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(54) Titre : PROCEDE ELECTROLYTIQUE ET APPAREIL POUR LE TRAITEMENT DE SURFACE DE METAUX NON FERREUX

(54) Title: ELECTROLYTIC PROCESS AND APPARATUS FOR THE SURFACE TREATMENT OF NON-FERROUS METALS

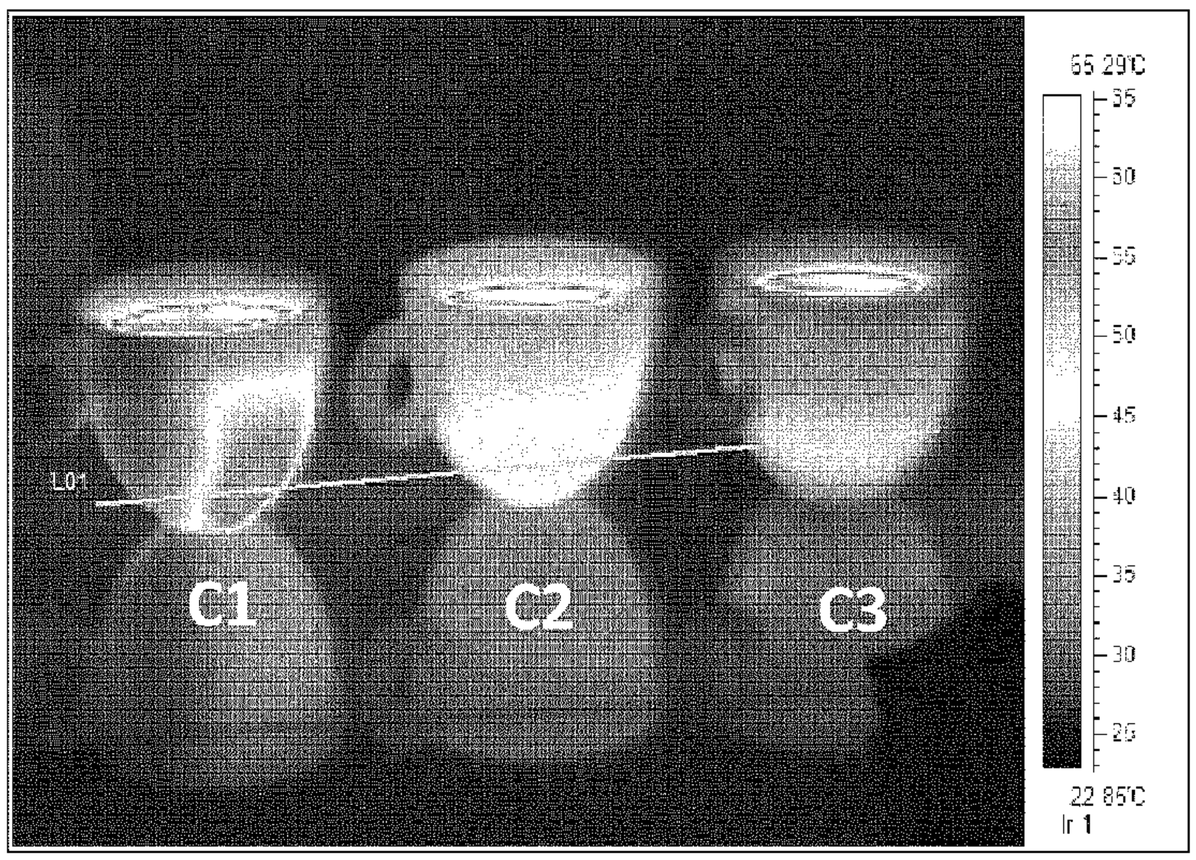

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FIG. 5

(57) Abrégé/Abstract:
An electrolytic process, an electrolytic solution and electrolytic assembly are disclosed, for anodizing in one main step non-ferrous metallic parts, or their alloys to form a coating. The electrolytic solution is free of toxic or harmful chemicals. Examples of treatable metals are aluminum, including cast aluminum, magnesium, hafnium, tantalum, titanium, vanadium, zinc, and zirconium. The treatment is preferably a one-step process since the cleaning and coating of the nonferrous metals are performed in the same electrolytic cell or tank and solution, preferably using the same electrical device for both actions. No preliminary steps like degreasing, de- smutting or activation are needed due to the absence of toxic acids or salts in the process. The process is therefore eco-friendly, easy to perform and provides excellent results. The non-ferrous metallic parts once coated can be used in the automotive or aircraft industries.

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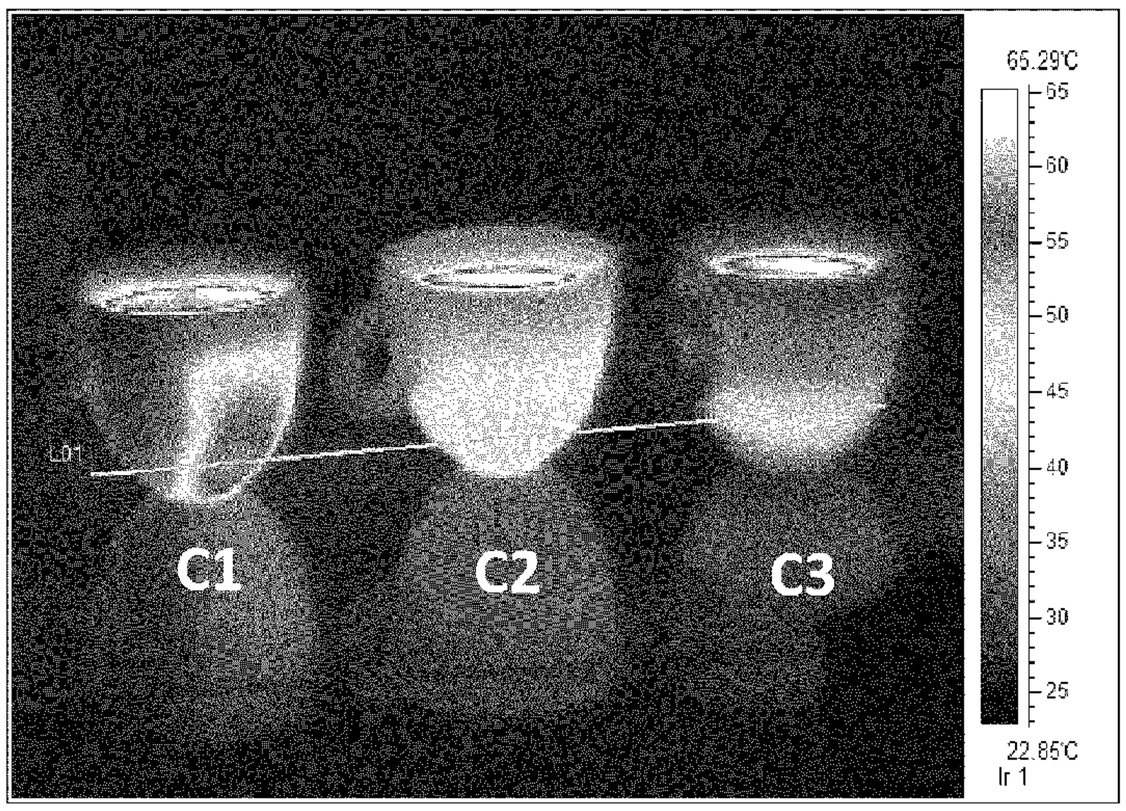

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FIG. 5

(57) Abstract: An electrolytic process, an electrolytic solution and electrolytic assembly are disclosed, for anodizing in one main step non-ferrous metallic parts, or their alloys to form a coating. The electrolytic solution is free of toxic or harmful chemicals. Examples of treatable metals are aluminum, including cast aluminum, magnesium, hafnium, tantalum, titanium, vanadium, zinc, and zirconium. The treatment is preferably a one-step process since the cleaning and coating of the non-ferrous metals are performed in the same electrolytic cell or tank and solution, preferably using the same electrical device for both actions. No preliminary steps like degreasing, de- smutting or activation are needed due to the absence of toxic acids or salts in the process. The process is therefore eco-friendly, easy to perform and provides excellent results. The non-ferrous metallic parts once coated can be used in the automotive or aircraft industries.

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WHAT IS CLAIMED IS:

1. A process for the electrolytic treatment of non-ferrous metallic parts, the process comprising the step of:

anodising the metallic parts by first applying a negative electric current to the non-ferrous metallic parts during a first given period of time and second applying a positive electric current during a second given period of time;

while maintaining the metallic parts in an electrolytic cell comprising an alkaline electrolytic solution having a pH from 9 to 12 and comprising at least one organic acid.

2. The process of claim 1, wherein the pH of said alkaline electrolytic solution is from 10 to 11.5.

3. The process of claim 1 or 2, wherein the process is performed by using a continuous current or a variously shaped pulsating current provided via a rectifier, said rectifier being optionally operatively connected to a harmonic filter.

4. The process of any one of claims 1 to 3, wherein the non-ferrous metallic parts comprises aluminum, magnesium, hafnium, tantalum, titanium, vanadium, zinc, zirconium, beryllium, scandium, yttrium, molybdenum, tungsten, alloys thereof or combinations thereof.

5. The process of any one of claims 1 to 4, wherein the process is free of chemical preliminary treatment before said electrolytic treatment.

6. The process of any one of claims 1 to 5, wherein the said first given period of time is selected according to the nature of the metal constituting the non-ferrous metallic parts under treatment and its final application.

7. The process of any one of claims 1 to 6, wherein the negative current is applied up to 10 minutes.

8. The process of any one of claims 1 to 7, wherein the negative current is applied up to 2 minutes.

9. The process of any one of claims 1 to 8, wherein the negative current has a current density of 0.5 to 5.0 A/dm^2.

10. The process of any one of claims 1 to 9, wherein the negative current has a current density of 2.0 A/dm^2.

11. The process of any one of claims 1 to 10, wherein the positive current is applied from 30 seconds to 60 minutes.

12. The process of any one of claims 1 to 11, wherein the positive current has a current density of 1 to 10 A/dm^2.

13. The process of any one of claims 1 to 12, wherein the positive current has a current density of about 2.0 A/dm^2.

14. The process of any one of claims 1 to 13, wherein the positive current has a voltage from 200 to 650 Volts.

15. The process of any one of claims 1 to 14, wherein the electrolytic solution is maintained at a temperature ranging between 5 and 40 °C.

16. The process of any one of claims 1 to 15, wherein the electrolytic solution is maintained at a temperature ranging between 15 and 20 °C.

17. The process of any one of claims 1 to 16, where the said at least one organic acid, or its salts, is present in a concentration of from 0.1 g/l up to solubility.

18. The process of any one of claims 1 to 17, where the said at least one organic acid, or its salts, is present in a concentration of 10 to 20 g/l.

19. The process of any one of claims 1 to 18, wherein the said at least one organic acid, or its salts, have a number n of atoms of C 7rom 1 to 20, linear or branched, and comprising from 0 to *m* hydroxyl groups, where *m* is a number from 0 to *(n-1)*.

20. The process of any one of claims 1 to 19, wherein the said at least one organic acid is carbonic acid, formic acid, acetic acid, hydroxyacetic acid, oxalic acid, citric acid, ethylenediaminotetraacetic acid or EDTA, or ascorbic acid, or its salts of alkali metals or of ammonium hydroxide obtained by the addition of alkali metals hydroxides or ammonia in the solution.

21. The process of any one of claims 1 to 20, wherein the pH is obtained by the addition in the solution of at least one alkali metal or ammonium hydroxide NH_3OH.

22. The process of claim 21, wherein the said at least one alkali metal is lithium, sodium or potassium.

23. The process of claim 21 or 22, wherein the said at least one alkali metal is present in a concentration range from 10 to 100 g/L.

24. The process of any one claim 21 to 23, wherein the said at least one alkali metal is present in a concentration range from 30 to 50 g/l.

25. The process of any one of claims 1 to 24, wherein the electrolytic solution further comprises phosphoric acid or its alkali metal salts, in a concentration up to about 20 g/l.

26. The process of any one of claims 1 to 25, wherein the electrolytic solution further comprises one or a mixture of tertiary alkanol amines in a concentration up to 75 g/l in the final solution.

27. The process of any one of claims 1 to 26, wherein the electrolytic solution further comprises aluminum hydroxide or an alkaline metal aluminate, in a concentration up to solubility in the final solution.

28. The process of any one of claims 1 to 27, wherein the electrolytic solution further comprises polyalcohols or glycols in a concentration up to 50 g/l in the final solution.

29. An electrolytic solution for use in a process for anodizing non-ferrous metallic parts, the electrolytic solution being an alkaline electrolytic solution having a pH from 9 to 12 and comprising at least one organic acid.

30. The electrolytic solution of claim 29, wherein the pH of said alkaline electrolytic solution is from 10 to 11.5.

31. The electrolytic solution of claim 29 or 30, where the said at least one organic acid, or its salts, is present in a concentration of from 0.1 g/l up to solubility.

32. The electrolytic solution of any one of claims 29 to 31, where the said at least one organic acid, or its salts, is present in a concentration of 10 to 20 g/l.

33. The electrolytic solution of any one of claims 29 to 32, wherein the said at least one organic acid, or salts thereof, have a number n of atoms of C from 1 to 20, linear or branched, and comprising from 0 to *m* hydroxyl groups, where *m* is a number from 0 to *(n-1)*.

34. The electrolytic solution of any one of claims 29 to 33, wherein the said at least one organic acid is carbonic acid, formic acid, acetic acid, hydroxyacetic acid, oxalic acid, citric acid, ethylenediaminotetraacetic acid or EDTA, or ascorbic acid, or its salts of alkali metals or ammonium hydroxide obtained by the addition of alkali metals hydroxides or ammonia in the solution.

35. The electrolytic solution of any one of claims 29 to 34, wherein the pH of the solution is obtained by the addition in the solution of at least one alkali metal or ammonium hydroxide NH_3OH.

36. The electrolytic solution of any one of claim 35, wherein the said at least one alkali metal is lithium, sodium or potassium.

37. The electrolytic solution of claim 35 or 36, wherein the said at least one alkali metal is present in a concentration range from 10 to 100 g/L.

38. The electrolytic solution of any one claim 35 to 37, wherein the said at least one alkali metal is present in a concentration range from 30-50 g/l.

39. The electrolytic solution of any one of claims 29 to 38, further comprising phosphoric acid or its alkali metal salts, in a concentration up to 20 g/l of the final solution.

40. The electrolytic solution of any one of claims 29 to 39, further comprising one or a mixture of tertiary alkanol amines in a concentration up to 75 g/l of the final solution.

41. The electrolytic solution of any one of claims 29 to 40, further comprising aluminum hydroxide or an alkali metal aluminate, in a concentration from up to solubility in the final solution.

42. The electrolytic solution of any one of claims 29 to 41, wherein the electrolytic solution further comprises polyalcohols or glycols in a concentration up to 50 g/l.

43. The electrolytic solution of any one of claims 29 to 42, wherein the non-ferrous metallic parts comprises aluminum, magnesium, hafnium, tantalum, titanium, vanadium, zinc, zirconium, beryllium, scandium, yttrium, molybdenum, tungsten, alloys thereof or combinations thereof.

44. Anodized non-ferrous metallic parts obtained by the process as defined in any one of claims 1 to 28.

45. The anodized non-ferrous metallic of claim 44, wherein the said non-ferrous metallic parts comprising a uniform anodized coating with a thickness up to about 20 µm.

46. The anodized non-ferrous metallic parts of claim 44 or 45, for use in the making of a transport vehicle.

47. The anodized non-ferrous metallic parts of claim 46, wherein the transport vehicle is an aircraft, an automobile or a train.

48. An electrolytic assembly for anodizing non-ferrous metallic parts, comprising:

a. an electrolytic cell configured to contain an electrolytic solution and to receive non-ferrous metallic parts for treatment, the cell having walls made of or lined with a material non-current-conductive;

b. at least one counter-electrode located in the cell along the walls thereof;

c. a hanging system supported by a main support frame located over the electrolytic cell, the hanging system being configured to clamp, hang and fly the non-ferrous metallic parts over the electrolytic cell, and also to dive the metallic parts into the electrolytic cell in a way that the parts are hanged in the cell at a minimum secure distance away from the at least one counter-electrode; and

d. an electrical power supply apparatus operatively connected to the counter-electrodes and the non-ferrous metallic parts, and configured to provide a negative current to the parts for a first period of time and a positive current to the parts for a second given period of time.

49. The electrolytic assembly of claim 48, wherein the walls of the cell are made of polypropylene (PP) or polyvinylchloride (PVC).

50. The electrolytic assembly of claim 48, wherein the walls of the cell are made of steel lined with polypropylene (PP) or polyvinylchloride (PVC).

51. The electrolytic assembly of any one of claims 48 to 50, wherein the hanging system comprises hanging bars spaced apart on a rail and configured to move along the rail, each hanging bar comprising at least one jig or clamp for attaching the non-ferrous metallic parts, the hanging bars and jigs or clamps being made of a conductive current material.

52. The electrolytic assembly of claim 51, wherein the conductive current material is aluminum or titanium.

53. The electrolytic assembly of any one of claims 48 to 52, wherein the hanging system is configured to hang the non-ferrous metallic parts in a middle section of the electrolytic cell, the minimum secure distance between the non-ferrous metallic parts and the counter-electrodes being from 10 to 50 cm.

54. The electrolytic assembly of any one of claims 48 to 53, wherein the counter electrodes placed on long sides of the cell's inner walls are made of stainless steel, aluminium or titanium.

55. The electrolytic assembly of claim 54, wherein the counter electrodes cover at least 75% of the long sides of the cell's walls.

56. The electrolytic assembly of any one of claims 48 to 55, further comprising a cooling system operatively connected to the electrolytic ell to maintain the electrolytic solution at a temperature ranging from 5 to 40 °C.

57. The electrolytic assembly of any one of claims 48 to 56, wherein the electrical power supply apparatus is an electrical rectifier.

58. The electrolytic assembly of any one of claims 48 to 57, wherein the electrical power supply apparatus is a pulse electrical rectifier with an electronic polarity reversal.

59. The electrolytic assembly of any one of claims 48 to 58, wherein the electrical power supply apparatus is operatively connected to a harmonic filter.

60. The electrolytic assembly of any one of claims 48 to 59, wherein the electrical power supply apparatus is controlled by a programmable logic controller (PLC) or a host computer.