

# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN COBALT ELECTROPLATING.

Specification forming part of Letters Patent No. 172,862, dated February 1, 1876; application filed January 17, 1876.

*To all whom it may concern:*

Be it known that I, ISAAC ADAMS, JR., of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and Improved Process of Cobalt Electroplating, which improvement is fully set forth in the following specification.

The history of the art of electroplating shows that various experiments have been made by electro-metallurgists in the electro-deposition of cobalt; and so far as these experiments or processes are described in the books, it appears that allusions to such deposits have been made as early as 1844, and since that date reference to the same subject may be found in the works of Smee, Becquerel, Ellsner, and Gore.

Gore (1860) simply mentions the solution of the chloride of cobalt as one which may be used. Ellsner (Leipsic, 1851) recommends the cyanide of cobalt and potassium. Becquerel, in a note printed in the Comptes Rendus of the French Academy for July, 1862, states that he has obtained a good deposit from the neutral chloride of cobalt. Smee, in his work on electro-metallurgy, (London, 1844,) in a measure contradicts Becquerel as to the chloride of cobalt, and recommends the solution of the chloride of cobalt with excess of ammonia. He says: "cobalt may be reduced from its chloride, to which excess of ammonia has been added, by using a cobalt positive pole connected with a series of batteries, when the deposition will take place upon the negative plate, which may consist of copper. The reduced metal is white, but it is not thrown down freely. The chloride of cobalt alone seems only to yield an oxide at the negative pole. The cobalto-cyanuret of potassium, formed by digesting oxide of cobalt in the cyanuret, yields, by decomposition with a compound battery, some metal, but hydrogen has a great tendency to be evolved from this solution."

But I have found that none of these processes are of such a nature as to give practical results, nor do they give such information to the practical electroplater as to enable him to produce uniformly and surely an electro-deposit of cobalt suited to the requirements or

exigencies of his art. I have found that a solution made and used in the manner described in the books will not produce such a continuous and uniform deposit of cobalt as is necessary for the successful and practical electroplating of metals with cobalt, and that if the electroplater follows the directions given in the books he not only will be unable to produce successful practical cobalt-plating, but in some cases will bring his solution into such a condition as to prevent any useful deposit of cobalt.

I have found, further, that the simple salts of cobalt, such as are recommended by Becquerel and others, are not such salts as can be used in the practical electroplating with cobalt, and this I find to be true even if they are prepared from pure cobalt.

I have found out, also, that the simple salts of cobalt, when associated with another electrolyte—such as the chloride of ammonium, or the sulphate of ammonia, or the chloride of magnesium, or the sulphate of magnesia—can be used so as to produce good results in practical cobalt-plating; and I find that no good results can be obtained except by the use of a simple salt of cobalt in combination with some other electrolyte of the alkalies or alkaline earths.

I have found that the best of such combined salts are, the chloride of cobalt and ammonium, the chloride of cobalt and magnesium, the sulphate of cobalt and ammonia, or the sulphate of cobalt and magnesia.

I have found, further, that, in order to produce the best results, the cobalt solutions should, in use, be neutral, and (except in covering poorly conducting surfaces) in no case acid.

I find, further, that when solutions of cobalt are used—such as are mentioned in Smee—and contain an excess of ammonia, they become changed, by contact with the air, into such salts of cobalt as are not suitable for practical electroplating with cobalt.

I have found, further, that the electro-deposition of cobalt does not successfully take place in solutions in which exist salts of alkalies—such as the nitrates of soda or potash, or free nitric acid—and the reason of this, I be-



lieve, is, that when these salts are present in the solutions in appreciable amount potash and soda are eliminated in the actual use of the solution simultaneously with the deposit of cobalt, and thus the deposit is rendered worthless for the purposes of the electroplater. Such salts of alkalies, and likewise free acid, are liable to exist in the solution when used, either because they have been introduced therein in the process of making, or because they are introduced or formed therein in the actual using of the solution.

I have now stated, in general terms, the process which I find to be the best for practical cobalt electroplating.

In order to enable a person skilled in the art to practice the process of cobalt electroplating so discovered by me, I give the following as a method by which he can make the necessary solutions and anodes. Pure cobalt is not found in the market, as there is no commercial demand for it, and therefore, in most instances, a cobalt solution would be made from black oxide of cobalt, which, in the state in which it is found in commerce, contains as impurities copper, arsenic, tin, iron, and manganese, or some of these substances, which it is necessary to eliminate. Proceed as follows: Dissolve a given weight of the oxide of cobalt in hydrochloric acid. To this solution add, for every pound of oxide used, a half-pound of the chloride of ammonium. Then filter the solution, if necessary, and to it add sufficient ammonia to render the solution strongly ammoniacal. Then allow this ammoniacal solution to stand, with occasional brisk stirring, until it becomes of a wine-red color. Then add an excess of commercial muriatic acid, and raise the whole to the boiling-point, and wash the light purple precipitate by decantation with cold water several times. Throw the precipitate upon a cloth filter, wash again with cold water, and allow it to drain and dry, and then heat the dried salt to a low red heat in a crucible or other suitable vessel, and a chloride of cobalt will be produced practically free from impurities.

To produce the chloride of cobalt and ammonium, make a solution by dissolving three ounces of the chloride of cobalt and two ounces of pure chloride of ammonium to each gallon of the solution.

To produce a solution of the chloride of cobalt and magnesium, make a solution as above, substituting chloride of magnesium for the chloride of ammonium.

To produce a solution of the sulphate of cobalt and ammonia, dissolve the chloride of cobalt in water, and for every five parts of such dry salt add four parts, by weight, of sulphuric acid and evaporate to dryness; redissolve in water and add five parts of pure sulphate of ammonia. If there should be an excess of acid, neutralize with ammonia.

To produce the sulphate of cobalt and mag-

nesia, make a solution as just directed, substituting sulphate of magnesia for sulphate of ammonia.

I have given the above as one of the processes of making such solutions as I have before herein referred to.

I do not claim the processes of making these solutions as my invention, and in no way limit my invention to the precise chemical processes by which these solutions are produced ready for use.

The solutions, when made as above described, will mark from 6° to 7° Baumé, though much weaker solutions may be used, and even stronger ones, if desired.

I do not confine my invention to the particular proportions of each salt contained in the solutions above described, for the proportions of each salt may be varied in any given solution. I have given the above proportions of these salts as those which I prefer.

The method for producing a suitable anode to be used with these solutions is as follows: Precipitate the chloride of cobalt with potash, soda, or carbonate of ammonia; then make a solution of tartaric acid, about three parts of acid to two parts of dry chloride, and add to it the moist oxide of cobalt, and raise the whole to the boiling-point. A tartrate of cobalt is formed, which throw upon the filter and wash several times with boiling water, dry, mix with a little lamp-black or other suitable form of pure carbon, and heat to whiteness in a closed Hessian or other suitable crucible. The tartrate of cobalt is thus reduced to the metallic state and fused, and can then be readily cast into plates or anodes of any desirable form.

After the solutions and anodes have been prepared as herein described, cobalt may be readily and continuously deposited; but in order to carry on the deposition of cobalt continuously it is necessary to observe certain precautions. First, great care should be exercised, in preparing the work for plating, that none of the acid or alkaline dips should be introduced into the solution. Second, a not too high battery-power should be used; a strength of current of two Smee cells is sufficient.

In plating articles of zinc with cobalt it is first necessary to coat them with copper.

Having thus described my invention of improved processes of electroplating with cobalt, I claim—

1. In the electro-deposition of cobalt, the use of a solution of a simple salt of cobalt, combined with another electrolyte, consisting of a salt of the alkalies or alkaline earths, substantially as described.

2. The use, in the electro-deposition of cobalt, of a solution of a chloride of cobalt and ammonium, or chloride of cobalt and magnesium, or sulphate of cobalt and ammonia, or the sulphate of cobalt and magnesia, substantially as described.



3. The use, in the electro-deposition of cobalt, of a neutral solution, neither acid nor alkaline, substantially as described.

4. The use, in the electro-deposition of cobalt, of solutions of cobalt, in the manner described, so as to be at all times during the operation free from the presence of soda, potash, or nitric acid, or either of them.

5. The process of making an anode of co-

balt, which consists in converting the chloride or other salt of cobalt into the tartrate, mixing this with carbon, heating to reduction, and finally casting, substantially as described.

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Witnesses:

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