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RUST-RESISTANT PLATED ARTICLE.

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To all whom it may concern:

Be it known that I, CHRISTIAN JOHN WERNLUND, a citizen of the United States, and resident of Tottenville, in the county of Richmond and State of New York, have invented certain new and useful Improvements in Rust-Resistant Plated Articles, of which the following is a specification.

My invention relates in general to the electroplating on iron and steel or other metal articles of alloys with zinc of metals having a higher solution potential than iron, such as cadmium.

Cadmium has many properties which render it advantageous over other metals and alloys as a protective coating for metals such as iron and steel. It is light in color and has a higher solution potential than iron, thus tending to protect the iron from corrosion. As its solution potential is higher than that of iron and lower than that of zinc, the same weight of protective coating of cadmium affords more protection to atmospheric corrosion than is afforded by straight zinc. Also more cadmium than zinc can be deposited per unit of current used. The oxide coating formed by atmospheric or other corrosion of cadmium is thinner and more adherent than that formed on zinc, consequently the tendency of cadmium to scale off and waste away is much less pronounced than that of zinc.

While I have found that pure cadmium coatings can be effectively deposited electrolytically, I have further found that alloy coatings comprising cadmium retain in large measure the advantageous features of pure cadmium coatings in durability and rapidity of deposit and can be much more cheaply and conveniently produced than previous coatings of pure cadmium. According to my invention, I produce alloyed coatings comprising cadmium and another metal, such as cadmium and mercury or zinc, or zinc cadmium and mercury, using either plain anodes with a suitable bath, or alloy anodes, or both. The coatings have the enhanced practical advantages characteristic of pure cadmium coatings in giving better protection than zinc with less thickness, good color of coating, and economy of current. The advantage of using mercury in combination with cadmium or zinc and cadmium is that the resultant coating is more resistant to corrosion than cadmium or zinc alone. The cathode potential is raised with consequent increased throwing power.

Such a coating may be formed by the use of a plating solution to which the proper addition of cadmium or cadmium and mercury compounds soluble in the bath have been made, or the metals can be furnished to the solution by the use of cadmium anodes and zinc anodes or alloy anodes. If mercury is not desired in the final product a binary anode of zinc and cadmium can be used.

Examples of the scope of this invention are as follows:

Example I.

To plate steel articles such as stampings for aeroplane parts, I may proceed as follows:

The parts are first cleaned, preferably by sand blasting until all of the scale and loose dirt are removed. They are then put in a hot alkaline cleaning solution containing from 1% to 5% of sodium hydroxide in order to preserve the clean surface.

The parts so cleaned are rinsed in water and suspended from the cathode rod into a cadmium mercury alloy plating solution of the following composition:

Water	1	L.	1 gal.
Sodium cyanide	60	G.	8 oz.
Sodium hydroxide	15	G.	2 oz.
Cadmium hydrate	15	G.	2 oz.
Mercuric oxide	0.1	G.	0.0125 oz.

Other conditions maintained are as follows:

Anodes	Cadmium.
Temperature	25° C. (77° F.)
E. M. F.	3 to 6 volts.
Current	15 amperes per sq. ft.

An average analysis of the coating produced will show cadmium 98–99% and mercury 1–2%.

The various ingredients of the bath must be replenished from time to time as they become depleted.

Example II.

I have found that a preferable method of stabilizing the cadmium and mercury contents of the bath is to use a cadmium mercury alloy anode to supply the desired quantities of these metals to the solution. A preferred composition of such an alloy anode is cadmium 98%, mercury 2%.

In plating for example steel fittings for aeroplane parts, I proceed as in Example I, with the exception that in this case, the above mentioned alloy anodes are used. A coating of similar analysis to that in Example I is obtained.

Example III.

To plate wire screen with a zinc cadmium alloy, the material is cleaned by an alkaline electric cleaner or when rusty by alternate acid and alkaline pickling until a chemically clean metallic surface is secured. The wire may then be plated in the following solution:

Water	1	L.	1 gal.
Sodium cyanide	45	G.	6 oz.
Sodium hydroxide	30	G.	4 oz.
Zinc cyanide	30	G.	4 oz.
Cadmium hydrate	7.5	G.	1 oz.

Other conditions maintained are as follows:

Temperature	25° C. (77° F.)
E. M. F.	3 to 6 volts.
Current	25 amperes per sq. ft.
Anodes	zinc.

The bath must be replenished from time to time as the several ingredients become depleted. An average analysis of the resulting coating will be zinc 70–75%, cadmium 25–30%.

Example IV.

I have also found that the zinc and cadmium contents of the bath may be stabilized by using zinc cadmium alloy anodes to supply the desire quantities of these metals to the solution. A preferred composition of such an alloy anode is zinc 75%, cadmium 25%.

In plating, for example, wire screen, I proceed as in Example III with the exception that in this case I substitute the zinc cadmium in place of the straight zinc anodes.

Example V.

To plate steel casters with a zinc cadmium mercury alloy, they are cleaned by one of the alternative methods given in Example III depending upon their condition. When a chemically clean surface has been obtained, they may be plated in the following solution:

Water	1	L.	1 gal.
Sodium cyanide	45	G.	6 oz.
Sodium hydroxide	30	G.	4 oz.
Zinc cyanide	30	G.	4 oz.
Cadmium hydrate	7.5	G.	1 oz.
Mercuric oxide	0.1	G.	0.0125 oz.

Other conditions maintained are as follows:

Temperature	40° C.
E. M. F.	3 to 6 volts.
Current	25 amperes per sq. ft.
Anodes	zinc.

The bath must be replenished from time to time as the several ingredients become depleted. An average analysis of the coating obtained is zinc 70–80%, cadmium 20–30%, mercury 1–2%.

Example VI.

I have also found that the zinc, cadmium and mercury contents of the bath may be stabilized by using zinc cadmium mercury alloy anodes to supply the desired quantities of these metals to the solution. A preferred composition of such an alloy anode is zinc 73%, cadmium 25%, mercury 2%.

In plating, for example, steel casters I proceed as in Example V, with the exception that in this case, I substitute the zinc cadmium mercury in place of the straight zinc anodes. A coating of similar analysis to that in Example V is obtained.

For some purposes, I have used a zinc cadmium mercury alloy anode of the following composition: zinc 93%, cadmium 5%, mercury 2%.

In Examples III, IV, V, and VI, I have described methods of depositing coatings containing zinc and cadmium with and without mercury and in which zinc is the major constituent. These are the best coatings involving economy of raw materials. If desired, alloy coatings can be deposited whose major constituent is cadmium without departing from the spirit of this invention.

In all the above examples the plating has been done in a still bath. It is understood that if mechanical solutions are used such as in barrel plating the concentrations of solutions, currents required, etc. may be changed considerably to conform to the different operating conditions.

The elimination of any single component of the ternary alloy described above and in the following claims gives a binary alloy deposit either superior to straight zinc deposits or cheaper than straight cadmium.

What I claim is:

1. As a new article of manufacture, a ferrous article having an electrolytic coating comprising zinc together with 2% or more of cadmium.

2. As a new article of manufacture, a ferrous article having an electrolytic coating comprising zinc, 2% or more of cadmium, and another metal having a solution potential lower than that of iron.

3. As a new article of manufacture, a ferrous article having an electrolytic coating comprising zinc and more than 2% of another metal having a solution potential higher than that of iron.

4. As a new article of manufacture, a ferrous article having an electrolytic coating comprising cadmium and zinc as major constitutents and mercury as a minor constituent.

5. As a new article of manufacture, a ferrous article having an electrolytic coating comprising cadmium from 2–30% and zinc from 70–98%.

6. As a new article of manufacture, a ferrous article having an electrolytic coating comprising cadmium from 2–30%, zinc from 70–97%, and mercury from 1–2%.

7. As a new article of manufacture, a ferrous article having an electrolytic coating comprising cadmium and mercury, cadmium being a major constituent.

8. As a new article of manufacture, a metal article, having an electrolytic coating comprising zinc together with 2% or more of cadmium.

9. As a new article of manufacture, a metal article, having an electrolytic coating comprising 2% or more of cadmium, zinc, and another metal having a solution potential lower than that of iron.

10. As a new article of manufacture, a metal article, having an electrolytic coating comprising zinc and more than 2% of another metal having a solution potential higher than that of iron.

11. As a new article of manufacture, a metal article having an electrolytic coating comprising 2% or more of cadmium, together with zinc and mercury.

12. As a new article of manufacture, a metal article, having an electrolytic coating comprising cadmium 2–30% and zinc from 70–98%.

13. As a new article of manufacture, a metal article having an electrolytic coating comprising cadmium from 2–30%, zinc from 70–97%, and mercury from 1–2%.

14. As a new article of manufacture, a metal article having an electrolytic coating comprising cadmium and mercury, cadmium being a major constituent.

Signed at Perth Amboy, in the county of Middlesex and State of New Jersey, this 28th day of December, A. D., 1923.

CHRISTIAN JOHN WERNLUND.