

1

3,249,409

CHROMIUM PLATED METAL STRUCTURES
Henry G. McLeod, St. Catharines, Ontario, Canada,
assignor to E. I. du Pont de Nemours and Company,
Wilmington, Del., a corporation of Delaware
No Drawing. Filed Jan. 23, 1963, Ser. No. 253,271
3 Claims. (Cl. 29—199)

This invention relates to improved chromium plated metal structures, and more particularly it relates to chromium plated metal structures having a greatly improved corrosion resistance and method for producing the same.

Metal structures such as iron, steel, zinc base die castings and the like are customarily plated with a series of electrodepositions of copper, nickel and chromium. The copper is electroplated as a smooth base coat, the nickel is electroplated over the copper plate for appearance and corrosion resistance and the chromium is plated over the nickel for decorative effect.

The corrosion resistance of such Cu-Ni-Cr composite electrodeposits is mediocre especially in northern industrial cities. Such composite plates on automobiles and other structures often shows unsightly rusting when exposed for only one winter in these areas.

It is an object of this invention to produce on metal substrates bright composite electroplates having an outside coating of chromium which will have a greatly increased corrosion resistance under such conditions.

It is another object of this invention to provide a composite Cu-Ni-Cr electrodeposit on metal structures with a particularly effective electrodeposited barrier layer to greatly increase corrosion resistance.

Other objects of the invention will appear hereinafter.

The objects of this invention may be accomplished by the electrodeposition of a thin layer of cadmium between the copper and nickel deposits of a composite Cu-Ni-Cr electrodeposit on a metal substrate. This extra deposit functions as a barrier layer to arrest any corrosion that may have affected the top chromium and nickel layers. A marked improvement in corrosion resistance results from the presence of this barrier layer. The extent of this improvement is far greater than expected and far exceeds that due merely from the thickness of this deposit. Marked improvement has been obtained with barrier layers as thin as 0.1 mil.

The following example is given to illustrate the improved corrosion resistance of the barrier layers of this invention, it being understood that the details of these examples are not to be taken as limiting the invention.

Example

Steel panels were plated with about 0.8 mil copper from a typical cyanide copper plating solution such as disclosed in Martin U.S. Patent No. 2,861,929 and then with about 0.7 mil nickel from a typical nickel plating solution such as disclosed in Towle U.S. Patent No. 2,972,571 and finally with about 0.01 mil chromium from a chromic acid plating bath, for example, as disclosed in Brown U.S. Patent No. 2,750,334. This represents a plating finish of the kind used commercially today.

Similar steel panels were next plated as in the preceding paragraph with copper, nickel and chromium with the exception that a 0.1 mil layer of cadmium was plated between the copper and nickel plates. The cadmium was plated from a typical cadmium plating bath such as disclosed in Hendrick's U.S. Patent No. 2,085,747.

For comparison, panels were prepared in which the steel was plated with 0.1 and 0.5 mil cadmium followed by

2

0.8 mil copper, 0.7 mil nickel and finally 0.01 mil chromium.

All panels were exposed to the "Cass" corrosion test with the results set forth below.

The "Cass" corrosion test refers to the copper accelerated acetic acid salt spray test developed for the auto industry to simulate corrosion observed on automobiles exposed to outdoor atmospheric conditions. This test is described in an article by W. L. Pinner in "Plating," vol. 44, p. 763 (1957). Briefly, in this test, parts are exposed in a closed cabinet to a fine mist of salt solution containing 5% NaCl, 1 to 1.1 g. per gallon copper chloride (CuCl₂·2H₂O) and made acid to pH 3.2 with acetic acid. The temperature within the cabinet is maintained at 120° F. Parts are examined once a day and are rated according to the following tabulation.

No failure	5
Slight failure, not over 10% of total visible area affected	4
Moderate failure, 10-30% of total visible area affected	3
Severe failure, 30%-70% of total visible area affected	2
Total failure, more than 70% of total visible area affected	1

The term "failure" in the above tabulation refers to rust, cracks, pits and blisters.

The coated panels above-described when subjected to the "Cass" test had the following ratings:

Coating thickness, Mils					Rating after exposure, hrs.	
Plating Order						
Cd	Cu	Cd	Ni	Cr	22	44
-----	0.8	-----	0.7	0.01	3.2	2.8
0.1	0.8	-----	0.7	0.01	4.2	2.2
0.5	0.8	-----	0.7	0.01	4.2	3.2
-----	0.8	0.1	0.7	0.01	5	4.8

Clearly, the inclusion of a thin plate of Cd between Cu and Ni improved corrosion resistance markedly whereas a similar Cd plate between the steel substrate and the copper was substantially ineffective in the 44 hour test.

The cadmium barrier plates of this invention should have a thickness of at least 0.1 mil and may have as much thickness as desired.

Throughout the specification and claims, any reference to parts, proportions and percentages refers to parts, proportions and percentages by weight unless otherwise specified.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited to said details except as set forth in the appended claims.

What is claimed is:

1. A metal substrate having a protective corrosion resistant composite electroplate comprising an electroplate of copper, a barrier electroplate of cadmium, and successive electroplates of nickel and chromium.

2. A metal substrate having a protective corrosion resistant composite electroplate comprising an electroplate of copper, a barrier electroplate of at least 0.1 mil thickness of cadmium, and successive electroplates of nickel and chromium.

3

3. A metal substrate having a protective corrosion resistant composite electroplate comprising an electroplate of copper, a barrier electroplate of cadmium and successive electroplates of nickel and chromium.

References Cited by the Examiner

UNITED STATES PATENTS

2,181,773	11/1939	Wernlund.	
2,388,019	10/1945	Strickland	29—196.6
3,009,236	11/1961	Wesley	204—41 XR
3,045,334	7/1962	Berzins	29—194

4

FOREIGN PATENTS

151,636	5/1953	Australia.
717,985	11/1954	Great Britain.

5

OTHER REFERENCES

Handbook of Engineering Materials by Miner & Seastone, published by John Wiley & Sons, 1955, New York, sections 2-321 to 2-333.

10 DAVID L. RECK, *Primary Examiner.*

HYLAND BIZOT, *Examiner.*