

UNITED STATES PATENT OFFICE

2,650,156

SURFACE FINISHING OF ALUMINUM AND ITS ALLOYS

Eric Shelton-Jones, London, England, assignor,
by mesne assignments, to Aluminum Company
of America, Pittsburgh, Pa., a corporation of
Pennsylvania

No Drawing. Application September 10, 1947, Se-
rial No. 773,311. In Great Britain September
13, 1946

10 Claims. (Cl. 41—42)

1

This invention comprises improvements in or relating to the surface treatment of aluminum and its alloys.

The object of this invention is to provide a surface finish on aluminum and certain of its alloys having a greater brightness than that produced by the etching agents usually employed for the cleaning, etching or pickling of aluminum. In the past solutions containing caustic soda, sodium carbonate, trisodium phosphate, sodium fluoride and mixtures of these chemicals have been employed for the cleaning and etching of aluminum and resulted in the production of attractive silver-white finishes. It has been found that by using the method described hereafter aluminum can be provided with a surface having a glossy and sparkling appearance which is attractive in itself and is a good base for subsequent anodic oxidation. Where the process of anodic oxidation is one that produces transparent or semi-transparent films the reflectivity of such films is improved by the prior treatment of the aluminum by the process of this invention.

According to the present invention, a process for brightening metal from the group consisting of aluminum and alloys and thereof comprises immersing the metal for a suitable period in a bath containing phosphoric acid of S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water with, if desired, up to 20% by volume of the solution of added water (in which case the solution may contain up to about 24% by weight of total water) at a temperature adequate to ensure brightening of the articles under treatment. Concentrated sulphuric acid may be mixed with the phosphoric acid, if desired, in a proportion not exceeding 2 volumes of sulphuric acid of S. G. 1.84 (which contains at least about 95% by weight of sulfuric acid of the formula H_2SO_4 and up to about 5% by weight of water) to 1 volume of the phosphoric acid, and water may be added up to 20% by volume of the solution. The time of treatment may be up to 30 minutes and depends upon the temperature of the bath and the extent to which it has accumulated aluminum salts during working and also, in the case of alloys, upon the composition of the alloy.

The exact composition of the bath can be varied over wide limits, typical compositions being as follows:

Example I

50% phosphoric acid, S. G. 1.72, by volume.

2

50% sulphuric acid, S. G. 1.84, by volume.
Used at 100–120° C. for 5–10 minutes.

Example II

5 33% phosphoric acid, S. G. 1.72, by volume.
66% sulphuric acid, S. G. 1.84, by volume.
Used at 125° C. for 4 minutes.

Example III

10 75% phosphoric acid, S. G. 1.72, by volume.
25% sulphuric acid, S. G. 1.84, by volume.
Used at 100° C. for one minute.

Example IV

15 100% phosphoric acid, S. G. 1.72, by volume.
Used at 80° C. for 5–10 minutes.

Example V

	Percent by volume
20 Water (added)	20
Phosphoric acid, S. G. 1.72	27.5
Sulphuric acid, S. G. 1.84	52.5

Used at 110° C. for 3 minutes.

25 After removal from the bath the metal should preferably be drained for a short time during which vigorous action occurs on the metal surface. It is found that the action which occurs during draining brightens the surface, so that a better result is secured than if the metal is transferred direct from the brightening bath to a hot water or acid rinse. After draining, the metal is thoroughly rinsed. This may be done in hot water or preferably in a hot solution of sulphuric and chromic acids, or phosphoric-chromic acid. A typical example of a suitable sulphuric-chromic mixture is:

30 Sulphuric acid 3% by volume.
Chromic acid 3 lbs. per 10 gallons of solution.
Water—Balance.
40 Temperature 60–80° C.

A typical example of a phosphoric-chromic acid mixture is:

45 Phosphoric acid, S. G. 1.72, 3% by volume.
Chromic acid, 3 lbs. per 10 gallons of solution.
Water—Balance.
Temperature 60–80° C.

50 As heat is evolved during the immersion of the metal to be treated in the brightening bath, in the case of large baths into which a considerable number of articles are dipped it may be found necessary to install in the bath a cooling system so as to avoid excessive temperature rise of the solution. The bath will also require a heating

system to bring it up to temperature before operations commence. When the bath has been in use for some time the aluminum content rises and the temperature of operation may safely be increased, in the case of the bath set out in Example V to 120° C. The best time of immersion, which has been given above for the case of commercial quality aluminum articles, will differ in the case of alloys and when treating a series of articles of a particular alloy it may be advisable to make a simple preliminary test with a view to determining the best time of immersion. If it is found that a given material does not give a good finish in, say, 3 minutes, the article can be reintroduced into the solution.

In some cases white stains may appear on articles which have been treated. This may be due to the presence of lead sulphate in the bath, especially if the baths are made up as is usual, in lead-lined tanks. The addition of a small amount of a metal electronegative to lead, such as copper, silver or antimony (conveniently in the form of oxide) will tend to overcome this problem. The use of antimony trioxide is preferred, and the quantity necessary is of the order of 0.05% to 0.25% in the weight of the solution.

Before dipping in the brightening bath, material which has been shot or sand-blasted may be etched in a caustic soda-sodium fluoride etching solution or in nitric acid or a pickle of chromic-sulphuric acid, in order to assist in removing embedded dirt.

Notwithstanding the presence of antimony trioxide in the solution, white stains are sometimes still found on the treated articles, possibly arising from the presence of aluminum phosphate, or too high a temperature of operation, there being an optimum temperature for each alloy and each bath composition. A whitish film due to this cause is easily removable in an acid solution capable of dissolving aluminum phosphate, for example in nitric acid, or chromic acid-phosphoric acid solution as hereinabove set out.

After removing the whitish film the work may be dried off and lacquered with clear lacquer or it may be subjected to anodic or chemical oxidation by processes well known to the art. The process has been found particularly suitable for treating aluminum that has been previously shot or sand-blasted, when a sparkling finish is obtained, but can also be applied to aluminum that has been prepared by other methods such as scratch brushing, chemical etching, polishing and finishing. When used on polished work it prevents the formation of the cloudy patches during subsequent anodic oxidation that arise from local overheating during polishing.

I claim:

1. A process for brightening metal from the group consisting of aluminum and alloys thereof which comprises immersing the metal in a bath having as the essential components thereof phosphoric acid of the formula H_3PO_4 and water, the water being present in a proportion to the phosphoric acid at least equal to that existing in phosphoric acid of about S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water) and in a total amount up to that existing in a solution of phosphoric acid of about S. G. 1.72 and 20 per cent by volume of the solution of added water (which solution contains about 24% by weight of total water), at a temperature of at least about 80° C.

2. A process for brightening metal from the

group consisting of aluminum and alloys thereof which comprises immersing the metal in a bath consisting of phosphoric acid of about S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water), at a temperature of at least about 80° C.

3. A process for brightening metal from the group consisting of aluminum and alloys thereof which comprises immersing the metal in a bath having as the essential components thereof phosphoric acid of the formula H_3PO_4 and water, and also containing sulphuric acid of the formula H_2SO_4 , the sulphuric acid being present in a proportion to the phosphoric acid up to that existing in a solution of about two volumes of concentrated sulphuric acid of about S. G. 1.84 (which contains at least about 95% by weight of sulphuric acid of the formula H_2SO_4 and up to about 5% by weight of water) to one volume of phosphoric acid of about S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water), and the water being present in a proportion to the phosphoric acid at least equal to that existing in phosphoric acid of about S. G. 1.72 and in a total amount up to that existing in a solution of phosphoric acid of about S. G. 1.72 and 20 per cent by volume of the solution of added water (which solution contains about 24% by weight of total water), at a temperature of at least about 80° C.

4. A process for brightening metal from the group consisting of aluminum and alloys thereof which comprises immersing the metal in a bath consisting of phosphoric acid of about S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water) and concentrated sulphuric acid of about S. G. 1.84 (which contains at least about 95% by weight of sulphuric acid of the formula H_2SO_4 and up to about 5% by weight of water), in a proportion up to about two volumes of said sulphuric acid to one volume of said phosphoric acid, at a temperature of at least about 80° C.

5. A process for brightening metal from the group consisting of aluminum and alloys thereof which comprises immersing the metal in a bath consisting of about 27.5 per cent by volume of phosphoric acid of about S. G. 1.72 (which contains about 87.5% by weight of phosphoric acid of the formula H_3PO_4 and about 12.5% by weight of water), about 52.5 per cent by volume of concentrated sulphuric acid of about S. G. 1.84 (which contains at least about 95% by weight of sulphuric acid of the formula H_2SO_4 and up to about 5% by weight of water) and about 20 per cent by volume of added water, at a temperature of at least about 80° C.

6. A process as claimed in claim 1 wherein a small amount of a salt of a metal electronegative to lead is present in the bath for the purpose described.

7. A process as claimed in claim 1 wherein a small amount of antimony trioxide is present in the bath for the purpose described.

8. A process as claimed in claim 1 wherein the metal is allowed to drain, after removal from the bath and before rinsing off the solution, until the surface has been further acted on and brightened by the liquid drawn out of the bath on the surface of the article.

9. A process as claimed in claim 1, wherein the metal is rinsed after removal from the bath

in a hot aqueous solution comprising sulphuric acid and chromic acid.

10. A process as claimed in claim 1, wherein the metal is rinsed after removal from the bath in a hot aqueous solution comprising phosphoric acid and chromic acid.

ERIC SHELTON-JONES.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,211,138	Gravell	Jan. 2, 1917

10

Name	Date
Gravell	Dec. 24, 1929
Hansen	Feb. 2, 1932
Edwards	Apr. 16, 1940
Brown	Apr. 13, 1943
Faust	Nov. 23, 1943
Pray	May 9, 1944
Ross	July 18, 1944
Pray et al.	July 27, 1948

Disclaimer

2,650,156.—*Eric Shelton-Jones*, London, England. SURFACE FINISHING OF ALUMINUM AND ITS ALLOYS. Patent dated August 25, 1953. Disclaimer filed Mar. 27, 1956, by the assignee, *Aluminum Company of America*.

Hereby disclaims the terminal part of the term of said patent subsequent to Jan. 3, 1956.

[*Official Gazette May 1, 1956.*]

5

in a hot aqueous solution comprising sulphuric acid and chromic acid.

10. A process as claimed in claim 1, wherein the metal is rinsed after removal from the bath in a hot aqueous solution comprising phosphoric acid and chromic acid.

ERIC SHELTON-JONES.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,211,138	Gravell	Jan. 2, 1917

10

6

Name	Date
Gravell	Dec. 24, 1929
Hansen	Feb. 2, 1932
Edwards	Apr. 16, 1940
Brown	Apr. 13, 1943
Faust	Nov. 23, 1943
Pray	May 9, 1944
Ross	July 18, 1944
Pray et al.	July 27, 1948

Disclaimer

2,650,156.—*Eric Shelton-Jones*, London, England. SURFACE FINISHING OF ALUMINUM AND ITS ALLOYS. Patent dated August 25, 1953. Disclaimer filed Mar. 27, 1956, by the assignee, *Aluminum Company of America*.

Hereby disclaims the terminal part of the term of said patent subsequent to Jan. 3, 1956.

[*Official Gazette May 1, 1956.*]

Disclaimer

2,650,156.—*Eric Shelton-Jones*, London, England. SURFACE FINISHING OF ALUMINUM AND ITS ALLOYS. Patent dated August 25, 1953. Disclaimer filed Mar. 27, 1956, by the assignee, *Aluminum Company of America*.

Hereby disclaims the terminal part of the term of said patent subsequent to Jan. 3, 1956.

[*Official Gazette May 1, 1956.*]