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METHOD OF GOLD PLATING STEEL AND FERROUS ALLOYS

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This invention relates to an improved method for plating gold on steel and ferrous alloys, the object being to produce a method whereby gold may be plated directly on steel, iron, and other desired ferrous material in a way to be securely united with the article being plated.

In carrying out the invention it has been found that certain solutions hereinafter fully set forth must be used to properly cleanse a metal article of oxide. It also has been found that the plating solution must contain a special reagent to inhibit the free acid remaining on the metal from attacking the surface of the metal during the plating operation.

When plating an article of steel or ferrous alloy, the article is first thoroughly cleaned of all oxide and is also etched to a certain extent, namely, until a fine etched surface is secured, so as to present an appreciably greater area to which the gold may cling. More specifically, in carrying out the method the article is first cleansed in a suitable alkaline cleanser. The article is then dipped in a special bath to remove all oxide film from the cleansed article. The desired bath for this purpose is set forth in the following formula:

By volume

	Parts
Hydrofluosilicic acid (concentrated), H_2SiF_6	50 to 100
Hydrofluoric acid (35%), HF	5
Water (distilled), H_2O	25 to 50

A substitute for the acid hydrofluosilicic could be fluoboric acid or the acids of the combination of fluorine and the silicon earth group. Acids of this type, while sufficiently strong to destroy the oxide film on steel do not appreciably affect the under surface during a short exposure to them, and are therefore also suitable for the purpose of the present invention.

The article to be plated is dipped in the above solution to secure the removal of the oxide film. This dipping operation may be from 30 seconds to 2 minutes according to the amount of etching desired as the solution will not only remove the oxide film but will etch the surface of the article to be plated. This dipping may be done by ordinary dipping or current may be used and caused to pass through the article during the dipping operation. This will produce a stronger etching effect.

After the article has been dipped as just described it is immediately immersed in clean water, which may be hot. After quickly dipping the article in clean water it is immediately immersed in the gold plating bath and the plating operation commenced. The preferable gold plating bath consists of the following ingredients in approximately the following proportions:

	Grams
Potassium cyanide	100
Potassium carbonate	80
Potassium gold cyanide	20
Ammonium benzoate	2.5
Sodium formate	2.5

Water to make 10 liters.

It will be noted that the ammonium benzoate and sodium formate are reagents and act to prevent too rapid plating. These inhibitors are desirable to cause a fine solid plating to be secured. It will therefore be seen that the formate and benzoate in the proportions set forth lower the oxidizing effect of the free cyanide on the article being plated by depressing the CN ionization. The gold has therefore the opportunity of being deposited on the surface of the article before a tarnish film can be formed on it.

As equivalents for the reagents and the other gold plating salts the following could be used;

$KAuCn_2$		$NaAu(CN)_2$
	or	$NH_4Au(CN)_2$
K_2CO_3		Na_2CO_3
	or	NH_4CO_3
KCN		NaCN
	or	$NH_4(CN)$
Sodium formate		Potassium formate
	or	Ammonium formate
Ammonium benzoate / Sodium	or	Potassium benzoate

It will, of course, be understood that the article may be submerged in the plating bath as long as desired with the full current flowing. For an extremely light plating coat five or six seconds would probably be satisfactory but usually the article is left in the bath for a longer time, as, for instance, one-half hour or longer with a current from 1 to 6 volts. As the surface is clean and is also formed with fine etching, the gold deposited on the article will interlock with the etched surface and form substantially an integral part thereof so that the plated article may be brushed or buffed, or polished in any desired way and without becoming loose or in any way injured.

I claim:

1. The method of electroplating gold on ferrous metals consisting in cleaning the article to be plated in an alkaline bath, subjecting the

cleaned article to a solution of hydrofluosilicic acid until all oxide has been removed and an etched surface produced, washing the article in water after removal from the acid bath, and then subjecting the article to an electroplating action in an electroplating bath containing potassium cyanide, potassium carbonate, potassium gold cyanide a reagent consisting of ammonium benzoate and sodium formate acting to suppress the too rapid ionization of the gold so as to cause the gold to be deposited in a fine adherent state.

2. The method of plating gold on steel and ferrous alloy articles consisting in subjecting the article to a mild ionized acid bath until all of the oxide on the article has been removed and the surface of the article has been attached sufficiently to enlarge its surface by a very fine etched surface, washing the article in water and immediately subjecting the article to an electroplating action in a plating bath containing potassium cyanide, potassium carbonate, potassium gold cyanide and a reagent consisting of ammonium benzoate and sodium formate acting to cause the lowering of the attacking effect of the free cyanide on the article by depressing the ionization to permit the gold to be deposited on the surface of the article before a tarnish film can form.

3. The method of gold plating an article of ferrous material on which an oxide film normally forms which includes subjecting the article to hydrofluosilicic acid until the oxide film has been removed and an etching operation has taken place to increase the surface, and electrolytically depositing a gold plate on the etched article from a cyanide plating bath containing ammonium benzoate and sodium formate.

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