

(19)



(11)

EP 4 372 187 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.05.2024 Bulletin 2024/21

(21) Application number: **23210505.6**

(22) Date of filing: **17.11.2023**

(51) International Patent Classification (IPC):
E04H 17/00 ^(2006.01) **B21F 27/00** ^(2006.01)
B05B 5/08 ^(2006.01) **B05D 7/14** ^(2006.01)
B05D 7/20 ^(2006.01) **B05D 7/00** ^(2006.01)
B21F 23/00 ^(2006.01) **B05D 3/04** ^(2006.01)
B05D 1/06 ^(2006.01)

(52) Cooperative Patent Classification (CPC):
(C-Sets available)
B05D 7/14; B05D 7/20; B05D 7/54; B21F 23/00;
E04H 17/161; B05D 1/06; B05D 3/0406;
B05D 2252/00; B05D 2451/00; B05D 2504/00;
B05D 2508/00; B05D 2601/28 (Cont.)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **18.11.2022 BE 202205932**

(71) Applicant: **Balak Coatings nv**
3900 Pelt (BE)

(72) Inventors:
• **van Hoeij, Marcel**
3900 Pelt (BE)
• **Vanvinckenroye, Willem**
3900 Pelt (BE)
• **Avontuur, Michiel**
3900 Pelt (BE)

(74) Representative: **Brantsandpatents bv**
Pauline Van Pottelsberghelaan 24
9051 Ghent (BE)

(54) **AN OPTIMALLY COATED TWIN-WIRE FENCE PANEL AND METHOD FOR THAT PURPOSE**

(57) The present invention relates to a twin-wire fence panel on which two or more coating sublayers have been applied, wherein a twin-wire fence panel consists of parallel vertical and parallel horizontal wires, wherein the vertical wires are welded at the same height between a pair of horizontal wires, and wherein the two or more

coating sublayers comprise: (a) at least one coating comprising an epoxy, and (b) at least one coating comprising a polyester, wherein the epoxy is a zinc epoxy comprising a zinc content between 0.1 and 40 m%. In a second aspect, the invention relates to a method for optimally coating a twin-wire fence panel.

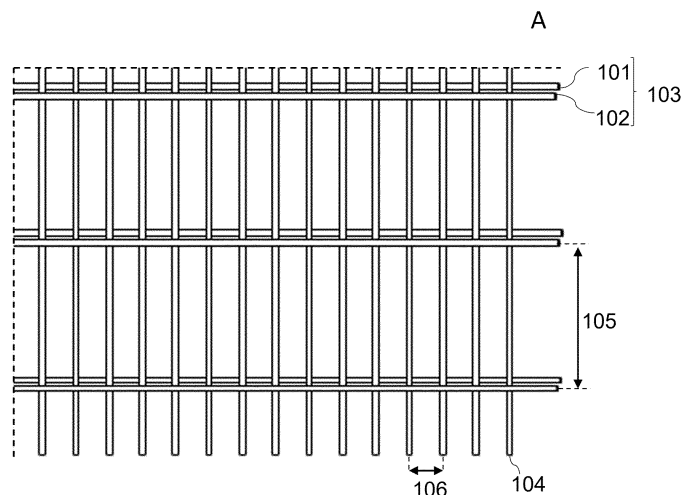


FIG. 2

(52) Cooperative Patent Classification (CPC): (Cont.)

C-Sets

B05D 2451/00, B05D 2401/32, B05D 2401/32

Description**TECHNICAL FIELD**

5 **[0001]** The invention relates to an optimally coated twin-wire fence panel. In a second aspect, the invention relates to a method for optimally coating a twin-wire fence panel.

PRIOR ART

10 **[0002]** An alternative to hot-dip galvanizing twin-wire fencing panels is to use a two-layer powder coating. The advantages of this alternative are the avoidance of skin formation, irregularities and sharp protruding parts.

[0003] A problem with this two-layer powder coating system is that the application of the first coating causes poor contact with the metal surface of the twin-wire fence panel, so that grounding is no longer possible. However, this grounding is necessary to be able to deposit a second coating on the first coating. As a result, the second coating does not adhere or adheres poorly to the twin-wire fence panel, resulting in an insufficient and/or non-uniform coating. This in turn leads to various weak points on the twin-wire fence panel, where corrosion thus has free rein. This problem mainly occurs with epoxy coatings, as epoxy has a strong insulating effect, which adversely affects the conductive contact.

15 **[0004]** In addition, poor grounding causes sparks to form during the coating process, which in turn results in a poor, i.e. too thin or irregular, coating at the place where sparks originated during the process.

20 **[0005]** The present invention aims to find a solution for at least some of the above problems.

SUMMARY OF THE INVENTION

25 **[0006]** The invention relates to a coated twin-wire fence panel according to claim 1. Preferred embodiments are presented in the dependent claims.

[0007] The twin-wire fence panel according to the invention is advantageous because it concerns an ungalvanized (not hot-dip galvanized) twin-wire fence panel to which a double coating has been applied in an efficient manner. Each point on the twin-wire fence panel is provided with at least one coating and there are no so-called support points or bearing points that do not contain a coating. The inventors have unexpectedly found that adding zinc to the epoxy provides an improved twin-wire fence panel in terms of coating uniformity. A twin-wire fence panel according to the invention is thus provided with two coatings, each with an improved uniformity in coating thickness, resulting in an improved uniformity in the coating thickness of the total coating.

30 **[0008]** The inventors also found that adding zinc to the epoxy had a strengthening effect on the corrosion resistance of the ungalvanized twin-wire fence panel. The inventors found that within the range of the zinc content as described in claim 1, a powder coating is obtained that can be processed as a powder coating, but also gives the coating a sufficiently high conductivity so that grounding of the twin-wire fence panel is possible for applying a subsequent coating. Moreover, it appears that within this range an improved corrosion resistance is still imparted to the ungalvanized twin-wire fence panel.

35 **[0009]** It was an object of the invention to provide an ungalvanized, twin-wire fence panel in which both the uniformity of the coating and the corrosion resistance of the twin-wire fence panel are optimized.

40 **[0010]** In a second aspect, the invention relates to a method for coating one or more twin-wire fence panels according to claim 7. Preferred embodiments are presented in the dependent claims.

[0011] The method allows, on the one hand, to provide two coatings on an ungalvanized twin-wire fence panel by using a zinc-containing epoxy, so that grounding of the twin-wire fence panel remains possible for applying the second coating. Moreover, the method is advantageous because the method ensures a uniform coating thickness in the obtained twin-wire fence panel.

45 **[0012]** The inventors unexpectedly found that applying a zinc epoxy as first coating resulted in a significantly better conductivity on the surface of the twin-wire fence panel, as a result of which the second coating showed a significantly better and more uniform adhesion, resulting in an improved twin-wire fence panel.

50 **[0013]** It is, among other things, an object of the invention to provide a method that avoids the occurrence of sparks in the event of poor grounding, and in which a twin-wire fence panel can simultaneously be obtained with a double coating that is as uniform as possible, so that both the protection of the metal and the aesthetic appearance is optimized.

[0014] It is also among other things an object of the invention to provide a method for coating in which refinishing, whether or not manually, of the ungalvanized twin-wire fence panels is superfluous. In such a way that the efficiency of the coating process increases.

55 **[0015]** It is a specific object of the invention to provide a method for coating horizontally positioned twin-wire fence panels. Since a horizontally positioned twin-wire fence panel has a high number of support points or bearing points, the method according to the present invention is particularly advantageous for this application, because refinishing, whether

or not manually, of all support points of the twin-wire fence panel is superfluous.

[0016] It was an object of the invention to provide a method for producing an ungalvanized (not hot-dip galvanized) twin-wire fence panel, wherein both the uniformity of the coating and the corrosion resistance of the twin-wire fence panel are optimized.

DETAILED DESCRIPTION

[0017] The invention relates to an optimally coated twin-wire fence panel.

[0018] Unless otherwise defined, all terms used in the description of the invention, including technical and scientific terms, have the meaning generally understood by those skilled in the technical field of the invention. For a better understanding of the description of the invention, the following terms are explained explicitly.

[0019] The term "ungalvanized twin-wire fence panel" refers to a twin-wire fence panel that has not been subjected to a hot-dip galvanizing step during its production process.

[0020] The terms "epoxy" and "polyepoxide" as used herein are synonyms and refer to a class of epoxy polymers with application in coatings, such as epoxy resins. Epoxy resins can react with themselves (become crosslinked) through catalytic homopolymerization, or with a wide variety of co-reactants, including polyfunctional amines, acids (and acid anhydrides), phenols, alcohols, and thiols (commonly referred to as mercaptans). These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is commonly referred to as curing. It should be clear that if a twin-wire fence panel has a coating comprising epoxy, this is a cured epoxy coating.

[0021] The epoxy is advantageous as a first coating because it already has inherent corrosion resistance.

[0022] The term "zinc epoxy," as used in the text, refers to an epoxy containing zinc, for example in a minimum amount of 0.1 m%.

[0023] The term "powder coating," as used in the text, refers to the electrostatic process whereby powder is applied to metal with a spraying means.

[0024] The terms "polyester" and "polyester resin" as used herein are synonyms and refer to a class of polymers containing an ester functional group in each repeating unit of their main chain. Possible polyesters are: polyether polyesters, poly(3-hydroxybutyrate-co-3-hydroxyvalerate), poly(lactic acid-co-glycolic acid), poly(ethylene succinate), polybutylene adipate terephthalate, polybutylene succinate, polybutylene terephthalate, polycaprolactone, polycyclohexylenedimethylene terephthalate, polydioxanone, polyethylene naphthalate, polyethylene terephthalate, polyglycolide, polyhydroxyalkanoates, polyhydroxybutyrate, polylactic acid, polytrimethylene terephthalate.

[0025] The expression "percent by weight," "wt%," "m%" or "% by weight" in this document refers to the relative weight of a component based on the total weight of the entire referenced product.

[0026] The terms "double wire fence panel" and "twin-wire fence panel", as used in the text, refers to a fence panel, wherein parallel vertical bars (wires) are welded to horizontal bars (wires), and wherein the vertical bars are welded at the same height between two horizontal bars (a pair).

[0027] The term "coating" in the current context refers to a substance or a mixture of substances for covering a substrate, such as a metal surface or other coating, with the aim of protecting the surface, making it more beautiful or making it safer. Several coatings can be applied or present on the same metal surface, in which case we can speak of a first and a second coating. Each coating can be applied in one or more layers, herein referred to as "coating sublayers." A single coating step thus covers the application of a single coating, wherein one or more coating sublayers are deposited on the surface.

[0028] It will be apparent to a person skilled in the art that the names of the wires in the twin-wire fence panel, namely "horizontal wires" and "vertical wires," are relative terms. The terms "horizontal wires," "horizontal bars," and "cross wires" refer to the wires or bars that, in a working form (installed condition) of the twin-wire fence panel, are positioned substantially horizontally with respect to the surface on which the fencing is positioned upright. The horizontal wires therefore correspond to the length of the twin-wire fence panel. The terms "vertical wires," "vertical bars," and "longitudinal wires" refer to the wires or bars that, in a working form (installed condition) of the twin-wire fence panel, are positioned substantially vertically relative to the surface on which the fencing is positioned upright. The vertical wires therefore correspond to the height of the twin-wire fence panel. The horizontal wires and vertical wires are thus positioned perpendicular to each other.

[0029] When the twin-wire fence panel is supplied in a substantially horizontal position during coating, both the horizontal wires and the vertical wires lie substantially in a plane parallel to the ground surface, still positioned perpendicular to each other.

[0030] The unit "mu" is synonymous with "μm" and "micron" and refers to the unit of length micrometer from the SI system.

[0031] In this document, "a", "an" and "the" refer to both the singular and the plural, unless the context presupposes otherwise. For example, "a segment" means one or more than one segment.

[0032] The terms "comprise," "comprising," "consist of," "consisting of," "provided with," "have," "having," "include,"

"including," "contain," "containing" are synonyms and are inclusive or open terms that indicate the presence of what follows, and which do not exclude or prevent the presence of other components, characteristics, elements, members, steps, as known from or disclosed in the prior art.

[0033] When the term 'around' or 'about' is used in this document with a measurable quantity, a parameter, a duration or moment, and the like, then variations are meant of approx. 20% or less, preferably approx. 10% or less, more preferably approx. 5% or less, even more preferably approx. 1% or less, and even more preferably approx. 0.1% or less than and of the quoted value, insofar as such variations are applicable in the described invention. However, it must be understood that the value of a quantity used where the term "about" or "around" is used, is itself specifically disclosed.

[0034] Quoting numerical ranges by endpoints includes all integers, fractions and/or real numbers between the endpoints, these endpoints included.

[0035] In a first aspect, the invention relates to a coated twin-wire fence panel.

[0036] A twin-wire fence panel according to the invention preferably has between 50 and 55, preferably 51, vertical wires and between 1 and 20 pairs of horizontal wires.

[0037] In one embodiment, the vertical wires have a length between 500 and 2500 mm, preferably the vertical wires have a length selected from the list: 630, 830, 1030, 1230, 1430, 1630, 1830, 2030, 2230, 2430 mm. It will be apparent to a person skilled in the art that the length of the vertical wires corresponds to the height of a twin-wire fence panel. In one embodiment, the horizontal wires have a length between 2000 and 3000 mm; preferably between 2400 and 2600, even more preferably between 2500 and 2550 mm, most preferably 2508 or 2510 mm. It will be apparent to a person skilled in the art that the length of the horizontal wires corresponds to the length of a twin-wire fence panel.

[0038] In a preferred embodiment, the distance between two adjacent vertical wires is 40-60 mm c.t.c., more preferably between 45 and 55 mm, even more preferably between 49 and 51, most preferably about 50 mm.

[0039] In another embodiment, the distance between the adjacent horizontal wires is 100-300 mm c.t.c., preferably 150-250 mm, more preferably 180-220 mm, most preferably about 200 mm.

[0040] The term "c.t.c." (center to center) refers to a distance between the center (the heart) of a circular cross-section of one wire and the center (the heart) of a circular cross-section of another wire.

[0041] In one embodiment, the twin-wire fence panel is manufactured from unalloyed steel, low-alloy steel or high-alloy steel. The twin-wire fence panel can be made from high or low carbon steel.

[0042] Unalloyed steel contains a maximum of 1.5% of alloying elements (excluding carbon (C)). Unalloyed steel has a carbon percentage of 0.5% to 2%. Low-alloy steel contains between 1.5 and 5% alloying elements (excluding carbon). High-alloy steel contains more than 5% of alloying elements. The twin-wire fence panel is preferably manufactured from unalloyed steel. The term "alloying elements" refers to the elements that are present in the alloy in addition to iron and carbon. In a preferred embodiment, the twin-wire fence panel is manufactured from an alloy comprising iron (Fe), carbon (C) and alloying elements. Preferably, the alloy comprises a maximum of 1.5% alloying elements, more preferably a maximum of 1.4%, even more preferably a maximum of 1.3%, even more preferably a maximum of 1.2%, most preferably a maximum of 1.1%. Preferably the alloy comprises at least 0.5% alloying elements, more preferably at least 0.6%, even more preferably at least 0.7%, even more preferably at least 0.8%, even more preferably at least 0.9%, most preferably at least 1%. In another preferred embodiment, the alloy comprises between 0.5 and 1.5% alloying elements, preferably between 0.6 and 1.5%, more preferably between 0.7 and 1.4%, even more preferably between 0.8 and 1.3%, even more preferably between 0.9 and 1.2%, most preferably between 1 and 1.1%.

[0043] In one embodiment, the alloy comprises a maximum of 0.1% C, more preferably a maximum of 0.09%, even more preferably a maximum of 0.085%, even more preferably a maximum of 0.08%, most preferably a maximum of 0.075%. Preferably, the alloy comprises at least 0.025% C, more preferably at least 0.03%, even more preferably at least 0.035%, even more preferably at least 0.04%, most preferably at least 0.045%. In another preferred embodiment, the alloy comprises between 0.02 and 0.1% C, preferably between 0.025 and 0.09%, more preferably between 0.035 and 0.085%, even more preferably between 0.04 and 0.08%, most preferably between 0.045 and 0.075%.

[0044] In a preferred embodiment, the alloy comprises alloying elements selected from the list of: manganese (Mn), silicon (Si), sulfur (S), phosphorus (P), nitrogen (N), copper (Cu), chromium (Cr), nickel (Ni), niobium (Nb), tin (Sn), aluminum (Al) or any combination thereof. Preferably the alloy comprises manganese (Mn), silicon (Si), sulfur (S), phosphorus (P), nitrogen (N), copper (Cu), and optionally chromium (Cr), nickel (Ni), niobium (Nb), tin (Sn), aluminum (Al).

[0045] Preferably, the alloy comprises Mn in an amount between 0.3 and 0.5%, more preferably between 0.35 and 0.45%, Si in an amount between 0.05 and 0.25%, more preferably between 0.1 and 0.2%, S in an amount between 0.01 and 0.045%, more preferably between 0.015 and 0.04%, P in an amount between 0.005 and 0.03%, more preferably between 0.005 and 0.025%, Cu in an amount between 0.2 and 0.4%, more preferably between 0.25 and 0.35%, N in an amount between 0.005 and 0.02%, more preferably between 0.005 and 0.015%, and Cr in an amount of up to 0.15%, more preferably up to 0.1%, Ni in an amount up to 0.15%, more preferably up to 0.1%, and Nb in an amount up to 0.005%, more preferably up to 0.002%, Sn in an amount up to 0.05%, more preferably up to 0.03%, and/or Al in an amount up to 0.005%, more preferably up to 0.003%. The percentages as stated above all refer to m%.

[0046] In a preferred embodiment, the twin-wire fence panel is provided with one or more coatings, preferably the

twin-wire fence panel is provided with two coatings.

[0047] In a further preferred embodiment, at least one coating comprises an epoxy, preferably one coating comprises an epoxy.

[0048] Epoxy has a number of advantages over polyester, such as creating a liquid-tight protective layer. The adhesion and mechanical strength of epoxy is also many times greater than that of a polyester. In addition, epoxy is also resistant to a large number of chemicals.

[0049] In a preferred embodiment, at least one coating comprises a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, preferably one coating comprises a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester.

[0050] Polyamides are condensation products of one or more amino acids, such as aminocaproic acid, amino-7-heptanoic acid, amino-11-undecanoic acid and amino-12-dodecanoic acid, or of one or more lactams, such as caprolactam, oenantholactam and lauryllactam, or of one or more salts or mixtures of diamines such as hexamethylenediamine, dodecamethylenediamine, metaxylenediamine, bis-p aminocyclohexylmethane and trimethylhexamethylenediamine with diacids such as isophthalic acid, terephthalic acid, adipic acid, azelaic acid, suberic acid, sebacic acid and dodecanedioic acid or mixtures of all these monomers, which lead to copolyamides.

[0051] Polyolefins are understood to mean polymers containing olefin units, such as, for example, ethylene, propylene, butene-1 units. Examples of polyolefins are:

- polyethylene, polypropylene, copolymers of ethylene with alpha-olefins. These products can be grafted with anhydrides of unsaturated carboxylic acids such as maleic anhydride or unsaturated epoxides such as glycidyl methacrylate, and
- copolymers of ethylene with at least one product selected from i) unsaturated carboxylic acids, their salts and esters, ii) vinyl esters of saturated carboxylic acids, iii) unsaturated dicarboxylic acids, their salts, esters, hemiesters and anhydrides, and iv) the unsaturated epoxides. These ethylene copolymers can be grafted with anhydrides of unsaturated dicarboxylic acids or unsaturated epoxides.

[0052] Polyesters can be chosen from the list of: poly(3-hydroxybutyrate-co-3-hydroxyvalerate), poly(lactic acid-co-glycolic acid), poly(ethylene succinate), polybutylene adipate terephthalate, polybutylene succinate, polybutylene terephthalate, polycaprolactone, polycyclohexylenedimethylene terephthalate, polydioxanone, polyethylene naphthalate, polyethylene terephthalate, polyglycolide, polyhydroxyalkanoates, polyhydroxybutyrate, polylactic acid, polytrimethylene terephthalate.

[0053] In a preferred embodiment at least one coating comprises a polyester, preferably at least one coating comprises a polyester selected from the list of: polybutylene succinate, polybutylene terephthalic acid, polycaprolactone, polyethylene naphthalate, polyethylene terephthalate, polyglycolide, polyhydroxyalkanoates, polyhydroxybutyrate, polylactic acid. In a particular preferred embodiment, the polyester is a polyether polyester.

[0054] In a particular preferred embodiment, the twin-wire fence panel is provided with two or more coatings, preferably two coatings, wherein the two or more coatings comprise:

- at least one coating comprising an epoxy, preferably one coating comprising an epoxy, and;
- at least one coating comprising a polyester, preferably one coating comprising a polyester.

[0055] In a particular preferred embodiment, the epoxy is a zinc epoxy. The inventors have unexpectedly found that adding zinc to the epoxy provides better grounding and consequently an improved twin-wire fence panel in terms of coating uniformity. A twin-wire fence panel according to the invention is thus provided with two coatings, each with an improved uniformity in coating thickness, resulting in an improved uniformity in the coating thickness of the total coating. The addition of zinc to the epoxy also has an improved effect on corrosion resistance.

[0056] Alternatively, the epoxy can be any metal epoxy such as iron epoxy for example. The inventors found that adding zinc to the epoxy had a strengthening effect on the corrosion resistance of the ungalvanized twin-wire fence panel. However, other metals can actually promote corrosion.

[0057] In a preferred embodiment, the zinc epoxy has a zinc content of at least 0.01 m%, preferably at least 0.05 m%, more preferably at least 0.1 m%, even more preferably at least 0.5 m%, and even more preferably at least 1 m%.

[0058] A minimum zinc content is necessary to achieve sufficient conductivity, and thus to optimally apply a second coating and to obtain an optimally coated twin-wire fence panel.

[0059] In another or further preferred embodiment, the zinc epoxy has a zinc content of at most 50 m%, preferably at most 45 m%, more preferably at most 40 m%, even more preferably at most 35 m%, and even more at preferably at most 30 m%.

[0060] The inventors found that higher zinc content causes the powder coating to become unworkable and consequently cannot be used anymore for powder coating. The specific weight of the zinc epoxy increases with the amount of zinc

present in the epoxy. The inventors have discovered experimentally that with a zinc content of 50 m% (1.41 g/cm³) the powder is already "too heavy". This has not only proven to adversely affect the processing of the powder (obtaining the powder cloud), but also the durability of the pumps, pipes and spray agents of the spray booth, as they become clogged.

[0061] The inventors found that the powder is processable with a zinc content of maximum 30 m%, and is even more processable with a zinc content of maximum 25 m% or even 20 m%.

[0062] In a further or other preferred embodiment, the zinc epoxy comprises a zinc content of between 0.01 and 50 m%, preferably between 0.05 and 45 m%, more preferably between 0.1 and 40 m%, even more preferably between 0.5 and 35 m%, and even more preferably between 1.0 and 30 m%, , even more preferably between 1.0 and 25 m%, and most preferably between 1.0 and 20 m%.

[0063] The inventors found that within this range a powder coating is obtained that can be processed as a powder coating and provides sufficient conductivity to the coating so that grounding of the twin-wire fence panel is possible for applying a subsequent coating. Moreover, it appears that within this range a certain corrosion resistance is still imparted to the ungalvanized twin-wire fence panel.

[0064] In a preferred embodiment, the coating comprising an epoxy has a coating thickness of at least 40 μ m, preferably at least 45 μ m, more preferably at least 50 μ m.

[0065] This coating thickness is the minimum required to obtain sufficient coverage of the twin-wire fence panel, so that a second coating layer can be applied.

[0066] In another or further preferred embodiment, the coating comprising an epoxy has a coating thickness of at most 180 μ m, preferably at most 170 μ m, more preferably at most 160 μ m, even more preferably at most 150 μ m, even more preferably at most 140 μ m, even more preferably at most 130 μ m, even more preferably at most 120 μ m, even more preferably at most 110 μ m, and most preferably at most 100 μ m.

[0067] The inventors found that a larger coating thickness is unnecessary because otherwise the coating would lead to higher coating losses.

[0068] In another or further preferred embodiment, the coating comprising an epoxy has a coating thickness of between 40 and 180 μ m, preferably between 45 and 170 μ m, more preferably between 50 and 160 μ m, even more preferably between 50 and 150 μ m, even more preferably between 50 and 140 μ m, even more preferably between 50 and 130 μ m, even more preferably between 50 and 120 μ m, even more preferably between 50 and 110 μ m, even more preferably between 50 and 100 μ m.

[0069] It has been found that this range allows a minimum conductivity that is required, moreover, this range limits the necessary coating quantity and therefore also the losses.

[0070] Moreover, it appears that within this range a certain corrosion resistance is still imparted to the ungalvanized twin-wire fence panel.

[0071] In a preferred embodiment, the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, has a coating thickness of at least 30 μ m, preferably at least 35 μ m, more preferably at least 40 μ m.

[0072] This coating thickness is the minimum required to obtain sufficient coverage of the twin-wire fence panel, so that an aesthetic advantage is obtained.

[0073] In another or further preferred embodiment, the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, has a coating thickness of at most 120 μ m, preferably at most 100 μ m, and most preferably at most 90 μ m.

[0074] The inventors found that a larger coating thickness is unnecessary because otherwise the coating would lead to higher coating losses.

[0075] In another or further preferred embodiment, the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, has a coating thickness of between 30 and 120 μ m, preferably between 35 and 120 μ m, more preferably between 40 and 120 μ m, even more preferably between 40 and 100 μ m, even more preferably between 40 and 90 μ m.

[0076] In a preferred embodiment, the coating thickness of the coating comprising an epoxy and the coating thickness of the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, are in proportion according to a ratio between 0.3 and 6, preferably between 0.35 and 5, more preferably between 0.4 and 4, even more preferably between 0.45 and 3, most preferably between 0.5 and 2.5.

[0077] The inventors unexpectedly found that the combination of the coatings in this thickness ratio results in an optimally coated twin-wire fence panel that can function as an alternative to hot-dip galvanized twin-wire fence panels.

[0078] The inventors unexpectedly found that the combination of a zinc epoxy and a polyester coating leads to improved corrosion resistance compared to other two-layer coating systems for ungalvanized fence panels.

[0079] In a preferred embodiment, the hardness of the coating comprising epoxy is at least 75 Buchholz resistance units (BH), preferably at least 80 BH, more preferably at least 85 BH, even more preferably at least 90 BH, even more preferably at least 95 BH, and most preferably a minimum of 100 BH.

[0080] "Buchholz resistance" or "Buchholz Hardness" is a recognized test described in standard ISO 2815: 1973. A

standard metal plate is coated with the "coating to be tested". The width of the impression is then measured with the microscope. This value (in mm) is converted into the Buchholz (BH) value via an official table.

[0081] The hardness can be measured by means of Buchholz hardness testers as known in the art. A Buchholz hardness tester preferably consists of a beveled disc indentation tool mounted in a stainless steel block and exerting a constant pressure of 500g. The meter is placed on the coating for 30 seconds and removed again after those 30 seconds. The length of the resulting indentation of the coating is measured with the scale reading microscope. The result is expressed in Buchholz indentation resistance units using the scale provided.

[0082] In a preferred embodiment, the hardness of the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, is between 60 and 120 Buchholz resistance units (BH), preferably between 65 and 115 BH, more preferably between 70 and 110 BH, even more preferably between 75 and 105 BH, even more preferably between 80 and 100 BH, and most preferably between 85 and 95 BH.

[0083] The hardness is advantageous for imparting robustness to the non-hot-dip galvanized twin-wire fence panel.

[0084] In a second aspect, the invention relates to a method for coating one or more twin-wire fence panels.

[0085] In a specific preferred embodiment, the method comprises the steps of:

- i. applying a coating comprising epoxy, preferably a zinc epoxy, to the one or more twin-wire fence panels; and
- ii. applying a coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, to the one or more twin-wire fence panels.

[0086] In a preferred embodiment, the coating is applied by means of powder coating. By applying a powder coating to an ungalvanized twin-wire fence panel, not only an aesthetically pleasing result is achieved, the corrosion resistance of the twin-wire fence panel is also considerably better.

[0087] The coating step is discussed below. It should be understood that the coating step describes both the application of the coating in step i and step ii. For example, when two coatings are applied, the coating step is performed twice.

[0088] In powder coating, a powder coating is applied to a metal surface by applying a charge to the powder, after which the powder is preferably sprayed onto the metal surface by means of a spraying means.

[0089] In one embodiment, the charge is applied to the powder by an electrode where a discharge takes place (the corona principle), or by friction along a non-conductive material (the tribo principle), preferably the charge is applied by means of the tribo principle by a tribo-charging system. The tribo principle is advantageous because the effect of a Faraday cage can be avoided.

[0090] In a preferred embodiment, the coatings are applied by means of powder coating, preferably triboelectric powder coating.

[0091] Prior to powder coating, the twin-wire fence panels must be grounded, i.e. connected to a zero potential. This grounding is important to ensure the deposition of the powder on the metal surface, as this allows the static charge on the powder to dissipate.

[0092] Many contaminants can occur on the ungalvanized metal surface, such as corrosion products, passivating coats, rolling oil, etc. In a further or other embodiment, the twin-wire fence panels are therefore pre-treated prior to coating. The pre-treatment preferably comprises one or more steps from the list of: degreasing, rinsing, demi-rinsing, pickling, fluxing, demi-fogging, conversion coating, such as phosphating, zirconizing, chromating, passivating, iron phosphating, zinc phosphating, manganese phosphating, stove-enameling, or a combination of these. In a preferred embodiment, the twin-wire fence panels are pre-treated by means of the steps of: alkaline degreasing, acid pickling, conversion coating, stove-enameling, or a combination of these. In a further preferred embodiment, the twin-wire fence panels are pre-treated by means of the steps of: alkaline degreasing, acid pickling, conversion coating, and stove-enameling. The conversion coating is preferably a combination of chromating, passivating or zirconizing, preferably in combination with fluorides.

[0093] During the pre-treatment, the twin-wire fence panels are preferably provided with a conversion coating or adhesion layer that has been formed on the metal surface by the action of a chemical agent, such as a polymer.

[0094] In a preferred embodiment, the twin-wire fence panels are coated in a substantially horizontal position. In a further preferred embodiment, the twin-wire fence panels are positioned for this purpose on four or more support points.

[0095] "The support points" are defined as positions on the twin-wire fence panels that make contact with a support means. The twin-wire fence panel is preferably provided with a zero potential via these support points, i.e. the twin-wire fence panel is grounded via these support points. A set of support points is a set of positions on the twin-wire fence panel that contact a support means.

[0096] In one embodiment, the twin-wire fence panels are positioned in step (i) and step (ii) on the same set of support points.

[0097] In an alternative and preferred embodiment, the twin-wire fence panels are positioned in step (i) on a first set of support points, and in step (ii) positioned on a second set of support points, wherein the first set of support points and the second set of support points are different, i.e. do not have any support point in common.

[0098] This is possible by moving or shifting the twin-wire fence panels horizontally with respect to the support means in an embodiment to form a new set of support points. Alternatively, this is possible by turning the twin-wire fence panels over, so that a new set of support points is formed on the opposite side face of the twin-wire fence panel.

[0099] This prevents no coating from ending up on the contact points made by the twin-wire fence panels on the support points during spraying, requiring manual touch-ups afterwards.

[0100] The zinc epoxy coating is advantageous here because the zinc particles ensure that grounding on the new support points is still possible by increasing the conductivity of the epoxy.

[0101] In one embodiment, a coating is applied to the twin-wire fence panels in one or more spray booths comprising spraying means.

[0102] In a further embodiment, the twin-wire fence panels are supplied substantially horizontally in a spray booth.

[0103] It has been found that spraying the coating horizontally is necessary specifically for twin-wire fence panels to obtain sufficient coating on the pairs of horizontal wires. Moreover, it has been found that spraying the coating horizontally ensures that there are fewer coating losses. Since the twin-wire fence panels are positioned horizontally, more support points are needed than, for example, when they are sprayed in suspended condition. This makes avoiding refinishing these supporting points very important, as it is very labor intensive to refinish every support point of every twin-wire fence panel.

[0104] In one embodiment, powder and therefore powder particles are sprayed onto the twin-wire fence panels in each spray booth by means of spraying means. The powder hereby adheres to the twin-wire fence panels through electrostatic forces. The powder particles are transported by an air stream to the spraying means. They receive an electrostatic charge and thus adhere to the grounded twin-wire fence panels through electrostatic forces. In a preferred embodiment, the spraying means sprays the powder in an upward vertical direction, i.e. the opposite direction of gravity, preferably perpendicular to the horizontal plane. In this process, the powder is atomized into a powder cloud, causing the double-wire fence panels to move.

[0105] The spraying means are preferably spray guns, more preferably the spraying means are triboelectric powder coating guns. The tribo-gun contains a friction system through which powder is guided and that comes out of the gun positively charged.

[0106] In a preferred embodiment, the spraying means spray the powder onto the twin-wire fence panels at a spraying speed of 2-8 m/min, preferably 3-7 m/min, more preferably 4-6 m/min.

[0107] In a preferred embodiment, the application of the coating comprising epoxy (step i) and the application of the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester (step ii), is done in two layers, such that each coating comprises two coating sublayers.

[0108] In a specific embodiment, the twin-wire fence panels are supplied substantially horizontally into two sequential spray booths, so that a second spray booth is positioned downstream of a first spray booth, whereby one coating sublayer is deposited on the twin-wire fence panels in each spray booth.

[0109] Feeding preferably takes place by means of guide means which guide the twin-wire fence panels substantially horizontally through the first and then through the second spray booth. The guide means preferably make a minimum number of contact points, i.e. support points, with the twin-wire fence panels or have a minimum contact surface with the twin-wire fence panels. This is because the contact points ensure that the twin-wire fence panels cannot be covered with powder in those areas. Therefore, the guide means can for instance comprise two narrow guide means, such as conveyor belts, which support two opposite sides of a twin-wire fence panel.

[0110] The use of two spray booths ensures that the layer thickness can be better controlled. As a result, the spraying means also have to process less powder per time unit, so that the spraying means last longer.

[0111] In one embodiment, the guide means are suitable for advancing the twin-wire fence panels through the spray booths at a constant speed between 1 and 10 m/min, preferably between 5 and 7.5 m/min.

[0112] In a preferred embodiment, prior to the application of the second coating sublayer, the powder of the first coating sublayer adhered to the vertical wires is blown away by means of air lances. In this case, the air lances are preferably only aimed at the vertical wires. In one embodiment, the powder is blown off all vertical wires simultaneously. In another embodiment, the powder is blown off the vertical wires one by one.

[0113] The preferred embodiment is advantageous because the powder adhered to the vertical wires is blown away by means of air lances after the application of the first coating sublayer, preferably after the first spray booth, so that a more uniform and thinner layer is obtained after spraying the second coating sublayer, preferably after spraying the coating sublayer in the second spray booth. A substantially equal coating thickness is hereby obtained on the vertical and horizontal wires.

[0114] In a preferred embodiment, approximately all powder on the vertical wires is blown away, so that the thickness of the coating sublayer present on the vertical wires after blowing is at most 5 μ m, preferably at most 4 μ m, more preferably at most 3 μ m, even more preferably up to 2 μ m, even more preferably up to 1 μ m, most preferably up to 0.1 μ m, or about 0 μ m.

[0115] In a further preferred embodiment, the air blown out of the air lances has a pressure between 1 and 2 bar,

preferably between 1 and 1.25 bar, more preferably about 1 bar.

[0116] In another or further preferred embodiment, the air is blown out of the air lances at a flow rate of between 100 and 600 m³/hour, preferably between 200 and 500 m³/hour, more preferably between 300 and 400 m³/hour.

[0117] In a preferred embodiment, the ratio of the coating thickness on the vertical wires to the coating thickness on the horizontal wires is at most 2.2/1, preferably at most 2/1, more preferably at most 1.8/1, even more preferably at most 1.6/1, even more preferably at most 1.4/1, even more preferably at most 1.2/1, most preferably at most 1.1/1. In a further or other preferred embodiment, the ratio of the coating thickness on the vertical wires to the coating thickness on the horizontal wires is at least 1/2.2, preferably at least 1/2, more preferably at least 1/1.8, even more preferably at least 1/1.6, even more preferably at least 1/1.4, even more preferably at least 1/1.2, most preferably at least 1/1.1. In a further preferred embodiment, the ratio of the coating thickness on the vertical wires to the coating thickness on the horizontal wires is between 2.2/1 and 1/2.2, preferably between 2/1 and 1/2, more preferably between 1.8/1 and 1/1.8, even more preferably between 1.6/1 and 1/1.6, even more preferably between 1.4/1 and 1/1.4, even more preferably between 1.2/1 and 1/1.2, most preferably between 1.1/1 and 1/1.1.

[0118] In a preferred embodiment, the twin-wire fence panels are stove-enameled following the application of the coating sublayers.

[0119] In a preferred embodiment, a plurality of parallel stacked horizontally positioned twin-wire fence panels are stove-enameled simultaneously.

[0120] In a preferred embodiment, the stove-enameled of the twin-wire fence panels continues in one or more ovens, preferably one oven.

[0121] In a preferred embodiment, the twin-wire fence panels have a residence time between 15 and 30 minutes, preferably between 20 and 28 minutes per oven.

[0122] In a preferred embodiment, the one or more ovens, preferably one oven, operate at an air temperature between 160 and 240°C, preferably between 180 and 220°C.

[0123] In one embodiment, the twin-wire fence panels are visually checked after stove-enameled, by one or more operators and/or checked on the basis of a layer thickness gauge or by weighing.

[0124] In a specific preferred embodiment, a coating is applied by means of the steps of:

- a. feeding one or more twin-wire fence panels into two sequential spray booths substantially horizontally, such that a second spray booth is positioned downstream of a first spray booth, wherein in each spray booth a powder is sprayed onto the twin-wire fence panels by means of spraying means, and wherein the powder adheres to the wires of the twin-wire fence panels through electrostatic forces, so that a coating sublayer is obtained; and
- b. stove-enameled the twin-wire fence panels in one or more ovens.

[0125] In a further embodiment, in step (a), before the one or more twin-wire fence panels are fed into the second spray booth, the powder adhered to the vertical wires is blown away by means of air lances.

[0126] In a specific preferred embodiment, the method comprises the steps of:

- i. applying a coating comprising epoxy to the one or more twin-wire fence panels, wherein the application of the coating takes place through the steps of:

- a. feeding one or more twin-wire fence panels into a first pair of sequential spray booths substantially horizontally such that a second spray booth is positioned downstream of a first spray booth, wherein in each spray booth a powder is sprayed onto the twin-wire fence panels by means of spraying means, and wherein the powder adheres to the wires of the twin-wire fence panels through electrostatic forces, so that a coating sublayer is obtained; and
- b. stove-enameled the twin-wire fence panels in one or more ovens; and

- ii. applying a coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, to the one or more twin-wire fence panels, wherein the coating is applied by means of the steps of:

- c. feeding one or more twin-wire fence panels into a second pair of sequential spray booths substantially horizontally such that a second spray booth is positioned downstream of a first spray booth, wherein in each spray booth a powder is sprayed onto the twin-wire fence panels by means of spraying means, and wherein the powder adheres to the wires of the twin-wire fence panels through electrostatic forces, so that a coating sublayer is obtained; and
- d. stove-enameled the twin-wire fence panels in one or more ovens.

In a further embodiment, in step (a) and (c), before the one or more twin-wire fence panels are fed into the second spray booth, the powder adhered to the vertical wires is blown away by means of air lances.

[0127] When the coating is applied by powder coating, it is clear that the coatings according to the present invention are applied as a powder on the metal surface. The powder comprises one or more components that form a protective coating on the object when heated.

[0128] In one embodiment, the D50 particle size of the coating comprising a polymer selected from the list of: a polyamide, a polyolefin, a polyester, or a combination thereof, preferably a polyester, is between 1 and 100 μm , preferably between 10 and 90 μm , more preferably between 20 and 80 μm , even more preferably between 30 and 70 μm , even more preferably between 40 and 60 μm , most preferably between 45 and 55 μm .

[0129] In one embodiment, the D50 particle size of the coating comprising an epoxy is between 1 and 70 μm , preferably between 10 and 60 μm , more preferably between 20 and 50 μm , most preferably between 30 and 40 μm .

[0130] In a preferred embodiment, the method is suitable for producing twin-wire fence panels according to the first aspect.

[0131] In what follows, the invention is described by way of non-limiting examples illustrating the invention, and which are not intended to and should not be interpreted as limiting the scope of the invention.

EXAMPLES

[0132]

Figure 1 shows a perspective view of a twin-wire fence panel.

Figure 2 shows an enlarged perspective view of a twin-wire fence panel (section A in **Figure 2**).

[0133] **Example 1** concerns a twin-wire fence panel, as shown in **Figure 1** and **Figure 2**, which can be coated according to the method of the first aspect.

[0134] A twin-wire fence panel (108) consists of parallel vertical wires (104) welded to horizontal wires (101, 102) with the vertical wires welded at any height between two horizontal wires (101, 102) forming a double pair (103). The distance between two adjacent vertical wires (106) is about 50 mm c.t.c. The distance between the adjacent horizontal wires (105) is about 200 mm c.t.c.

[0135] It will be apparent to a person skilled in the art that the names of the wires in the twin-wire fence panel, namely "horizontal wires" and "vertical wires," are relative terms. The terms "horizontal wires" and "cross wires" refer to the wires or bars which, in a working form (installed condition) of the twin-wire fence panel, are positioned substantially horizontally with respect to the surface on which the fencing is positioned upright. The horizontal wires therefore correspond to the length of the twin-wire fence panel. The terms "vertical wires" and "longitudinal wires" refer to the wires or bars that, in a working form (installed condition) of the twin-wire fence panel, are positioned substantially vertically relative to the surface on which the fencing is positioned upright. The vertical wires therefore correspond to the height of the twin-wire fence panel. The horizontal wires and vertical wires are thus positioned perpendicular to each other.

[0136] When the twin-wire fence panel is positioned substantially horizontally during coating, both the horizontal wires and the vertical wires lie substantially in a plane parallel to the ground surface, still positioned perpendicular to each other.

[0137] **Example 2** concerns an embodiment of the method according to the second aspect. For clarification, reference is made to **Figure 3**. In a first coating step (200), ungalvanized twin-wire fence panels are fed (201) substantially horizontally to a first spray booth (202) in which powdered zinc epoxy, with a D50 = 30-40 μm , is sprayed onto the twin-wire fence panels by means of triboelectric powder coating guns, such that the powder is electrically charged through the triboelectric effect. In this example, the zinc epoxy comprises an epoxy obtained after polymerization of diglycidyl ether and bisphenol A. Before spraying the zinc epoxy powder, the twin-wire fence panels are grounded, i.e. connected to a zero potential. The guns spray the zinc epoxy powder at a spraying speed of 4-6 m/min onto the twin-wire fence panels. The twin-wire fence panels remain in the first spray booth for between 20 and 28 seconds. Subsequently, the zinc epoxy powder adhered to the vertical wires is blown away (203) so that a maximum of 1 μm , and preferably about 0 μm , of epoxy powder is present on the vertical wires. Subsequently, the twin-wire fence panels are passed through (204) to a second spray booth (205). The triboelectric powder coating guns spray the powder with a spraying speed of 4-6 m/min onto the twin-wire fence panels. The twin-wire fence panels remain in the second spray booth (205) for between 20 and 28 seconds. The twin-wire fence panels are then stove-enameled in an oven to harden the coating (206). Zinc epoxy coated ungalvanized twin-wire fence panels are obtained (207) comprising horizontal wires with a zinc epoxy coating with a thickness of approximately 70 μm and vertical wires with a zinc epoxy coating with a thickness of approximately 70 μm .

[0138] In a second coating step (300), the twin-wire fence panels are fed substantially horizontally (301) to a first spray booth (302) in which polyester in powder form, with a D50 = 50 μm , is sprayed onto the twin-wire fence panels by means of triboelectric powder coating guns, such that the powder is electrically charged through the triboelectric effect. In this

example, the polyester is a polyether polyester, such as obtained after polycondensation of terephthalic acid diglycidyl ester and trimellitic acid triglycidyl ester. Before spraying the polyester powder, the twin-wire fence panels are grounded, i.e. connected to a zero potential. The guns spray the polyester powder at a spraying speed of 4-6 m/min onto the twin-wire fence panels. The twin-wire fence panels remain in the first spray booth for between 20 and 28 seconds. Subsequently, the polyester powder adhered to the vertical wires is blown away (303) so that a maximum of 1 μ m of polyester powder is present on the vertical wires. Subsequently, the twin-wire fence panels are passed through (304) to a second spray booth (305). The triboelectric powder coating guns spray the polyester powder with a spraying speed of 4-6 m/min onto the twin-wire fence panels. The twin-wire fence panels remain in the second spray booth (305) for between 20 and 28 seconds. The twin-wire fence panels are then stove-enameled in an oven to harden the coating (306). A zinc epoxy+polyester coated ungalvanized twin-wire fence panel is obtained (307), comprising horizontal wires with a zinc epoxy coating with a thickness of approximately 70 μ m and a polyester coating with a thickness of approximately 50 μ m and vertical wires with a zinc epoxy coating with a thickness of about 70 μ m and a polyester coating with a thickness of about 50 μ m.

[0139] Example 3 concerns an embodiment of the method according to the second aspect, as described in Example 2. In this embodiment, the position of the support points is changed between the two coating steps.

[0140] This prevents no coating at all from ending up on the contact points made by the twin-wire fence panels on the support points, which means that manual refinishing has to be done afterwards.

[0141] The zinc epoxy coating is advantageous here because the zinc particles ensure that grounding on the new support points is still possible by increasing the conductivity of the epoxy.

[0142] The inventors found that the zinc epoxy coating results in twice as good conductivity compared to an epoxy without zinc. The method according to the invention also avoids the problem of "sparking" in case of poor conductivity by the use of this zinc epoxy.

[0143] The present invention should not be construed as being limited to the embodiments described above and certain modifications or changes may be added to the examples described without having to re-evaluate the appended claims. For example, the present invention has been described with reference to a twin-wire fence panel with seven pairs of horizontal wires, but it should be understood that the invention can be applied to e.g. a twin-wire fence panel with 7 pairs of horizontal wires or 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 pairs of horizontal wires.

Example 4-11: electrical resistance measurements

[0144] Resistance measurements were performed on test plates coated with 0% zinc epoxy (Examples 4-7) and zinc epoxy with a zinc content of 5 m% (Examples 8-11).

[0145] The test plates were coated with a layer thickness of 45-50 μ m, and the resistance was measured with a test voltage of 5000 V over two measuring points on the test plate located 15 mm apart. The results are shown in **Table 1**. This shows that the electrical resistance in an epoxy coated test plate is much higher than the electrical resistance in a zinc epoxy coated test plate. It is clear that adding zinc to the epoxy ensures that the electrical current is less obstructed and thus the conductivity is increased.

TABLE 1

Example	Resistance measurement in T Ω
4	15.00 (maximum value of the measuring device)
5	15.00 (maximum value of the measuring device)
6	11.82
7	14.41
8	5.60
9	7.36
10	3.11
11	3.70

Example 12-16: electrical resistance measurements

[0146] Resistance measurements were carried out in quadruplicate on test plates coated with epoxy with 0% zinc (ex. 12) and zinc-epoxy with a zinc content of 0.5 m% (ex. 13), 1 m% (ex. 14), 5 m% (ex. 15) and 15 m% (ex. 16).

[0147] The test plates were provided with a coating with a layer thickness of 45-50 μ m, and the resistance was

measured with a measuring voltage of 5000 V across two measuring points on the test plate located 15 mm apart. The results are shown in **Table 2**. This shows that the electrical resistance in an epoxy-coated test plate is much higher than the electrical resistance in a zinc-epoxy coated test plate. The advantageous lower limit is 1 m% because it has been shown that a resistance $<10 \text{ T}\Omega$ is required to obtain sufficient grounding of the panel.

TABLE 2

Example	m% zinc	Resistance measurement in $\text{T}\Omega$
12	0	15.00 (maximum value of the measuring device)
	0	15.00 (maximum value of the measuring device)
	0	15.00 (maximum value of the measuring device)
	0	15.00 (maximum value of the measuring device)
13	0.5	15.00 (maximum value of the measuring device)
	0.5	13.31
	0.5	15.00 (maximum value of the measuring device)
	0.5	11.20
14	1	9.51
	1	8.14
	1	10.20
	1	9.45
15	5	5.60
	5	7.36
	5	3.11
	5	3.70
16	15	0.15
	15	0.14
	15	0.18
	15	0.13

Example 17-23: Sparking during the coating process

[0148] Examples 17 to 23 concern experiments regarding how many panels show "sparks" during the coating process, performed with zinc epoxies with different percentages of zinc. This sparking thus occurs if the grounding is not sufficient.

[0149] The percentage of panels that show sparks during the coating process is advantageously below 5%. Experimentally, 1 m% zinc appears to be a preferable lower limit.

TABLE 3

Example	m% zinc	Number of panels tested	Number of panels with sparks	Percentage of panels with sparks
17	0	50	11	22%
18	0.5	75	7	9.3%
19	0.75	50	4	8%
20	1	100	2	2%
21	1.5	75	1	1.3%
22	2	100	1	1%

(continued)

Example	m% zinc	Number of panels tested	Number of panels with sparks	Percentage of panels with sparks
23	5	50	0	0%

Claims

1. A twin-wire fence panel provided with two or more coatings, wherein a twin-wire fence panel consists of parallel vertical and parallel horizontal wires, wherein the vertical wires are welded at the same height between a pair of horizontal wires, the two or more coatings comprising:

- at least one coating comprising an epoxy, and
- at least one coating comprising a polyester,

characterized in that the epoxy is a zinc epoxy comprising a zinc content between 1 and 30 m%.

2. Twin-wire fence panel according to claim 1, wherein the coating comprising an epoxy has a coating thickness comprised between 40 and 180 μ m, preferably between 50 and 80 μ m.

3. Twin-wire fence panel according to any one of the preceding claims, wherein the coating comprising polyester has a coating thickness comprised between 30 and 120 μ m, preferably between 40 and 60 μ m.

4. Twin-wire fence panel according to any one of the preceding claims, wherein the coating thickness of the coating comprising an epoxy and the coating thickness of the coating comprising polyester are in a ratio of between 0.4 and 3, preferably between 0.8 and 2.

5. Twin-wire fence panel according to any one of the preceding claims, wherein the hardness of the coating comprising epoxy is at least 100 Buchholz resistance units (BH).

6. Twin-wire fence panel according to any one of the preceding claims, wherein the hardness of the coating comprising polyester is between 80 and 100 Buchholz resistance units (BH).

7. A method of coating one or more twin-wire fence panels, wherein a twin-wire fence panel consists of parallel vertical and parallel horizontal wires, wherein the vertical wires are welded at the same height between a pair of horizontal wires, comprising the steps of:

- i. applying a first coating comprising epoxy to the one or more twin-wire fence panels; and
- ii. applying a second coating comprising polyester to the one or more twin-wire fence panels;

characterized in that the epoxy is a zinc epoxy comprising a zinc content between 1 and 30 m%.

8. Method according to claim 7, wherein the application of the first and the second coating takes place by means of powder coating, preferably triboelectric powder coating.

9. Method according to claim 7 or 8, wherein the twin-wire fence panels are coated in a substantially horizontal position, wherein the twin-wire fence panels are positioned on four or more support points.

10. Method according to claim 9, wherein the support points in step (i) are different from the support points in step (ii).

11. Method according to any one of claims 7-10, wherein the application of the first (step i) and the second (step ii) coating takes place in two layers, such that each coating consists of two coating sublayers.

12. Method according to claim 7-11, wherein a coating is applied by means of the steps of:

- a. feeding one or more twin-wire fence panels substantially horizontally into two sequential spray booths, such

that a second spray booth is positioned downstream of a first spray booth, wherein in each spray booth a powder is sprayed onto the twin-wire fence panels by means of spraying means, and wherein the powder adheres to the wires of the twin-wire fence panels through electrostatic forces, so that a coating sublayer is obtained; and b. stove-enameling the twin-wire fence panels in one or more ovens.

5

13. Method according to claim 12, wherein prior to the feeding of the one or more twin-wire fence panels into the second spray booth, the powder adhered to the vertical wires is blown away by means of air lances.

10

14. Method according to claim 13, wherein the air blown from the air lances has a pressure between 1 and 2 bar, preferably between 1 and 1.25 bar, more preferably about 1 bar.

15

15. Method according to any one of claims 13-14, wherein the air is blown out of the air lances at a flow rate of between 100 and 600 m³/hour, preferably between 200 and 500 m³/hour, more preferably between 300 and 400 m³/hour.

20

25

30

35

40

45

50

55

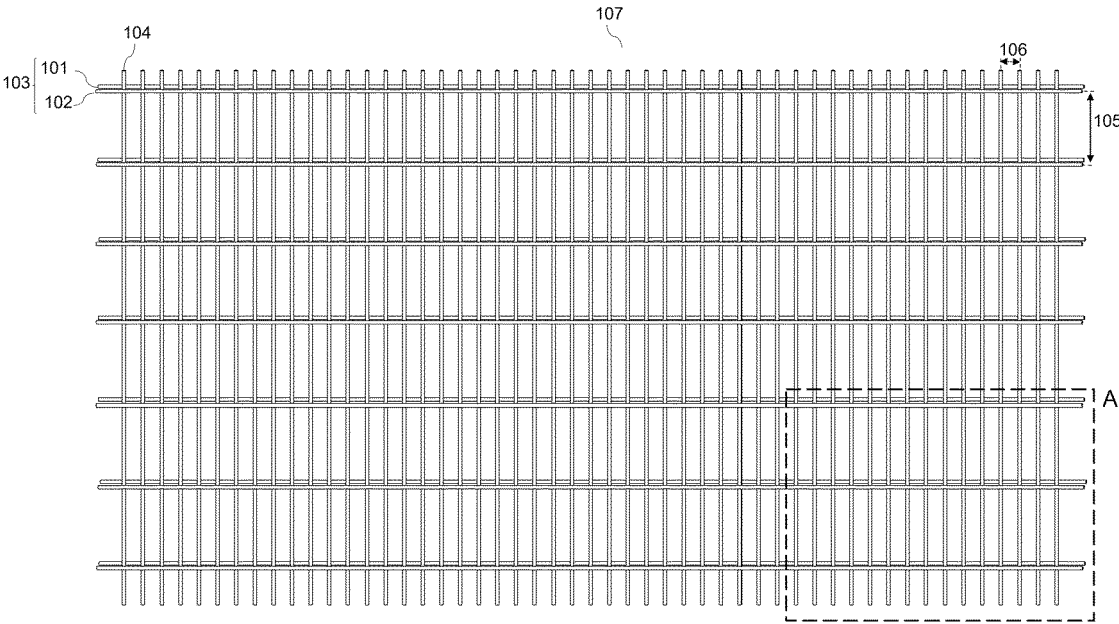


FIG. 1

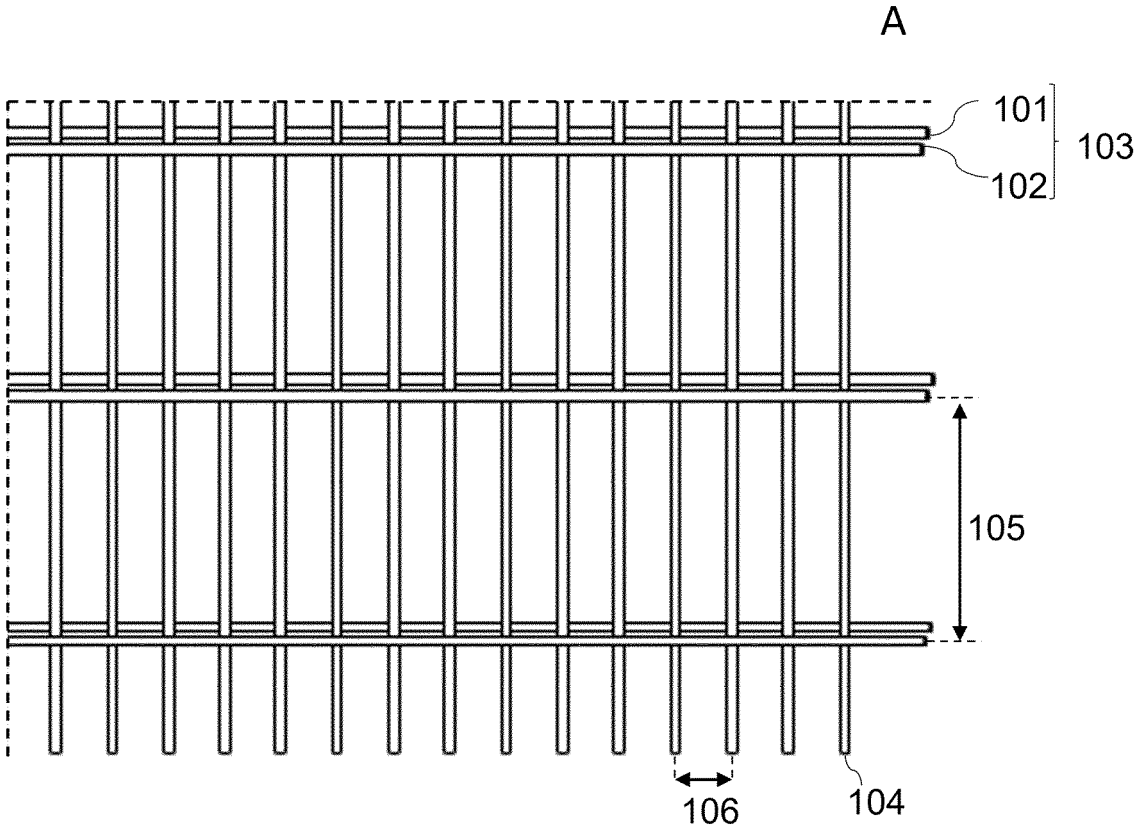


FIG. 2

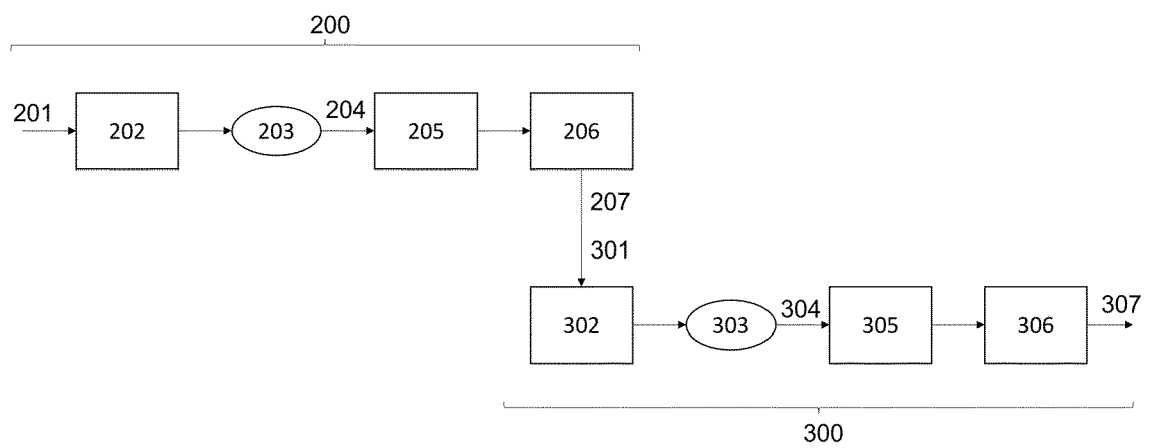


FIG. 3



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 0505

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	GB 1 239 951 A (ICI LTD [GB]) 21 July 1971 (1971-07-21) * page 2, line 36 - line 44 * * page 2, line 83 - line 88 * * page 8, line 110 - line 112 * -----	7-15	INV. E04H17/00 B21F27/00 B05B5/08 B05D7/14 B05D7/20 B05D7/00 B21F23/00
A	GB 1 239 952 A (ICI LTD [GB]) 21 July 1971 (1971-07-21) * page 3, line 43 - line 48 * * page 3, line 94 - line 97 * * page 3, line 105 - line 108 * -----	1-15	ADD. B05D3/04 B05D1/06
A	GB 2 263 423 A (PLASGALV LIMITED [IE]) 28 July 1993 (1993-07-28) * claims 7, 8 * -----	1-15	
X	CN 108 097 563 B (CHONGQING LIFAN DECORATION ENG CO LTD) 23 March 2021 (2021-03-23) * claims; examples * -----	1-6	
Y		7-15	TECHNICAL FIELDS SEARCHED (IPC)
A	CN 105 817 839 B (CHUZHOU BOHAO DOOR MFG CO LTD) 16 April 2019 (2019-04-16) * claims; examples * -----	1-15	E04H B21L B05D B21F
A	CN 111 992 475 A (POWERCHINA ROADBRIDGE GROUP CO LTD) 27 November 2020 (2020-11-27) * claims; examples * * par. before Ex. 1 ("the present invention replaces hot-dip galvanizing" * -----	1-15	
A	CN 113 042 341 A (ANHUI YISAN POLYMER MAT CO LTD) 29 June 2021 (2021-06-29) * claims; examples * ----- -/--	1-15	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 March 2024	Examiner Slembrouck, Igor
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 0505

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	Iso: "international standard ISO 2815:1973", , 15 December 1973 (1973-12-15), pages 1-8, XP093140470, Retrieved from the Internet: URL:https://cdn.standards.iteh.ai/samples/7812/cb9a13dd143a4199966331c07abelad1/ISO-2815-1973.pdf [retrieved on 2024-03-12] * the whole document * -----	5, 6	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		12 March 2024	Slembrouck, Igor
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 21 0505

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-03-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1239951 A	21-07-1971	NONE	
GB 1239952 A	21-07-1971	NONE	
GB 2263423 A	28-07-1993	BE 1003742 A6 GB 2263423 A	02-06-1992 28-07-1993
CN 108097563 B	23-03-2021	NONE	
CN 105817839 B	16-04-2019	NONE	
CN 111992475 A	27-11-2020	NONE	
CN 113042341 A	29-06-2021	NONE	