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ELECTROPLATING BATH COMPOSITION AND METHOD OF PRODUCING THE SAME

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My invention relates to electro-plating bath compositions, and more particularly it pertains to a novel plating composition which results in a brilliant white plate of the tin-zinc-copper type; the invention further relating to a method of compounding the novel plating composition.

In the past it has not been considered commercially feasible to plate an alloy of tin, zinc, and copper upon a base metal. The difficulty has resided in maintaining a proper balance between the plate ingredients in the plating bath. Consistent results with a plate of this type have only been secured with great difficulty, if at all; where a proper plate has been secured the plating period could not exceed one minute, and a highly skilled operator is necessary to maintain a proper balance in the bath.

Now, I have devised a method of compounding a novel plating composition, a plating bath containing the latter being capable of producing a brilliant white plate of the tin-zinc-copper type; and the plating operation being adapted to continue for periods as high as 10 to 12 minutes without affecting the color or brilliant lustre of the plate.

It may, therefore, be stated that one of the primary objects of this invention is to provide a novel plating bath, and composition therefor, which includes, in addition to tin, zinc and copper compounds, other ingredients whose function it is to maintain an accurate balance between the three plate alloy ingredients during the plating operation.

Another important object of my invention is to provide a method of compounding a plating bath composition which, in operation, results in a tin-zinc-copper alloy plate characterized by its tarnish resisting property; the plate requiring no polishing after plating; and giving a consistently brilliant white plate which is between rhodium and silver in whiteness.

Another object of the invention is to provide a plating bath composition resulting from the compounding of copper cyanide; sodium cyanide, sodium bisulfite, sodium stannate and tri-sodium phosphate with zinc oxide and zinc sulphate; the resulting bath producing a brilliant white plate of the tin-zinc-copper type.

Other objects of this invention are to improve generally the electro-plating of tin-zinc-copper alloys, and more especially to provide a plating composition for this type of plate which is not only compounded with ease and economy, but is employed in the actual plating process with consistent results and at low cost.

The following method of compounding the plating bath composition, embodying this invention, is given by way of illustration. It will be appreciated, however, that various modifications may be made in the practical operation of the method, as well as in the application of the product, without departing from the scope of the invention.

According to my invention, the following ingredients are mixed; the percentage ranges (per ounce) being given:

		Per cent
Copper cyanide	CuCN	15–20
Sodium cyanide	NaCN	30–40
Sodium bisulfite	$NaHSO_3$	4– 5
Zinc oxide	ZnO	12–16
Zinc sulfate	$ZnSO_4.7H_2O$	9–10
Sodium stannate	$Na_2SnO_3.3H_2O$	9–12
Tri-sodium phosphate (monohydrate)	$Na_3PO_4.H_2O$	5–15

The percentage ranges are given per ounce of dry final product because when the bath is prepared two ounces per gallon of bath is used. Of course, in mixing the ingredients the percentages selected from the ranges given will total 100%. In compounding the final product it is highly important to keep the zinc compounds out of physical contact with the other ingredients until the entire batch is ready for mixing. Hence, the various dry ingredients, save the zinc compounds, may be weighed out in a common receptacle; the zinc compounds, also dry, in a separate container. The two groups of dry ingredients can then be thoroughly mixed in any conventional mixer. Within a short period, say ten minutes, a hot reaction sets in. For this reason the mixture is kept in a metal container for about 24 hours. During the reaction, steam from the water of hydration and CN vapors will be generated. The resulting product is lumpy in nature; grinding and screening for desired particle size then follow.

The functions of the various ingredients will now be given. These functions are inter-related to the extent that a proper plate requires the presence of these factors. The copper cyanide provides the copper content of the bath. The compound is insoluble in water. Accordingly, sodium cyanide is used as a solvent for the copper cyanide. The zinc oxide and zinc sulfate provide the zinc content of the bath. The zinc oxide reacts with the sodium cyanide, when the reaction period explained above sets in, to produce sodium zinc cyanide. The zinc sulphate is employed to provide a smoother deposit during plat-

ing; the lustre of the plate is improved. During the aforesaid reaction period the sodium cyanide reacts with the zinc sulphate to produce sodium sulphate and sodium zinc cyanide; the sodium sulfate is beneficial in the plating. The sodium stannate provides the tin content of the bath.

In order to "brighten" the plate, there are employed "brighteners". The sodium bisulphite functions as a brightener for the copper and zinc content of the bath. There may be employed in place of this specific brightener other brighteners such as: sodium sulfite, sodium thiosulfate; arsenic trioxide; sodium arsenite; phenol. In general, there may be utilized any organic or inorganic compound which functions as a brightening agent for the copper and zinc content of the bath. The brightening action may be said to involve a retardation of plate metal crystal size for the purpose of increasing the brilliance of the plate. The tri-sodium phosphate is used as the tin brightener. This use of independent brighteners results in a highly attractive plate lustre eliminating the need for polishing after plating. The mono-hydrate form of the phosphate is employed because it prevents "soup" formation of the finished product. The resulting composition remains dry after packing; the value of the mono-hydrate form of the phosphate will, therefore, be readily appreciated. Any other type of tin brightener may be used, such as glucose; dextrose; potassium acid tartrate; glue; dextrin; ammonium alum; di-sodium phosphate.

In usage 2 oz. of the resulting composition is added to one gallon of water containing 2 oz. of sodium cyanide. However, the bath will operate properly from concentrations of 1 oz. of the composition to 3 ozs. Within this concentration range the bath metallic content will be as follows:

	Percent
Copper	0.0795–0.32
Zinc	0.0873–0.3395
Tin	0.0298–0.119

The mixture is heated to boiling, and cooled. Iron or carbon anodes may be used in the plating process; 4 to 9 volts can be employed. The temperature of the bath should be 150–180° F. Color variation of the plate is obtained by lowering the voltage (more blue), or raising the voltage (more yellow). When necessary the bath solution is replenished by adding from a replenishing solution made from a concentration of one oz., of sodium cyanide to 2 oz., of the bath composition brought to a boil.

The plate produced by using the composition in an electro-plating bath is tarnish resistant, and is between rhodium and silver in whiteness. It can be formed directly over nickel; German silver; brass; copper; gold; silver; iron and steel; hard solders and a majority of soft solders. The reflectivity of the plate is approximately 88% of silver; over a long period, as two years, the reflectivity is greater than that of silver. Average plating time is one minute, although plates can be produced for a period of ten minutes if desired. As far as hardness is concerned, the plate is much harder than nickel for the same thickness.

It will now be seen that I have disclosed a highly useful method of producing economical plates in a simple and consistent manner. No expert, or highly skilled, operators are required during the electro-plating operation when the composition of the present invention is used; it will suffice merely to employ an operator who is trained in the electro-plating art. While I have described the preferred embodiment of the invention, and have given specific examples thereof, it is to be understood that the invention is not to be limited thereto, except as indicated in the appended claims. For example, the corresponding potassium salts may be employed in place of the sodium compounds disclosed herein.

What I claim is:

1. As a composition of matter for the electro-deposition of copper-zinc-tin alloys, the reaction product of copper cyanide; sodium cyanide; sodium bisulfite; zinc oxide; zinc sulfate; sodium stannate; tri-sodium phosphate in the mono-hydrate form, said product being characterized by its ability to produce brilliant white electro-deposited alloy plates from solution.

2. A combination of the following for an electro-plating bath composition:

Copper cyanide
Sodium cyanide
Sodium bisulfite
Zinc oxide
Zinc sulfate
Sodium stannate
Tri-sodium phosphate

wherein the percentages by weight in the respective ingredients do not exceed the following values:— 20%; 40%; 5%; 16%; 10%; 12%; 15%.

3. An electro-plating bath comprising an alkaline cyanide solution having a copper content of 0.0795 to 0.32%; zinc content of 0.0873 to 0.3395%; tin content of 0.0298 to 0.119%, a brightener for the tin content chosen from the empirical group including tri-sodium phosphate, glucose, dextrose, potassium acid tartrate, glue, ammonium alum, di-sodium phosphate; and a brightener for the remaining metallic content chosen from the empirical group including sodium bisulphite, sodium sulphite, sodium thiosulphate, arsenic trioxide, sodium arsenite, phenol.

4. A combination of the following for an electro-plating bath composition:

	Percent
Copper cyanide	15–20
Sodium cyanide	30–40
Sodium bisulfite	4–5
Zinc oxide	12–16
Zinc sulfate	9–10
Sodium stannate	9–12
Tri-sodium phosphate	5–15

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