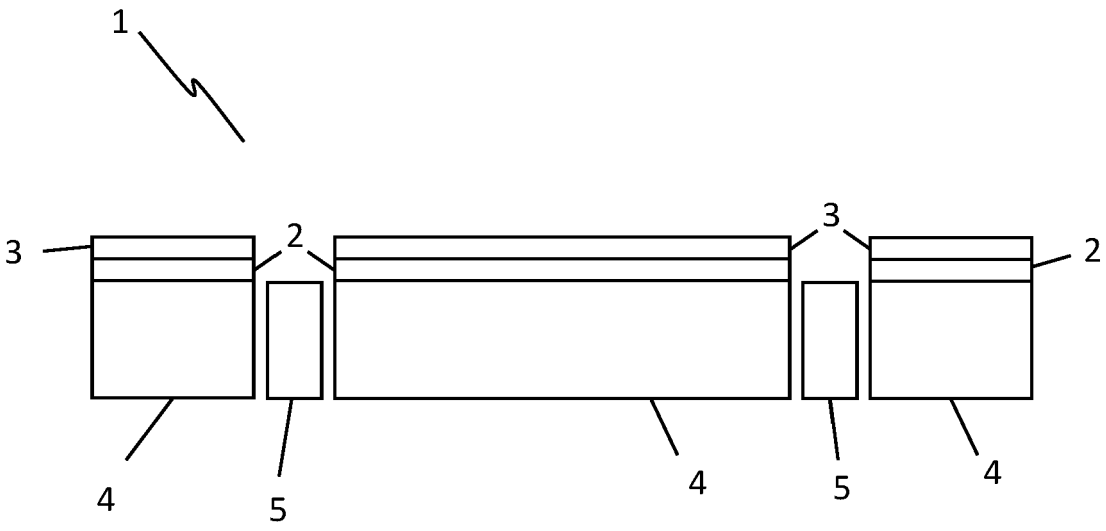

Figure 1

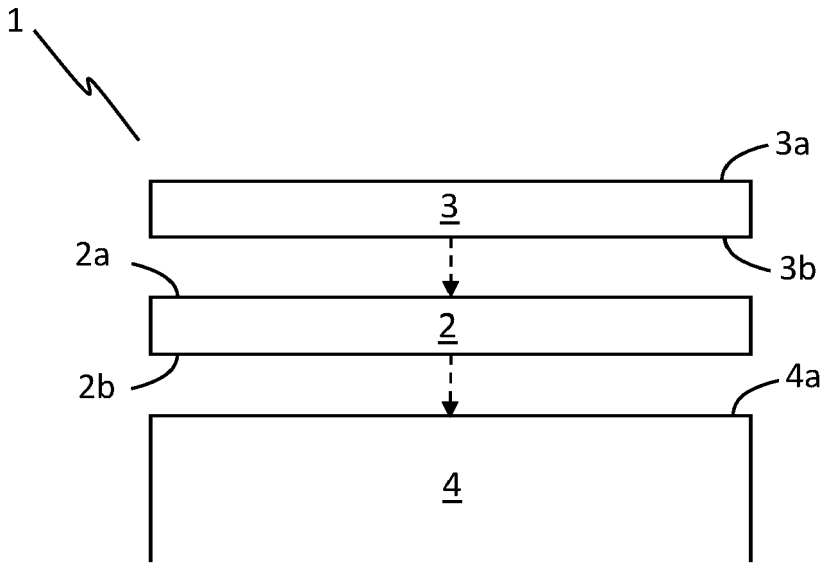

Figure 1a

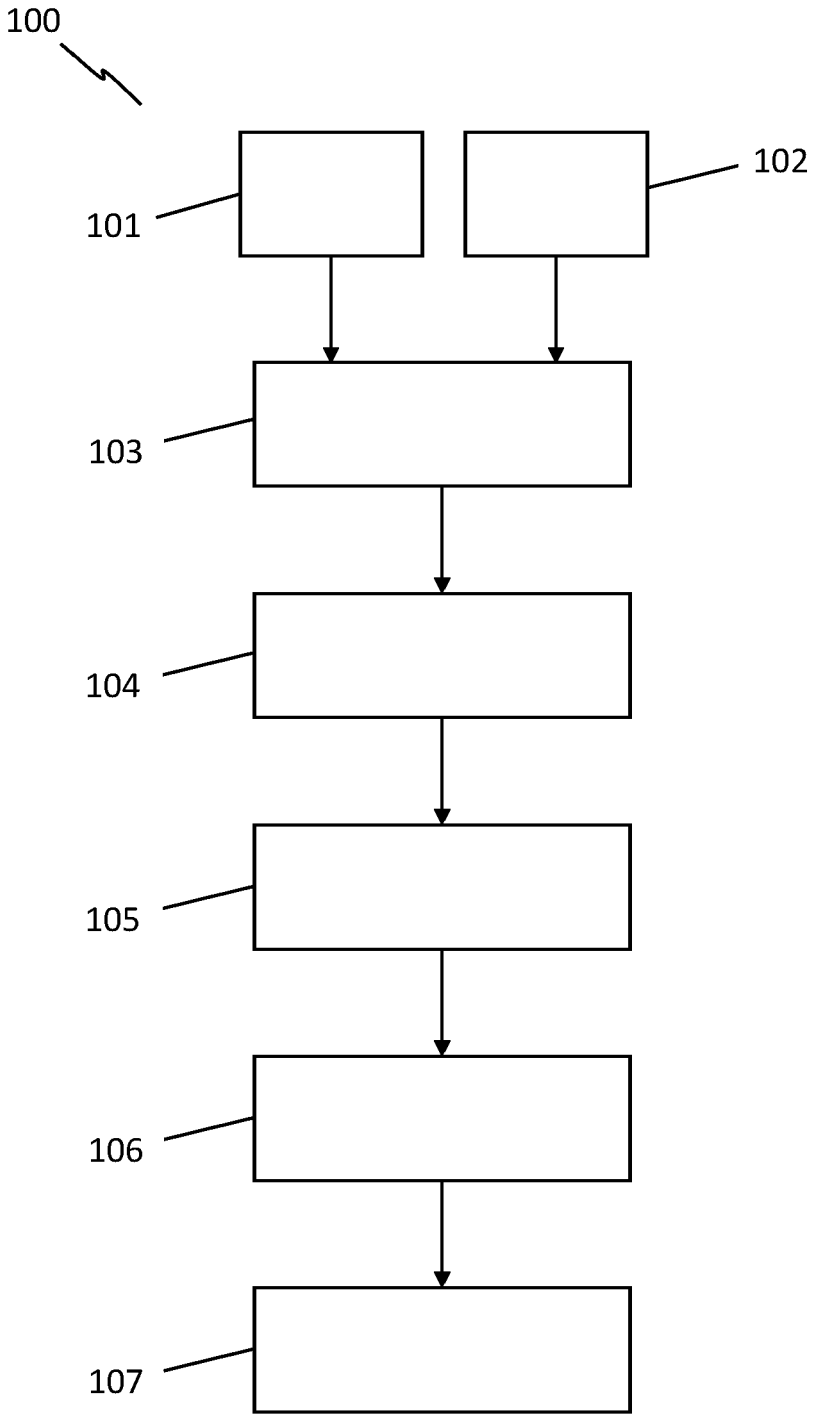

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 20 02 0259

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2013/074385 A1 (GREER ROBERT W [US] ET AL) 28 March 2013 (2013-03-28) * the whole document *	1-3,5-15	INV. E01C9/04 E01F9/512 E01F9/518
X	WO 97/22757 A1 (RIEBER & SOEN DIVISJON NORSKI [NO]; DIETRICHSON STEIN [NO]) 26 June 1997 (1997-06-26) * the whole document *	1-5,8-15	E01F9/506
A	EP 2 182 034 A1 (KRAIBURG ELASTIK [DE]) 5 May 2010 (2010-05-05) * paragraphs [0012] - [0015] *	1-15	
A	DE 197 04 366 A1 (FRANK HARALD [DE]) 6 August 1998 (1998-08-06) * column 6, lines 60-68; figures 1-3 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
E01C
E01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 September 2020	Flores Hokkanen, P

CATEGORY OF CITED DOCUMENTS

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28-09-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013074385 A1	28-03-2013	US 2013074385 A1	28-03-2013
		US 2018080185 A1	22-03-2018
WO 9722757 A1	26-06-1997	AU 1213197 A	14-07-1997
		DE 19681686 B4	30-12-2004
		DE 19681686 T1	29-04-1999
		US 6116814 A	12-09-2000
		WO 9722757 A1	26-06-1997
EP 2182034 A1	05-05-2010	DE 102008053656 A1	06-05-2010
		EP 2182034 A1	05-05-2010
DE 19704366 A1	06-08-1998	NONE	

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