ELECTROLYTIC POLISHING OF ALUMINUM

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1 Claim. (Cl. 204—140.5)

This invention relates to processes of electrolytic polishing of metals.

The main object of this invention is to devise a process for the electrolytic polishing of aluminum articles, or articles formed from aluminum-rich alloys so that a lustrous mirror-like surface having a high specular reflectivity free from pitting is obtained.

Further objects of the present invention will become clear from reading of the following description and claims.

A process of producing a smooth, lustrous surface on articles of aluminum or aluminum-rich alloys according to the present invention is characterized by immersing the articles at an elevated temperature in an electrolyte containing phosphoric acid, sulphuric acid, an aliphatic poly-alcohol or ether-alcohol soluble in phosphoric acid, and water, whereby etching is effected, and then subjecting the immersed article to direct current voltage, the article being made anode in the bath.

Preferably, the aliphatic poly-alcohol or ether-alcohol soluble in phosphoric acid is an alkylene glycol or ether thereof having a boiling point above 20° C.

The electrolyte used may consist of a mixture of orthophosphoric acid (H₃PO₄), sulphuric acid (H₂SO₄), water, and an organic material, or materials, of boiling point greater than 120° C., soluble in phosphoric acid, included under the class of chemical compounds known as alkylene glycols and their ethers. Experiments have shown that the ethers of ethylene glycol and diethylene glycol tend to give the most satisfactory results, particularly ethylene glycol mono methyl ether (C₃H₇OCH₂CH₂OH).

Very satisfactory results have also been obtained with diethylene glycol mono ethyl ether (C₄H₉OCH₂CH₂CH₂OH).

Preferably, the greater proportion of the electrolyte consists of the phosphoric acid, with relatively small additions of sulphuric acid and water, together with a proportion not exceeding 15% by weight of the organic material previously mentioned.

In order that the invention may be more clearly understood, a preferred embodiment will now be described, by way of example, as applied to the production of a lustrous surface on electric torch cases manufactured by impact extrusion from aluminum or aluminum alloy, one end of the torch being permanently closed, while the other is preferably flared, and formed to receive a reflector and a transparent cover therefor.

An electrolyte is prepared according to the following composition:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent by weight</th>
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<tr>
<td>Orthophosphoric acid (H₃PO₄)</td>
<td>66</td>
</tr>
<tr>
<td>Sulphuric acid (H₂SO₄)</td>
<td>15</td>
</tr>
<tr>
<td>Ethylene glycol mono ethyl ether</td>
<td>15</td>
</tr>
<tr>
<td>Water</td>
<td>16.0</td>
</tr>
</tbody>
</table>

The electrolyte is heated to a temperature of 70° to 80° C. and the torch case immersed therein.

After a preliminary period, e.g. about 60 seconds, during which etching of the torch case occurs, whereby natural films of oxide and absorbed grease or the like are removed, direct current at 7 to 25 volts is applied, the torch case being made anode in the bath.

The preferred current density is 150 amperes per square foot corresponding to an electrical potential of approximately 10 to 15 volts. During treatment it is preferable for the electrolyte to be agitated by air, or by other means well known in the art.

The cathodes may be of lead or graphite, preferably the first mentioned, and should be substantially greater in area than the projected area of the torch case being treated; a ratio of 6:1 has been found to be satisfactory.

The time of treatment varies according to the smoothness of the original surface of the torch case, but varies from approximately 5 to 20 minutes.

After this period the torch case is removed from the bath and is rapidly swilled, e.g. in water which may be hot or cold or contain suitable known wetting agents to render swilling more rapid and effective. It then has a brilliant appearance free from surface scratches and with a high specular reflectivity.

After polishing, the surface of the article has a thin non-adherent oxide film which it is desirable to remove before the subsequent anodising process. This film can be removed by immersion of the article in a suitable solution without attack on the polished surface. The composition of such solutions are well known and may consist, for example, of solutions of caustic soda, or a mixture of chrome and phosphoric acids or chrome and sulphuric acids, or solutions of the salts of these acids. The time of immersion in such solutions should be no longer than is necessary to remove the surface film and may for example vary from 30 seconds to 1 minute.

After further swilling the torch case may be, in accordance with the invention, then subjected to anodic treatment in a bath containing either chromic acid (H₂CrO₇) or sulphuric acid (H₂SO₄) according to whether an opaque or transparent protective film respectively is desired. The film can subsequently be sealed, and, if desired, sealed for example by immersion in hot water to render the absorptive anodic film impermeable non-absorbive and non-staining, and also to render the torch case unaffected by finger marking. Alternatively, the drying may be omitted and the coating sealed immediately after the said further swilling.

The composition of the electrolyte and conditions of electrolysis cited above can be modified considerably without departure from the scope of the invention. For example, the percentage by weight of orthophosphoric acid may be from 45% to 80%, and the percentage by weight of sulphuric acid may be from 5% to 20%, with the total acid concentration 45% to 90% by weight, while the temperature range may be between 60° C. to 100° C. without detrimental effect. Under these conditions satisfactory results can be obtained with current densities varying between 80 and 250 amperes per square foot, corresponding to electrical potentials of between 7 and 25 volts. The percentage by weight of the alkylene glycol or its ether may vary from 3% to 15% by weight without adverse effect.

By the present invention shaped articles of aluminum or alloys of aluminum can be given a lustrous surface even though the surface of the article before treatment is uneven, scratched or mildly scored and the mirror-like finish is obtained without deformation of the article from the shape possessed before the process was commenced.

This is particularly important as regards extruded or deep-drawn articles of the metals mentioned because of their liability to deformation, e.g. with radial pressure.

However, in accordance with the present invention a
light mechanical polishing may be advantageously effected on the article before being subjected to electrolytic polishing by the process described, and subsequently anodic treatment may be effected in a chromic acid type or sulphuric acid type bath to obtain an opaque or transparent protective film as desired, which film may be dyed.

I claim:

A process of producing a smooth, lustrous surface on an article of aluminum or aluminum-rich alloys, said process comprising immersing said article in an electrolyte at a temperature of from 60°C. to 100°C., said electrolyte comprising, by weight, 45% to 80% orthophosphoric acid, 5% to 20% sulfuric acid, the total of the two acids being not more than 90% of said electrolyte, 3% to 15% of an organic compound selected from the group consisting of aliphatic poly-alcohols and ether-alcohols soluble in phosphoric acid, and the remainder water, etching said article in said electrolyte, and then subjecting said article to a direct current voltage while making said article an anode in said electrolyte.

References Cited in the file of this patent

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<table>
<thead>
<tr>
<th>Number</th>
<th>Office</th>
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<td>558,925</td>
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<tr>
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<td>Great Britain</td>
<td>Nov. 12, 1948</td>
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