

**Practical Hints on Cobalt Plating.**

BY ALEXANDER WATT.

Since cobalt as a coating for other metals, as brass, copper, and steel, for instance, presents some advantages which would render cobalting a useful substitute for nickel plating, I have lately made a series of experimental trials with a view to point out as far as possible the most favorable conditions under which successful and uniform results may be obtained in the deposition of this metal for practical purposes. Cobalt, being a whiter metal than nickel, would be a useful coating for ornamental brasswork, as also for small fancy articles in which a cheap white metallic film is desirable. Being softer than nickel, articles coated with cobalt may readily be brightened by burnishing, a process that could not advantageously be applied to nickel-plated surfaces. Like nickel, cobalt is a non-oxidizable metal, and therefore retains its color in ordinary atmospheres. Although cobalt is a dearer metal than nickel, I am disposed to think that its employment as a substitute for the latter metal would not in the long run greatly exceed, if at all, that of nickel-plating, and for the following reasons: Only one-third of the quantity of "salts" are required to make up a bath; about one-third of the anode surface is required; the deposited metal, being softer than nickel, naturally requires less labor in finishing; and, finally, less current is required than for nickel. Taking, therefore, these points into consideration, they will probably be found to balance those in favor of the cheaper metal. As to the difference in value of the respective metals when actually deposited upon the work done, this might probably be counterbalanced by extra charges for the cobalting articles, which might reasonably be demanded so long as the cobalting remained a novelty.

In making up a bath, the salts employed were the double sulphates of cobalt and ammonia, this compound being practically the most suitable for commercial purposes; and in order to ascertain the proper density at which the bath should be prepared, solutions of various densities were tried, and the one which appeared to yield the best results was selected. The next point to determine was the density of current which would give a perfectly adherent deposit of good color, and free from "burning" at the corners of a flat plate or projecting surfaces of an article. After making many modifications in the strength of the solution, it was found that a bath of the specific gravity of 1015 (water being 1,000) at 60° F. gave the best results, and this was obtained by dissolving 4½ oz. of the double sulphates of cobalt and ammonia in one gallon of water. This solution worked most favorably with a current of about 0.800 ampere, the E. M. F. being about two volts. The electrodes used in the first trials were a well-cleaned brass plate 3 in. by 2 in. for the cathode, while the anode consisted of a plate of rolled cobalt, supplied by Messrs. Henry Wiggin & Co., of Birmingham, from whom also the cobalt salts were obtained. The next point to determine was the amount of anode surface which was necessary to admit of a prompt deposit, and yet not too quick for an adherent film. With the current named, and about equal electrode surface, it was found necessary, after a few minutes' immersion of the brass cathode, to remove a considerable portion of the anode from the bath, in consequence of the plate becoming blackened or "burnt," as it is termed, at the corners; when the surface of the anode was reduced to about one-third that of the brass plate, deposition took place with perfect uniformity, and there was no longer the least tendency to the discoloration referred to. It thus became evident that an important consideration in the electro-deposition of cobalt is the amount of anode surface which is most suitable in a cobalt bath of a given density. In nickel-plating, as is well known, this is not a matter of so much importance, and it is commonly the practice to employ a very large surface of anodes in the baths, almost regardless of the actual surface presented by the articles suspended in the solution. My object in directing special attention to this difference between the operations of cobalting and nickel plating is that I believe that one of the reasons why the electro-deposition of cobalt has not been successful in some hands is that too little attention has been paid to the detail I have pointed out.

To prepare a solution bath for cobalt plating, 4½ oz. of the crystals of double sulphate of nickel and ammonium for each gallon of the bath should be dissolved in hot water, and the solution then made up to the required quantity by the necessary addition of cold water. The solution should then have a specific gravity of about 1015 at the temperature of 60° F. For the successful deposition of cobalt upon articles formed of brass, copper, steel, or iron, the anodes may be of rolled cobalt, in narrow strips, say about 2 in. wide and 12 in. to 18 in. long, according to the size of the depositing tank. The anodes should be placed about 6 in. apart along the sides of the tank, and in the case of large tanks, say vessels holding 200 or 300 gallons or more, a corresponding series of anodes should be suspended from a conducting rod placed lengthwise, and resting on the ends of the tank, as in nickel plating, etc. All work to be coated with cobalt should be

polished and prepared for the solution precisely in the same way as for nickel plating, and before they are immersed in the bath the current must be so regulated that the work may become coated with a film of metal, or "struck," as it is termed, within a few seconds after being placed in the bath. There need be no fear of the work stripping—provided it has been properly potashed and scoured—if the articles become coated immediately after immersion, but in this case the current must be at once reduced, otherwise the work is sure to "burn," or become discolored, at certain parts in a few minutes after. It is far preferable, indeed necessary, after the first film has been obtained, to immediately diminish the current, this being again augmented when other articles are put into the bath. By watching the rate at which each article becomes coated, and regulating the current accordingly, the probability of burning the work will be readily overcome. My reason for directing special attention to this is that cobalt deposits so much more readily than nickel that any person unacquainted with the deposition of cobalt and treating it as he would nickel might naturally fall into error, readily avoided, which would cause failure and disappointment. It should always be the rule, therefore, in cobalt plating to diminish the current so soon as the article is fairly coated all over, but more especially is this the case when the work becomes coated instantly after immersion. Since copper does not appear to receive a deposit of cobalt quite so readily as brass with the same amount of current, it will be found advisable, when copper articles are to be cobalting, to start with a somewhat stronger current than would be required for the yellow alloy; but when the piece of work has fairly struck all over with the stronger current, this must afterward be reduced somewhat during the remainder of the time the article is in the bath. In cases where a dead cobalt surface is required, the articles, having been dipped in the usual way, may be scoured with powdered pumice, or, still better, with powdered bathbrick, and after rinsing placed in the bath, using a rather strong current at first, and reducing it after the work is coated all over. If such articles have projecting points, these must not be allowed to approach too close to the anodes, otherwise such parts will be apt to become dark; should such be the case at any time, however, the piece of work must be removed and again scoured at the discolored spot and then rinsed and returned to the bath, a weaker current being used. All dead work, after removal from the bath, should be plunged into clean boiling water and allowed to dry spontaneously, care being taken not to handle the work at such parts as will be required to present a clean white surface. When a brighter surface is required, the work may be scratch-brushed at the lathe with brushes made from fine steel wire, moistened with beer in the usual way, after which the pieces may be dipped in a solution of cyanide of potassium, and finally rinsed in boiling water and then put into clean box sawdust. Buttons and other small fancy brass articles may be treated in this way.

In depositing cobalt upon steel or iron surfaces a much weaker current is required than for either brass or copper. The current from a single Daniell cell is amply sufficient for coating small steel articles, and, since cobalt adheres very firmly to this metal, it will be found useful for imparting a white coating to many articles formed of steel or iron. It is also important to note that steel articles coated with cobalt may be brightened by ordinary burnishing, for, as before observed, cobalt is softer than nickel and yields very readily to the pressure of the burnisher. When depositing cobalt upon cast iron, a rather strong current must be used to secure an immediate coating after the work has been placed in the bath, after which, as before, the strength must be diminished and sustained at a uniform density until a sufficiently stout coating is obtained. Here, again, it is necessary to point out that projecting surfaces must be kept as far away from the anode as possible, so that those portions may not become discolored or "burnt" and necessitate rescouring.

There is another feature in cobalt depositing which presents an advantage over nickeling which it is well to mention, namely, that when it is found necessary from any cause to rescour a piece of work and return it to the bath until finished, the operator need not fear, I believe, that the work will be liable to strip after the second coat has been given, for I have generally found that brass and even steel surfaces may be frequently rescoured and cobalting again and again without the metal stripping in the least degree. In the case of nickel we all know that the deposition of film upon film of this metal is almost invariably succeeded by the second coating separating from its predecessor. It may be further remarked that the rescouring of the work, to produce an improved surface upon a defective film, can scarcely be applied to a nickel-plated article, owing to the extreme hardness of the metal. With respect to cobalt, however, the case is different, for with good brisk brushing with pumice, silver sand, or bathbrick reduced to a powder, I have found no difficulty in producing the surface necessary

for a satisfactory deposit of the metal when from various causes it was found necessary to repeatedly rescour the plates used in the experimental trials referred to. In no instance, however, did the subsequent layers of cobalt strip or peel off the metal already deposited.

Some attempts were made to deposit cobalt upon zinc from the double sulphate solution, but in each instance it was found that the film was non-adherent, except in portions of surface where partial adhesion of the metals occurred. Although there are some other solutions of cobalt than the above which would be more suitable for cobalting zinc, it is somewhat doubtful whether a really good deposit of cobalt on this metal could be obtained with any degree of certainty.

In working the solution prepared from the double sulphates of cobalt and ammonium, it appears to be necessary to maintain the liquid at as uniform a density as possible, and for several reasons. For instance, if the bath be allowed to acquire a higher density than about 1.015, by the spontaneous evaporation of a portion of its water, the color of the deposit will probably become affected, and a darker tone imparted to the articles instead of a tolerably good white characteristic of electrolytic cobalt when deposited under more favorable conditions. To obviate such a defect in the metallic strength of the bath, the hydrometer should be floated in the liquid at least once a week, especially in warm weather; and whenever the solution indicates a higher density than it originally had, an addition of water must be made until the specific gravity has been reduced to the proper figure. These additions of water, however, should be made in the evening, or when the bath is not being used, and the solution must be well stirred, and then allowed to rest for at least 12 hours. It is also necessary to avoid adding an excess of water, since a solution much weaker than that indicated will be apt to cause the deposit to be patchy, and certain parts of the article may for a time refuse to receive the deposit. These observations are based upon results actually obtained under the conditions referred to, but the defects may readily be avoided by adopting the precautions suggested.

Respecting what is understood as the color of the deposit, this is greatly influenced by the strength and tension of the current. For instance, it is perfectly easy to obtain film of cobalt upon brass surfaces with an E. M. F. of one volt and a large surface of anode, but this deposit will not be so white as when the current has an E. M. F. of two volts, with small anode surface—that is, about two-thirds less than that of the cathode, or article to be coated.

With respect to the purposes to which cobalting is most applicable, these may be taken as being, on the whole, similar to those for which nickel plating is adopted, but, like the latter metal, it should never be applied to culinary or drinking vessels, since it is, like nickel, readily acted upon and stained by vegetable acids, vinegar, for example, beer, and also by vegetable infusions, such as tea, the water in which cabbages have been boiled, and other liquors of a similar nature. Cobalt also resembles nickel in becoming dull when long exposed to damp atmospheres, and should not, therefore, be employed for articles which are required for out-of-door ornamentation, unless the surfaces can be persistently rubbed over with a dry leather every day. On the other hand, cobalt plating may be adopted for any class of art metal work which is destined to remain in ordinary dry apartments, as fenders, fireirons, etc., or for ornamental work to be worn on the person. Mullers, sausage warmers, dental instruments, and cast brasswork, such as lavatory taps and so forth, may be advantageously coated with cobalt, the articles being prepared and finished as before observed precisely in the same way as in nickel plating.—*Electrical Engineer, London.*

**New Zealand Sulphuric Acid Works.**

The long-closed sulphur works at Tauranga, 100 miles south of Auckland, are about to be opened, and utilized in the manufacture of sulphuric acid, by Messrs. Sharland & Co., of Auckland. On a small islet, called White Islet, some miles off the coast, there is an inexhaustible supply of crude sulphur in a high degree of purity, but, owing to the lessee and part owner of the island refusing to allow it to be worked, this source is not available; but at Matata, some 50 miles south of Tauranga, there is another enormous deposit of sulphur. Other localities, too, not far removed are rich in this element, and the proprietors of the works will have no difficulty in obtaining supplies.

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