

# UNITED STATES PATENT OFFICE.

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## ELECTROLYTE AND METHOD OF ELECTRODEPOSITING COPPER.

946,903.

Specification of Letters Patent.

Patented Jan. 18, 1910.

No Drawing.

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*To all whom it may concern:*

Be it known that I, EDWARD F. KERN, citizen of the United States, residing at Knoxville, in the county of Knox and State of Tennessee, have invented certain new and useful Improvements in Electrolytes and Methods of Electrodepositing Copper, of which the following is a specification.

This invention relates to an improved process for the electrodeposition of copper.

The invention also relates to an electrolyte for use in the practice of the said process.

I have discovered that a smooth, dense, coherent and adherent deposit of copper may be obtained by the electrolysis of a bath containing fluo-silicate of copper in solution and that particularly good results may be obtained by the use of a soluble alkaline or alkaline earth fluo-silicate preferably ammonium fluo-silicate or in some cases aluminium fluo-silicate with the copper fluo-silicate and that the operation may be further improved in some cases by the additional employment of an alkaline fluorid as ammonium fluorid either alone or with an organic salt preferably an alkaline tartrate.

In a bath for coating iron, steel or zinc, I prefer to employ the following materials in the proportions specified:

|                        |             |
|------------------------|-------------|
| Water                  | 100 parts.  |
| Copper fluo-silicate   | 12 "        |
| Ammonium fluo-silicate | 8 "         |
| Ammonium tartrate      | 6 "         |
| Ammonium fluorid       | 5 or more " |

In a bath for coating brass, copper or certain other metals, I preferably employ the following materials in the proportions specified:

|                        |             |
|------------------------|-------------|
| Water                  | 100 parts.  |
| Copper fluo-silicate   | 12 "        |
| Ammonium fluo-silicate | 8 "         |
| Gelatin or tannin      | 0.06 "      |
| Ammonium fluorid       | 5 or more " |

Where the copper is to be deposited on iron, steel or zinc, I employ the solution in a neutral or slightly alkaline state, the bath being maintained in such condition by the use of a suitable alkali preferably ammonia.

Where the copper is to be deposited on brass, copper or certain other metals the bath may be acidified with free fluo-silicate acid or it may be maintained in a neutral condi-

tion in which case I preferably employ aluminium fluo-silicate instead of ammonium fluo-silicate.

It is to be understood that in the bath for depositing copper upon brass, copper or certain other metals aluminium fluo-silicate is the equivalent of ammonium fluo-silicate for the purposes of my process.

I have found that it is advantageous, when using the bath in an acid condition as hereinbefore referred to, to add gelatin or tannin to the bath preferably in the proportion of one part of the solid gelatin or one part of the concentrated extract of tannin to about 2,000 parts of the bath. The gelatin and the tannin mentioned are, it is to be understood, equivalents for use in my process and either or both may be employed as desired.

In the electrolysis of my improved bath, I employ an anode of copper or an anode consisting of an alloy the greater part of which is copper.

In order to restrain the separation of silica in the operation of my process, I have found it advisable to add ammonium fluorid from time to time, this material being added to the bath at the outset in the preferred proportion of one part by weight of ammonium fluorid to one or more parts of the copper fluo-silicate in the electrolyte. The addition of the ammonium fluorid thereafter may be made as required.

While I have stated the proportions of the materials which I prefer to employ, it will be understood that these proportions may be widely varied, and that commercially satisfactory results may be obtained, omitting certain constituents of the bath as hereinbefore mentioned or by replacing the ammonium fluo-silicate with aluminium fluo-silicate.

While I have particularly referred to the use of an alkaline fluo-silicate in connection with the fluo-silicate of copper it is to be understood that the use of an alkaline earth silicate with such fluo-silicate of copper is contemplated as within the purview of my invention and the scope of the appended claims, an alkaline earth silicate being the equivalent of an alkaline silicate for use in my process.

Having described my invention, I claim:

1. A process of electrodepositing copper, which consists in electrolyzing a solution

containing fluo-silicate of copper and a soluble alkaline fluo-silicate.

2. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper and ammonium fluo-silicate.

3. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, an alkaline fluo-silicate and an alkaline fluorid.

4. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, an alkaline fluo-silicate and ammonium fluorid.

5. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, ammonium fluo-silicate and ammonium fluorid.

6. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, an alkaline fluo-silicate, an alkaline fluorid and an organic salt.

7. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, an alkaline fluo-silicate, an alkaline fluorid and an alkaline tartrate.

8. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, an alkaline fluo-silicate, an alkaline fluorid and ammonium tartrate.

9. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper, ammonium fluo-silicate, ammonium fluorid and ammonium tartrate.

10. A process of electrodepositing copper, which consists in electrolyzing a solution containing fluo-silicate of copper and ammonium fluo-silicate and adding ammonium fluorid thereto from time to time during the electrolysis.

11. An electrolyte comprising fluo-silicate of copper and an alkaline fluo-silicate.

12. An electrolyte comprising fluo-silicate of copper and ammonium fluo-silicate.

13. An electrolyte comprising fluo-silicate of copper, an alkaline fluo-silicate and an alkaline fluorid.

14. An electrolyte comprising fluo-silicate of copper, an alkaline fluo-silicate and ammonium fluorid.

15. An electrolyte comprising fluo-silicate of copper, ammonium fluo-silicate and ammonium fluorid.

16. An electrolyte comprising fluo-silicate of copper, an alkaline fluo-silicate, an alkaline fluorid and an organic salt.

17. An electrolyte comprising fluo-silicate of copper, an alkaline fluo-silicate, an alkaline fluorid and an alkaline tartrate.

18. An electrolyte comprising fluo-silicate of copper, an alkaline fluo-silicate, an alkaline fluorid, an organic salt and ammonia.

19. An electrolyte comprising fluo-silicate of copper, ammonium fluo-silicate, ammonium fluorid, ammonium tartrate and ammonia.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD F. KERN.

Witnesses:

R. M. DOLL,

J. T. GARRETT.