

UNITED STATES PATENT OFFICE.

JAMES POWELL, OF CINCINNATI, OHIO.

SOLUTION FOR ELECTRO-DEPOSITION OF NICKEL.

SPECIFICATION forming part of Letters Patent No. 228,389, dated June 1, 1880.

Application filed May 2, 1879.

To all whom it may concern:

Be it known that I, JAMES POWELL, of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful

5 Improvements in the Electro-Deposition of Nickel; and I hereby declare the following to be a full, clear, and exact description of the same, which will enable others skilled in the art to make and use it.

10 The solutions now in general use for the electro-deposition of nickel, such as the double salts of sulphate or chloride of nickel and ammonia, become, under the continuous influence of the electric current, more or less de-

15 composed, and do not afford satisfactory results, the deposit being often black and powdery and easily rubbed off the article so plated.

My invention is designed to obviate these objections; and I accomplish this by forming

20 entirely new combinations of nickel salts, and adding thereto the pyrophosphates in their free or combined states. By varying the proportions of the salts I insure different qualities of deposit—as, for example, for bright and

25 smooth work the deposit should be uniform and dense in structure, so as to obviate laborious polishing and prevent undue abrasion of the prominent parts or edges of the plated goods. On the other hand, goods that are

30 “chased” or “matted” require that the plating should be of a “dead” or “frosted” appearance. This difference in the character of the deposit cannot be obtained with any other solution that I am aware of—as, for instance, the

35 double salts previously alluded to (sulphate or chloride of nickel and ammonia) can be successfully worked only when there is neither an acid nor alkaline reaction, or when said salts are pure and free from the presence of soda,

40 potash, lime, or other foreign salts, and these solutions must be strictly maintained in definite proportions to insure even ordinary results.

My method of preparing my solution is such

45 that when an additional ingredient is added no destructive decomposition or reaction occurs which would be injurious to its working qualities, but rather the contrary—namely, that each ingredient added shall be with a view

50 to insure the better operation of the solution for its special work. I have discovered that

pyrophosphoric acid, when properly combined with other nickel salts, makes a very superior depositing solution, and the great advantage arising from its use is, that the addition of

55 other salts does not affect its or their chemical affinities in the least.

I am aware that a solution of the double normal phosphate of potash and nickel is mentioned by Gore as a theoretical test for the

60 deposition of nickel, but no formula is given; and in practice it has been found that such a solution is unstable and cannot give constant or uniform results, from the fact that, the phosphate of potash not being a solvent of the

65 nickel anodes, the small proportion of nickel contained in the solution when freshly prepared is soon extracted under the action of the electrical current, and it ceases to yield

70 its metal in a reguline state. I therefore do not claim the use of that salt; but I have discovered that while the phosphates of soda or potash have little or no affinity for the nickel

75 bases, on the contrary, the pyrophosphates will readily dissolve nickel in various combinations, for the reason that the phosphate of soda or potash is a tribasic compound, being formed

80 of one equivalent of phosphoric acid, two equivalents of soda, and one equivalent of water. This salt, when placed in a crucible of cast-iron

85 and subjected to a high temperature, melts and first loses all of its water of crystallization; then by increasing the temperature it finally loses all of its combined water.

The nature of the salt is now completely

85 altered, it having been converted into a bi-basic salt capable of combining readily with a metallic base in place of the equivalent of water lost. When the alkaline pyrophosphates are thus united to a metallic base they again

90 become tribasic salts and remain so permanently.

The peculiar action of the pyrophosphates causes a great improvement in the character of the deposit, and by making combinations of

95 certain proportions I am enabled to so modify my solutions as that their action under the influence of the electric current can be made to produce a bright deposit for highly-finished work, or a frosted or dead-white deposit for

100 matted or chased work.

It has been common heretofore to add bisul-

phite of ammonia to nickel-plating solutions; but as the ammonia, under the influence of the electric current, is soon driven off as a gas, it ceases to give beneficial results; but I have
5 discovered that bisulphite of soda, when combined with certain nickel salts, and more especially with phosphate of nickel, gives a higher degree of conducting power, and also improves the character of the deposit, and as
o the soda cannot be driven off, it forms a fixed compound.

My improvement may be more fully described as follows:

First, it consists in the use of the pyrophosphates, combined with other salts, to dissolve the nickel base; second, in the combination of the pyrophosphates of nickel with the bisulphite of soda, with or without the addition of ammonia.

I do not limit myself to a precise formula, as the amounts of the various ingredients may be varied without departing from the spirit of my invention.

One great advantage arising from the use of my solutions is, that the various metals and their alloys are electro-negative with reference to a solution containing pyrophosphates or phosphoric acid; hence no decomposition or local action occurs when they are immersed in the bath. Thus zinc articles, which cannot be plated in a solution of double sulphate or chloride of nickel and ammonia, are beautifully plated with a firm adhesive layer of metal by using my solutions, and the deposit is white in color and very ductile.

Without limiting myself to the precise formula, and reserving to myself the right to vary the proportion and ingredients to suit the requirements of special cases, I prefer the following proportions for a general average solution for most work: To each gallon of water add three ounces of phosphate of nickel;

three and one-half ounces of pyrophosphate of soda; two ounces of citrate of nickel; one ounce of citric acid; one-half ounce of bisulphite of soda; five ounces of aqua-ammonia, (16%.) 45

In preparing the phosphate of nickel I prefer to use the carbonate of nickel and dissolve it in aqueous solution of phosphoric acid until it is saturated, which solution may then, if desired, be evaporated and crystallized for future use. 50

After compounding my solutions I prefer to add a small excess of the acid or alkali to them for the purpose of improving their conducting power, using an excess of acid when the work to be plated is composed of copper or its alloys, while an excess of alkali is added for work composed of iron or lead and tin and their alloys. 55 60

If preferred, instead of dissolving the carbonate or oxide of nickel in the acids, the uncombined salts may be dissolved in the water alone, and the proper amount of nickel can be added by placing the anodes in the bath and connecting them with the electric current in the usual manner well known to electroplaters. 65

Having thus described my invention, my claim is— 70

1. An electro-depositing solution of the single or double salts of nickel to which has been added the pyrophosphate of soda or potash.

2. An electro-depositing solution composed of the pyrophosphate of soda, phosphate of nickel, the bisulphite of soda, and citrate of nickel and ammonia, substantially as set forth. 75

In testimony of which invention I hereunto set my hand.

JAMES POWELL.

Witnesses:

JAMES H. LAYMAN,
GEORGE H. KOLKER.