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ALLOY PLATED IRON AND STEEL AND PROCESS OF MAKING THE SAME

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This invention relates to alloy plated iron and steel; and it comprises iron or steel coated and protected with an electrodeposited layer of zinc-tin alloy; and it further comprises a method of producing such articles wherein iron or steel articles are plated with a zinc-tin alloy from a compound bath containing zinc and tin salts and also containing cyanides, pyrophosphates and alkali, the saline composition of said bath being advantageously adjusted to give zinc and tin about the same deposition potential, replenishment of the bath being advantageously by electric solution of double anodes of zinc and tin or by anodes of zinc-tin alloy; all as more fully hereinafter set forth and as claimed.

The protection against corrosion afforded to iron and steel by an electroplated coating depends partly upon its continuity and partly upon the position of the coating metal in the electrochemical scale. Copper coatings, for example, owe their entire value to their continuity, since copper is electronegative to iron and, with a break or pore in the coating, corrosion is accelerated. Zinc, being highly electropositive to iron, protects not only because of its shielding value, but because corrosion is restricted to zinc where both zinc and iron are exposed. However, this also means that the zinc corrodes more quickly because of the presence of iron; any kind of a pore or break in the surface tending to enlarge. Cadmium coatings have lately come into extensive use, since, in addition to their decorative value, they are found in practice to have great protective value even with very thin films; a fact which is probably due, in part, to the position of cadmium relative to iron in the electrochemical scale. It does not tend to accelerate corrosion of the iron. Cadmium coatings have a much greater protective value than zinc coatings. Standard salt spray tests on electrodeposited zinc coatings on iron or steel sheets indicate an average life of about 200 hours with a coating of about 0.0012 inches, while much thinner cadmium coatings, say, only 0.0002 inches will give a life of 500 to 1,000 hours. A cadmium coating on iron of 0.0003 inches is sometimes regarded as equivalent, for protective purposes, to a zinc coating of 0.001 inches.

Cadmium is, however, a much more expensive metal than zinc. It is an object of the present invention to produce a coating practically as inexpensive as one of zinc, of greater protective value and without its undesirable characteristics; this coating being even more advantageous than one of cadmium, while cheaper. To this end, we use as a protective coating a zinc-tin alloy; zinc containing some alloying tin. We find that in practice the amount of tin in the coating should not be less than about 5 per cent and we often use as high as 35 per cent. Much depends upon the particular purpose for which the coating is intended. Generally, however, we do not go below 7 per cent or above 25 per cent. A 25 per cent alloy is particularly suitable for our purposes. The appearance of these alloys, after buffing and polishing, is extremely decorative. Coatings of zinc-tin alloys made under the present invention have a protective value commensurate with that of cadmium of the same thickness. The new coatings buff and polish well and give an excellent base for the deposition of chromium coatings (see Patents 1,614,303 and 1,615,585).

In making baths for depositing tin-zinc alloys, any ordinary soluble salts of zinc and of tin may be used; but it is usually desirable to adjust the saline composition of the bath to reduce the difference of potential between zinc and tin electrodes immersed therein. An equipotential condition is not essential but the difference in voltage should be small; a condition which may be readily determined by immersing a plate of each metal into the solution connected through a millivoltmeter. In making this adjustment, pyrophosphates and cyanides may be added; advantageously both. A good bath under the present invention may be made by dissolving stannous chlorid in a 6 per cent solution of sodium pyrophosphate and adding zinc cyanide and sodium cyanide. Addition of caustic soda to make the bath more alkaline is advantageous. The presence of some sodium chlorid or ammonium chlorid is often desirable to enhance conductivity. Presence

of dextrine as an "addition agent" is desirable.

A typical 10 liter bath under the present invention may be made as follows: One solution is prepared by dissolving 22.5 grams of commercial stannous chlorid and 180 grams of sodium pyrophosphate in 3 liters of water. Dextrine to the amount of 22.5 grams may be added. Another solution is made by dissolving 472.5 grams of zinc cyanide, 420 grams sodium cyanide 52.5 grams caustic soda and 157.5 grams of sodium chlorid in water enough to make 7 liters. The two solutions are then mixed. This bath is adapted to deposit a 75:25 alloy of zinc and tin.

It is found in practice that baths of this type have very good throwing power; the throwing power being superior to that of the usual zinc solutions employed in zinc plating.

This solution is used in an ordinary way, being contained in a steel or wood tank of an ordinary type fitted with suitable conducting rod or rods connected to the positive side of a direct current generator. A voltage of about 6 is correct. From these rods are hung rolled or cast anodes of zinc-tin alloy. With the bath just mentioned, the alloy may have a zinc-tin ratio of 75:25. Instead of using a zinc-tin alloy, which is sometimes not convenient, two anodes may be used, one of zinc and one of tin. In this particular case, the relative surface areas should be in the ratio of 75:25. The work to be plated is hung from cathode rods in the usual way. A cathode density of about 1 ampere per square decimeter is suitable. With the ordinary thickness of coating, a plating time of about 30 minutes is required.

In the example just given the electroplated coating has a zinc-tin ratio of 75:25. This ratio may be readily varied to suit the requirements of special uses to which the plated articles may be put. Probably the simplest method of varying this ratio is to change the metal content of the bath. In order that the metal content of the bath should be replenished in the desired ratio it is usually necessary to adjust the active anode areas of zinc and tin to approximately the same ratio; replenishment being by solution of the metal from the anodes.

Some variation in the zinc-tin ratio of the coating may be accomplished by change in the current density. We have noted that, other conditions remaining the same, there is a tendency for a larger proportion of tin to plate out at the lower current densities and vice versa.

While soluble anodes are usually employed in our invention, it is sometimes convenient to use insoluble anodes and to replenish the metal content of the bath by the addition of zinc and tin salts. In this case the equipotential condition of the bath is of less importance. In a mixed method, soluble anodes of one of the metals may be used in connection with insoluble anodes; the relative ratios of the two being adjusted and replenishment of the bath being accomplished by the addition of a salt of the other metal. Thus zinc anodes in addition to insoluble anodes may be used; the zinc content of the bath being replenished as the zinc anode dissolves while the tin is supplied to the bath in the form of one of its salts.

What we claim is:—

1. An iron or steel article carrying an electrodeposited coating of an alloy consisting of zinc and tin, the zinc and tin being in the ratio of about 75:25.

2. An iron or steel article carrying an electrodeposited coating of an alloy consisting of zinc and tin; the percentage of tin being from 7 to 35 per cent of the total.

3. In the protection of iron and steel articles, the process which comprises making such articles cathodes in a bath containing zinc salts and tin salts and also containing sufficient cyanide and pyrophosphate to make the solution approximately equipotential as regards tin and zinc.

4. In the electroplating of iron and steel articles with alloys consisting of zinc and tin, the process which comprises making such articles cathodes in a bath containing stannous chlorid, zinc cyanide, sodium chlorid, caustic soda and sufficient sodium pyrophosphate and sodium cyanide to make the bath approximately equipotential as regards tin and zinc.

In testimony whereof, we have hereunto affixed our signatures.

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