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PROTECTION OF METAL ARTICLES AGAINST CORROSION BY COATING BY ELECTRO-DEPOSITION

Samuel Thomas Roberts, Southgate, London, England

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6 Claims. (Cl. 204—43)

This invention relates to the protection of metal articles against corrosion, and its principal object is the provision on ferrous and other metal articles of an anti-corrosion surface alloy or coating of great efficacy and durability.

According to the invention, I provide a process for protecting a metal article against corrosion comprising the electro-deposition of an alloy containing cadmium and mercury from an alkaline bath containing aluminium in solution in addition to the constituents of the alloy.

The aluminium appears to increase the "throwing power" of the bath to such an extent that the recesses and interior surfaces of irregularly-shaped and hollow articles are found to be quite uniformly covered without any necessity for special anode shapes or distributions to conform with the particular article to be treated, assuming of course that the article is completely immersed and that no air pockets are allowed to form in it. In this connection, it is preferable to suspend the article as a cathode, in the bath by means of aluminium carrier wires or hooks, and these may with advantage be arranged to penetrate as far as possible into any deep cavities or interior spaces in the article.

The following is an example of a process according to the invention which has given particularly good results:

Example I

An aqueous solution is made up in a conventional way, if necessary with the aid of heat, containing per gallon of water:

Sodium cyanide	ounces	12
Caustic soda	do	12
Zinc sulphate	do	10
Cadmium sulphate	do	4
Bichloride of mercury	do	2
Potassium aluminium sulphate	do	3½
Dextrine	do	2
Glycerhyzine (ammoniated glycerine)	grams	1¼

This solution is accommodated in a glass-lined steel tank, and there is inserted therein an anode formed of two concentric or coaxial tubes, an outer one of cadmium and an inner one of zinc, secured to an intervening conductive support. Mercury is mixed or amalgamated with both tubes during their casting, and the arrangement is such that the zinc, cadmium and mercury are present in the approximate proportions by weight of 8:4:1.

Alternatively the anode may be cast from a homogeneous mixture or amalgam of zinc, cadmium and mercury.

Example II

	Ounces
Sodium cyanide	12
Caustic soda	12
Cadmium sulphate	12
Bichloride of mercury	½ to 2
Aluminium potassium sulphate	2
Cobalt sulphate	¼ to 2
Dextrine	2

Example III

Sodium cyanide	12
Caustic soda	12
Cadmium sulphate	12
Bichloride of mercury	½ to 2
Aluminium potassium sulphate	2
Nickel sulphate	¼ to 2
Dextrine	2

The constituents specified in Examples I and II are in each case, added to one gallon of water. The cobalt or nickel sulphate is added to the solution in the form of their double cyanides, but these are usually formed by adding the nickel or cobalt salts, preferably sulphates, to the requisite amount of sodium or potassium cyanide, and allowing a 25% excess of free cyanide in the solution. The solutions are otherwise treated substantially as that described with reference to Example I. The anode in this case may comprise zinc, cadmium and mercury in the ratio 8:4:1 or 8:2:1, the nickel or cobalt being added as a metallic salt to the solution when required. Or the anode may comprise cadmium and mercury in the ratio 9:1. Or I may employ a cadmium anode carried by a cobalt or nickel member.

The article to be treated, after cleaning and de-scaling (if necessary) is suspended in the bath by means of wires or carriers of aluminium, and a current of 10 to 25 amperes per square foot of article surface is passed. It is preferable to use the article as an anode for a few moments initially, as this "opens up" its surface pores and enables a firmly adherent coating or surface alloy to be formed when the current is thereafter reversed for the deposition step.

This deposition then takes place with extreme rapidity; in fact a 10 minute cathodic treatment as above has been found to give steel and cast iron articles a perfect and lasting resistance to oxidation and general corrosion. It has also been observed that the articles so treated do not

have their dimensions appreciably increased thereby, this being of course a valuable feature where nuts, bolts and working or interfitting parts are concerned. If the cathodic step is unduly prolonged, further metal is deposited, but in the form of a friable layer or fur which may be readily brushed away from the underlying surface coating or alloy proper.

The use of mercury appears to give the surface alloy a remarkably dense, homogeneous and nonporous nature, despite its thinness, and its incorporation in the anode not only ensures replenishment of the bath at the correct rate but enables the zinc and cadmium to be alloyed with a uniformity not otherwise possible. The anode thus wears away very evenly, and the deposition as a whole therefore proceeds very uniformly and steadily.

It will be furthermore noted that the aluminium carrying means maintains the aluminium metal content of the solution during the anodic period and also gives greater conductivity to the circuit leading to the article suspended.

In my opinion the aluminium carrying member is more electropositive to the solution containing aluminium than other known means of suspension.

The aluminium in solution in the bath is believed to form an inorganic colloid thereby yielding a fine-grained and more corrosion-resisting deposit. It also improves the throwing power of the solution for cadmium.

What I claim and desire to secure by Letters Patent is:

1. A process for protecting a metal article against corrosion comprising electrically depositing thereon a ternary alloy containing zinc, cadmium and mercury in which the cadmium zinc ratio is approximately 1 to 1 from an aqueous alkaline cyanide bath containing at least about 12 ounces of caustic soda per gallon of water and containing aluminum sulphate in solution in addition to the metal ions of the alloy being deposited, and employing an alloy anode containing zinc, cadmium and mercury, the zinc-mercury ratio of the anode being about 8 to 1 and the zinc-cadmium ratio thereof being about 2 to 1.

2. A process for protecting a metal article against corrosion comprising electrically depositing thereon a ternary preponderatingly cadmium alloy of zinc, cadmium and mercury from an aqueous alkaline cyanide bath containing at least about 12 ounces of caustic soda per gallon of water and containing aluminum sulphate in solution in addition to the metal ions of the alloy being deposited, and employing an alloy anode containing zinc, cadmium and mercury, the zinc-mercury ratio of the anode being substantially 8 to 1 and the zinc-cadmium ratio thereof being substantially 2 to 1.

3. A process for protecting a metal article against corrosion comprising electrically depositing thereon a ternary alloy containing zinc, cadmium and mercury in which the cadmium-zinc ratio is approximately 1 to 1 from an aqueous alkaline cyanide bath containing at least about 12 ounces of caustic soda per gallon of water and containing aluminum sulphate in solution in addition to the metal ions of the alloy being deposited, and employing an alloy anode containing zinc, cadmium and mercury, the zinc-mercury ratio being about 8 to 1 and the zinc-cadmium ratio thereof being from 2 to 1 to a ratio of 4 to 1.

4. A process for protecting a metal article against corrosion comprising electrically depositing thereon a ternary preponderatingly cadmium alloy of zinc, cadmium and mercury from an aqueous alkaline cyanide bath containing at least about 12 ounces of caustic soda per gallon of water and containing aluminum sulphate in solution in addition to the metal ions of the alloy, and employing an alloy anode containing zinc, cadmium and mercury, the zinc-mercury ratio of the anode being substantially 8 to 1 and the zinc-cadmium ratio thereof being from 2 to 1 to a ratio of 4 to 1.

5. A process for protecting a metal article against corrosion comprising electrically depositing thereon a ternary alloy containing zinc, cadmium and mercury in which the cadmium-zinc ratio is approximately 1 to 1 from an aqueous alkaline cyanide bath containing at least about 12 ounces of caustic soda per gallon of water and containing aluminum sulphate in solution in addition to the metal ions of the alloy being deposited, and employing an alloy anode containing zinc, cadmium and mercury, the zinc-mercury ratio of the anode being about 8 to 1 and the zinc-cadmium ratio thereof being about 2 to 1, the total combined content of the zinc and cadmium in the bath in proportion to the mercury content being substantially in the ratio of 2.5 to 1.

6. A process for protecting a metal article against corrosion comprising electrically depositing thereon a ternary preponderatingly cadmium alloy of zinc, cadmium and mercury from an aqueous alkaline cyanide bath containing at least about 12 ounces of caustic soda per gallon of water containing aluminum sulphate in solution in addition to the metal ions of the alloy being deposited, and employing an alloy anode containing zinc, cadmium and mercury, the zinc-mercury ratio of the anode being substantially 8 to 1 and the zinc-cadmium ratio thereof being substantially 2 to 1, the total combined content of the zinc and cadmium in the bath in proportion to the mercury content being substantially in the ratio of 2.5 to 1.

SAMUEL THOMAS ROBERTS.