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(54) Title: *METHOD OF PRINTING ON ANODISED ALUMINIUM*

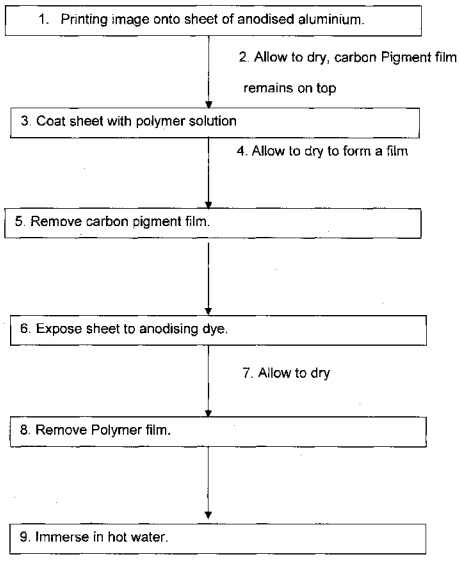

Figure 1

(57) Abstract: The invention relates to a printing process for printing an image directly onto the porous surface of a sheet of anodised aluminium, the process comprising the steps of depositing an ink directly onto the porous surface of a sheet of anodised aluminium to form a printed image, drying the ink, leaving a film of solid micro-particles on the surface of the sheet of anodised aluminium, coating the sheet with a film forming polymer solution, and allowing to dry, removing the solid micro-particle film from the top of the porous surface and exposing the sheet to anodising dye.

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METHOD OF PRINTING ON ANODISED ALUMINIUM

TECHNICAL FIELD OF THE INVENTION

This invention relates to a method of printing on anodised aluminium, and to apparatus for printing on anodised aluminium.

BACKGROUND ART

Aluminium and Aluminium based alloys are commonly used for signs, labels and asset tags. A number of processes are known for printing on Aluminium, and specifically on anodised aluminium, the surface of which comprises an open pore oxide layer, capable of absorbing the printing medium during the printing process.

The methods commonly known in the art include photolithographic printing, which utilises photoresist masks, screen printing and sublimation. However, all these methods are time consuming, complicated and the photolithographic method in particular requires expensive machinery.

Furthermore, where variable data is required to be printed- for example barcodes on asset tags, the screen printing method is not ideal, as a new screen is required for each new barcode.
It is an object of this invention to provide a method of printing on anodised aluminium and apparatus for printing on anodised Aluminium which, at least partially, alleviates some of the abovementioned problems.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a process for printing on anodised aluminium, the process comprising the steps of:
depositing an ink consisting of a liquid suspension of solid micro-particles directly onto the porous surface of a sheet of anodised aluminium to form a printed image;
allowing the liquid suspension to dry, leaving a film of solid micro-particles on the surface of the sheet of anodised aluminium;
coating the sheet with a film forming polymer solution, and allowing to dry;
removing the solid micro-particle film from the top of the porous surface and
exposing the sheet to anodising dye.

Inkjet technology may be used to print the image onto the sheet of anodised aluminium.

The ink is preferably a pigment-based ink. The solid micro particles of pigment in the pigment-based ink are too large to enter the anodised pores of the anodised aluminium, and remain as a film on top of the sheet, sealing off the anodised pores below. It is preferable for the pigment-based ink to comprise carbon particles and for the film of solid micro-particles to be a carbon film.

The polymer solution may include any inert polymer such as, but not limited to a polyurethane or acrylic polymer dissolved in an appropriate solvent, such as ethanol, isopropanol, benzene or acetone.

Coating the anodised sheet with the polymer seals off the remaining exposed porous areas, not covered by the solid micro-particles.

Removal of the film of micro-particles once the polymer film has dried may be accomplished by wiping the film of micro-particles off with water or suitable solvent, thus exposing the pores that were previously sealed off by the micro-particles.

On removal of the film of micro-particles, only the polymer film will remain to protect the pores sealed off by it from being exposed to the anodising dye.

The sheet may then be soaked in a bath of anodising dye as known in the art, allowing the exposed pores to be dyed.

Once the sheet has been exposed to the anodising dye, the polymer film may be removed using a relevant solvent such as acetone or thinners, and the dyed sheet may be sealed by one of a number of means known in the art. In a preferred embodiment of the invention, the dyed sheet is sealed by immersing in hot water, which causes the anodised pores to close.

It is envisaged that the above process can additionally be combined with a screen print process as known in the art where relevant, such as where it is required to print multiple colours.

The invention also extends to apparatus for printing on anodised aluminium, the apparatus including at least two of the following: means for applying a liquid suspension of solid micro-particles onto the porous surface of a sheet of anodised aluminium, means for applying a polymer film to the printed sheet of anodised aluminium, means for removing the micro-particle film from the

top of the porous surface once the polymer film has dried, and means for exposing the sheet to anodising dye.

The suspension of solid micro-particles is preferably a suspension of pigment-based ink, further preferably a carbon ink, and the apparatus for applying the pigment-based ink is preferably an inkjet printer.

The polymer film may be applied by one of a number of means, including dipping the sheet into the diluted polymer, or spraying a fine film of polymer solution over the sheet.

The drying means may include hot air blowers or infrared heaters

The micro-particle film may be removed using one or more of a number of means, including a damp cloth, a soft scourer, a buffing machine or a high pressure jet.

The means for exposing the sheet to anodising dye may include an anodising dye bath. It is preferable for the bath to be heated.

In a preferred embodiment of the invention, at least a part of the process is automated, and a conveyor system may be employed to move the anodised sheets through at least the first stages of the process. In this embodiment an inkjet printer will be employed to apply a carbon ink to the anodised sheets before they are conveyed through a dryer to dry the film of carbon particles, a spray coater for applying a polymer film, another dryer and a high pressure sprayer for removal of the carbon film. The sheets may then be moved to an anodising bath for dying prior to removal of the polymer film by application of a solvent and finally sealing of the dyed sheet.

The invention further extends to anodized aluminium work pieces produced in accordance with the above process.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention is described below by way of example only and with reference to the following drawings, in which;
Figure 1 is a flow diagram, showing the steps of the process;
Figure 2 is a representation of an anodised sheet to which the ink has been applied;
Figure 3 is a representation of the anodised sheet to which the polymer film has been applied;
Figure 4 is a representation of the anodised sheet from which the ink has been removed.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, the printing process includes the following steps;

1. Printing an image directly onto the porous surface of a sheet of anodised aluminium using a pigment-based ink and ink jet technology. Referring to figure 2, the solid micro-particles of pigment 10 in the pigment based ink are approximately 0.05 to 0.2 micro meter in diameter, and as such are too large to enter the anodised pores 12 of the anodised aluminium sheet 14 which are approximately 100 to 250 angstroms in diameter. As a result, the micro-particles of pigment 10 remain as a film on the surface of the anodised sheet 14, sealing off the anodised pores 12 below. In a preferred embodiment of the invention, the pigment ink is a carbon ink, as carbon does not bond with the polymer film. As a result, the ink used will ordinarily be black;

2. Allowing the liquid portion of the ink 16 to be absorbed into the porous surface, and allowing the pigment remaining behind on the surface of the sheet to dry leaving a film of pigment 10 on top. The liquid portion 16 comprises water, alcohol and other chemicals including glycerine, surfactants and anti-fungal agents;

3. Coating the sheet with a polymer solution 18. The polymer solution may include any inert polymer such as polyurethane or acrylic polymer dissolved in an appropriate solvent, such as ethanol, isopropanol, benzene or acetone. The polymer solution should comprise a polymer that is capable of temporarily sealing the exposed pores, while also being removable with the aid of a suitable solvent when required. In addition the polymer should cross-link when drying.

Referring to Figure 3, by coating the anodised sheet 14 with the polymer 18, the remaining exposed porous areas 20, not covered by the carbon particles 10, in other words the non printed areas, are sealed;

4. Allowing the polymer solution18 to dry, forming a film.

5. Removing the carbon pigment film 10 from the top of the porous surface 14. This may be accomplished by wiping the carbon film 10 off using water or a solvent, thus exposing the pores 12 that were previously sealed off by the carbon particles.

Referring to Figure 4, by removing the carbon film 10, only the polymer film 18 will remain. In this way, a print negative is formed, with the areas not to be printed on being protected by the polymer

film 18 which seals the relevant pores 20, while the pores 16 previously covered by the carbon pigment 10 are now open.

6. Exposing the sheet to anodising dye. The sheet is soaked in a bath of anodising dye as known in the art, at a temperature of between 25°C and 60°C for about 30 minutes, allowing the dye 22 to penetrate the exposed pores.

7. Allowing the dyed sheet to dry.

8. Removing the polymer film using a relevant solvent such as acetone or thinners.

9. Sealing the dyed sheet by immersing in hot water, causing the anodised pores to close. Typically this would involve soaking the sheets in water of up to 95 degrees Celsius for about 45 minutes. The sheets may be soaked at lower temperatures if additives are used.

In an alternative embodiment, the above process can additionally be combined with a screen print process as known in the art where relevant, for instance, where it is required to print multiple colours. The variable data such as bar codes can be printed using the technology of the invention, while the fixed data, such as a corporate logo can be printed using known screen printing technology.

Numerous modifications to this embodiment are possible, without departing from the scope of the invention.

The invention therefore provides a novel process for printing on anodised aluminium.

CLAIMS:

1. A process of printing on anodised aluminium, characterised in that the process comprises the steps of:
   depositing an ink consisting of a liquid suspension of solid micro-particles directly onto the porous surface of a sheet of anodised aluminium to form a printed image;
   allowing the liquid suspension to dry, forming a film of solid micro-particles on the surface of the sheet of anodised aluminium;
   coating the sheet with a film forming polymer solution, and allowing to dry;
   removing the solid micro-particle film from the top of the porous surface and exposing the sheet to anodising dye.

2. The process of printing on anodised aluminium as claimed in claim 1 characterised in that Inkjet technology is used to print the image onto the sheet of anodised aluminium.

3. The process of printing on anodised aluminium as claimed in either of claims 1 or 2 characterised in that the ink is a pigment-based ink.

4. The process of printing on anodised aluminium as claimed in claim 3 characterised in that the pigment-based ink comprises carbon particles.

5. The process of printing on anodised aluminium as claimed in any of claims 1 to 4 characterised on that the film of solid micro-particles is a carbon film.

6. The process of printing on anodised aluminium as claimed in claim 1 characterised in that the polymer solution comprises any inert polymer including, but not limited to a polyurethane or acrylic polymer dissolved in an appropriate solvent, including but not limited to ethanol, isopropanol, benzene or acetone.

7. The process of printing on anodised aluminium as claimed in claim 1 characterised in that the film of solid micro-particles is removed by wiping off the film of micro-particles with water or a suitable solvent.

8. The process of printing on anodised aluminium as claimed in claim 1 characterised in that the sheet is soaked in a bath of anodising dye as known in the art, allowing the exposed pores to be dyed.

9. The process of printing on anodised aluminium as claimed in claim 1 characterised in that it includes the step of removing the polymer film using a relevant solvent such as acetone or thinners.

10. The process of printing on anodised aluminium as claimed in claim 1 characterised in that the dyed sheet is sealed by one of a number of sealing means known in the art.

11. The process of printing on anodised aluminium as claimed in any of claims 1 to 10, characterised in that at least a part of the process is automated.

12. The process of printing on anodised aluminium as claimed in claim 11 characterised in that a conveyor system is employed to move the anodised sheets through at least the first stages of the process.

13. Apparatus for use in the process of printing on anodised aluminium as claimed in any of claims 1 to 12, characterised in an inkjet printer is employed to apply a carbon ink to the anodised sheets.

14. Apparatus for use in the process of printing on anodised aluminium as claimed in any of claims 1 to 13 characterised in that the means for drying the film of carbon particles includes hot air blowers and/or infrared heaters.

15. Apparatus for use in the process of printing on anodised aluminium as claimed in any of claims 1 to 14 characterised in that a spray coater is employed for the application of a polymer solution to the anodised sheet.

16. Apparatus for use in the process of printing on anodised aluminium as claimed in any of claims 1 to 15 characterised in that the means for drying the polymer solution to form a polymer film includes hot air blowers and/or infrared heaters the polymer film.

17. Apparatus for use in the process of printing on anodised aluminium as claimed in any of claims 1 to 16 characterised in that the means removing the carbon film from the sheets includes any of a damp cloth, a soft scourer, a buffing machine or a high pressure jet.

18. Apparatus for use in the process of printing on anodised aluminium as claimed in any of claims 1 to 17 characterised in that an anodising bath is employed to expose the sheet to anodising dye.

19. Apparatus as claimed in claim 18 characterised in that the bath is heated.

20. Anodized aluminium work pieces produced in accordance with the process of any of claims 1 to 12.

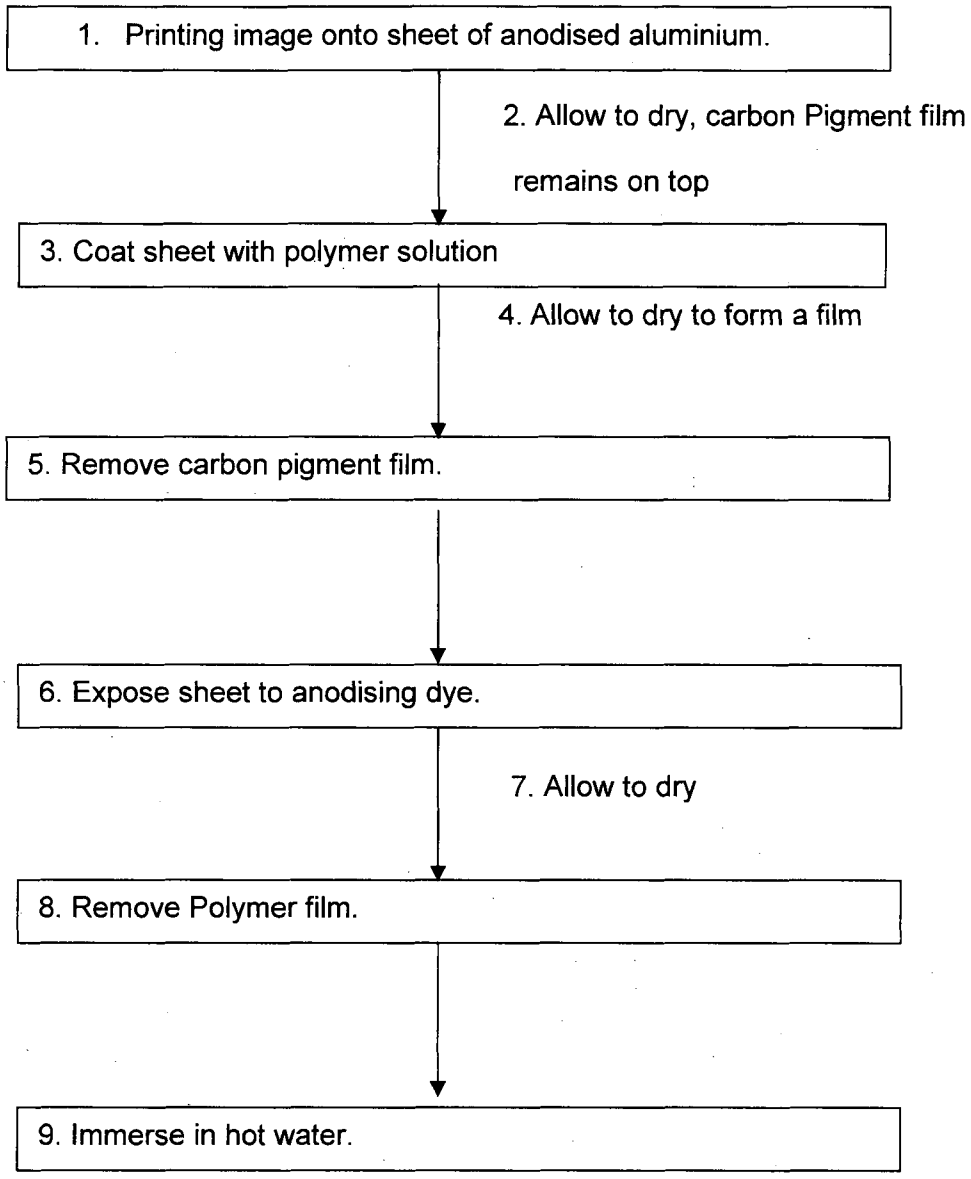
1. Printing image onto sheet of anodised aluminium.
2. Allow to dry, carbon Pigment film remains on top
3. Coat sheet with polymer solution
4. Allow to dry to form a film
5. Remove carbon pigment film.
6. Expose sheet to anodising dye.
7. Allow to dry
8. Remove Polymer film.
9. Immerse in hot water.

Figure 1

FIGURE 2

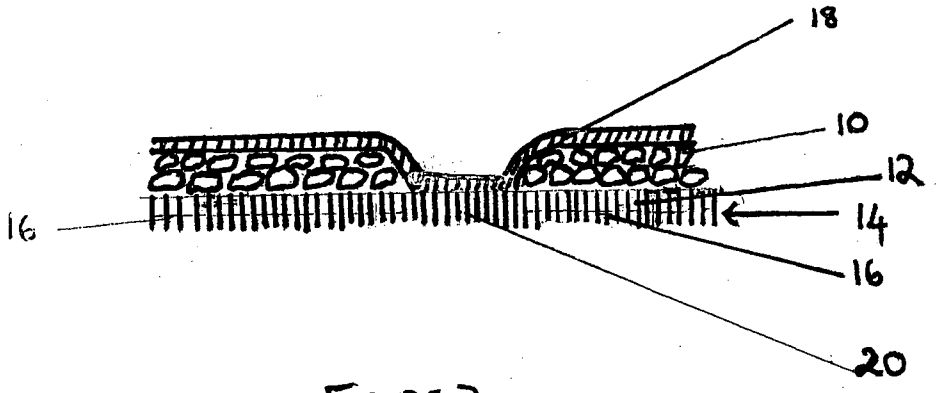

FIGURE 3

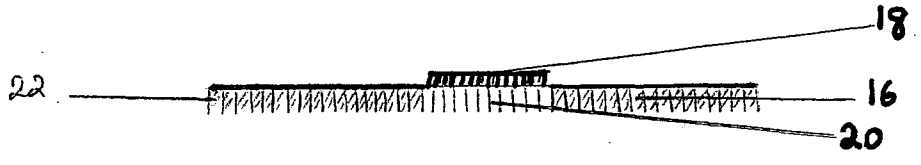

FIGURE 4