METHOD FOR TIN PLATING BUNCED AND BRAIDED WIRE

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This invention relates to the manufacture of tin plated wire composed of a plurality of constituent strands which are woven or twisted together to form what is known as "bunched" wire or cable, or woven to form a braid. More particularly, the invention relates to a process for electroplating tin simultaneously on all the strands of a formed cable or braid without joining or fusing one strand to another, thus producing a flexible tin plated wire cable or wire braid.

Such cabled or braided wire is useful as, among other things, an electrical conductor, the tin coating thereon being of assistance in subsequent soldering operations where it is desired to solder the cable or braid. Also, in the case of copper containing wire the tin coating prevents contact between the wire and rubber-containing insulating materials and thus avoids the deterioration of the rubber by the copper.

It is, of course, necessary in this connection that the tin coated cable or braid shall be flexible.

Herefore tinned binned or cable has been fabricated by tinning individual strands, as by hot dipping, and then weaving or twisting the tinned strands to form the final product. Since the individual strands are usually of very fine gauge, they have a relatively low strength, and because of this factor there has been an appreciable incidence of breakage in the tinning vessel. On the other hand, if braid or cable as such is attempted to be tinned by hot dipping, the constituent strands of the final product would be completely joined together and the product would lose all of its flexibility as well as take up excessive amounts of tin.

It has now been found that it is possible to fabricate tinned wire braid or cable by first twisting or weaving it from untinned individual strands, and then tin plating the braid or cable so formed in an electroplating bath to produce a product that is quite satisfactory. This surprising result is not all, for not only may a formed braid or cable be successfully tinned as described, but the invention also enables flexible tinned braid or cable to be made at a production rate higher than in other known methods.

The weaving or twisting of the individual strands may be done by conventional methods and need not be described. The plating step may be carried out in conventional strip or wire plating equipment. An alkaline stannate plating solution is used, preferably comprising potassium stannate and potassium hydroxide, the stannate concentration ranging from about 0.25 to about 3.0 mols per liter, and the free potassium hydroxide ranging from about 0.15 to about 3.5 mols per liter. During the plating operation, the cathode current density should be about 30 to about 1000 amperes/sq. ft., and the temperature of the bath should preferably lie between about 50° C. to substantially the boiling point of the bath. A sodium stannate bath may also be employed, the sodium stannate ranging from about 0.25 to about 5.0 mols per liter, the free sodium hydroxide from about 0.2 to about 0.6 mols per liter, the cathode current density from about 10 to about 100 amperes/sq. ft., and the temperature from about 50° to about 80° C. The higher current densities are compatible with high wire speeds through the plating bath, while lower current densities are suitable for low wire speeds. After the plating step, the tinned wire is rinsed and dried. While not necessary for a useful product, it is often desirable, and preferable, to subject the tinned wire to reflowing in a non-oxidizing atmosphere to improve the coating, as by brightening it. Any suitable reflowing method may be used, including induction heating and the use of hot oil. In this connection, a convenient, suitable oil temperature is about 240° C. with a contact time of about 2 or 3 seconds, followed by a vapor degreasing step to remove the oil. At higher temperatures the contact time may be lower, and vice versa, but in every case the temperature must be above the melting point of tin.

In the plating operation, it is necessary to limit the amount of tin deposited on the wire in order to secure effective results. Plating should proceed until the amount of tin deposited is in the range of about 1 to about 2% by weight of the wire being plated. In some cases, the amount of tin deposited may be as high as 3% by weight of the wire, and in other cases as low as 0.5% by weight, but for most purposes about 1 to 2% by weight is preferred.

Amounts of plated tin outside of these quantities will not result in a satisfactory product, for it will be either incompletely coated or else the constituent strands of the cable or braid will be joined together.

The following examples may illustrate the invention.

Example 1

An 8 ft. length of round 7/28 bunched copper wire or cable was placed in a potassium stannate bath containing 0.4 mol/liter of potassium stannate and 0.2 mol/liter of free potassium hydroxide. By "7/28" is meant that the wire was composed of 7 strands of 28 gauge wire. Plating of the wire was carried out for 2 minutes, using a cathode current of 10 amperes and a bath temperature of 90° C. After the plating, the bunched wire was reflowed in hot fat for about 3 seconds at a temperature of 240° C. Examination of the wire showed a satisfactory flexible tinned product. The amount of tin deposited on the wire was 2.7% by weight of the wire.

The above experiment was repeated several times, except that different sizes of wire, i. e., lengths of 10/30, 26/30, and 16/30 bunched wire, were used. A satisfactory product in each case was obtained, the amount of tin deposited being 3% by weight for the 10/30 wire, 1.15% by weight for the 26/30 wire, and 1.85% by weight for the 16/30 wire.

Example 2

A sample of flat banded copper wire 1/4" wide x 3/16" thick x 3" long was plated in the bath of Example 1 for 5 minutes at 1/4 ampercure. It was then reflowed in hot fat as described. Examination showed it to be a good flexible tinned braid. The amount of tin deposited was 1.2% by weight of the braid.

Example 2 was repeated with other similar samples of braid except that the plating current and plating time were varied. In one case a current of 1 ampercure for 1 minute was employed, in another 1/4 ampercure for 3 minutes, and then 2 ampercures for 2 minutes. In each case a good product was made, the amount of tin deposited in these cases being 0.48, 0.72, and 1.9% by weight, respectively.

A "bunch" of wire is commonly defined as the product of a stranding operation in which several wires are twisted together in the same direction and in a uniform manner into a rope-like form. A "braid" is defined as the product of crossing a number of strands diagonally in such a way that each strand passes alternately over and under one or more of the others. Braided wire is made on a machine that builds up a tube of interwoven wires of any number
desired on the outside of a core or on a spindle. In the latter case the braided tube comes off the spindle and is usually rolled flat to form a flat flexible strip.

In general, metal articles consisting of adjacent lying, intertwined metallic component strands, including mesh and link material may be satisfactorily tin plated without joining the individual strands to one another. The invention makes it possible to uniformly plate all of the individual strands, even those deeply buried in the article, without causing the article to lose its flexibility. The article itself may be composed of any metal which is capable of being tin plated.

In the light of the foregoing description, the following is claimed:

1. Process for making tin plated bunched or braided copper wire consisting of a plurality of fine gauge constituent strands regularly intertwined or interwoven together, which comprises immersing untinned bunched or braided wire in a potassium stannate electroplating bath, said bath containing about 0.25 to about 3.0 mols per liter of potassium stannate and about 0.15 to about 3.5 mols per liter of free potassium hydroxide, operating said bath at a cathode current density of about 30 to about 1000 amperes per sq. ft. and a temperature of about 50° C. to substantially the boiling point of the bath, electroplating tin upon each of said strands of said wire to entirely cover each strand and until an amount of tin equal to about 1 to about 2% by weight of the wire has been plated, thereby forming a tin bunched or braided wire in flexible condition of whose constituent strands are plated with tin and separated from adjacent lying strands, removing the wire from the bath and rinsing and drying the same, and heating the plated wire under non-oxidizing conditions to refloat the tin plate.

2. Process for making tin plated bunched or braided copper wire consisting of a plurality of fine gauge constituent strands regularly intertwined or interwoven together, which comprises immersing untinned bunched or braided wire in a sodium stannate electroplating bath, said bath containing about 0.25 to about 0.5 mols per liter of sodium stannate and about 0.2 to about 0.6 mols per liter of free sodium hydroxide, operating said bath at a cathode current density of about 10 to about 100 amperes per sq. ft., and at a temperature of about 50° C. to about 80° C., electroplating tin upon each of said strands of said wire to entirely cover each strand and until an amount of tin equal to about 1 to about 2% by weight of the wire has been plated, thereby forming a tin bunched or braided wire in flexible condition of whose constituent strands are plated with tin and separated from adjacent lying strands, removing the wire from the bath and rinsing and drying the same, and heating the plated wire under non-oxidizing conditions to refloat the tin plate.

3. Process for making tin plated bunched or braided metal wire consisting of a plurality of fine gauge constituent strands regularly intertwined and interwoven together, said metal being capable of being tin plated and having a specific gravity of about 8.5, which comprises immersing untinned bunched or braided wire in an alkaline stannate electroplating bath, electroplating tin upon each of said strands of said wire to entirely cover each strand and until an amount of tin equal to about 1 to about 2% by weight of the wire has been plated, thereby forming a tin bunched or braided wire in flexible condition of whose constituent strands are plated with tin and separated from adjacent lying strands, removing the wire from the bath and rinsing and drying the same, and heating the plated wire under non-oxidizing conditions to refloat the tin plate.

4. Process for making a tin plated metal article consisting of adjacent lying, intertwined or interwoven metallic fine gauge constituent strands, said metal being capable of being tin plated and having a specific gravity of about 8.5, which comprises immersing said article in untinned condition in an alkaline stannate electroplating bath, electroplating tin upon each of said strands of said article to entirely cover each strand and until an amount of tin equal to about 0.5 to about 3% by weight of the article has been plated, thereby forming a tin article in flexible condition of whose constituent strands are plated with tin and separated from adjacent lying strands.

5. Process for making tin plated bunched or braided copper wire consisting of a plurality of fine gauge constituent strands regularly intertwined or interwoven together, which comprises immersing untinned bunched or braided wire in an alkaline stannate electroplating bath, electroplating tin upon each of said strands of said wire to entirely cover each strand and until an amount of tin equal to about 0.5 to about 3% by weight of the wire has been plated, thereby forming a tin bunched or braided wire in flexible condition of whose constituent strands are plated with tin and separated from adjacent lying strands.

6. Process for making tin plated bunched or braided copper wire consisting of a plurality of fine gauge constituent strands regularly intertwined or interwoven together, which comprises immersing untinned bunched or braided wire in an alkaline stannate electroplating bath, electroplating tin upon each of said strands of said wire to entirely cover each strand and until an amount of tin equal to about 1 to about 2% by weight of the wire has been plated, thereby forming a tin bunched or braided wire in flexible condition of whose constituent strands are plated with tin and separated from adjacent lying strands.

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