United States Patent Office 2,842,435 Patented July 8, 1958

2,842,435

METHODS OF STRIPPING TIN AND TIN ALLOY SURFACE COATINGS FROM IRON AND IRON ALLOY ARTICLES

Michael G. Milo, Greensboro, N. C., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

No Drawing. Application December 1, 1955
Serial No. 550,492

5 Claims. (Cl. 75—98)

This invention relates to methods of stripping metals from dissimilar base metals, and more particularly to methods of stripping tin and tin alloys from dissimilar base metals.

In tin soldering operations carried out on a mass production basis, it is inevitable that a small percentage of imperfections will occur, and it is desirable from the economic standpoint to attempt to salvage imperfectly soldered articles. The salvage of such articles depends on the removal of substantially all of the coating of tin from the article, which may be fabricated from iron, steel or copper base metals.

Heretofore, conventional stripping processes have not been entirely satisfactory. In particular, a conventional bulk stripping process utilizing a stripping solution containing hydrochloric acid and antimony trioxide produces a residue which clings tenaciously as a smutty film to the surface of the base metal during the stripping process. This smut film is extremely difficult to remove, and heretofore the removal of the smut film by subsequent conventional processes has not been entirely satisfactory.

It is an object of this invention to provide new and improved methods of stripping metals from dissimilar base metals.

Another object of this invention is to provide new and improved methods of stripping tin and tin alloys from dissimilar base metals.

A method illustrating certain features of the invention for stripping a surface coating consisting principally of tin from a metallic article may include the steps of immersing such a coated article in an acid tin-stripping bath containing antimony trioxide until the coating has been stripped from the article whereby an antimony-containing smut forms on the article, and treating the article with a solution of a copper compound whereby copper is precipitated from the solution on the smut. The precipitated copper is then converted into a copper sulphide and the article is then treated in an alkali cyanide bath to dissolve the copper in the copper sulphide therefrom whereby the surface of the article is caused to be clean and substantially smut-free.

In carrying out a stripping process in accordance with the present invention, for example, to remove tin from a steel base article, the article is immersed in a tin stripping bath comprising concentrated hydrochloric acid, antimony trioxide and a suitable wetting agent. The article is kept immersed in the tin stripping bath until no reaction can be detected, indicating that the tin has been stripped completely from the steel base metal.

Although it is well known that the hydrochloric acid will attack both the tin and the steel base metal of the article, the antimony trioxide functions as an inhibitor to slow down the reaction of the hydrochloric acid with the steel base metal to the extent that there is only a slight loss of steel base metal, whereas the tin is stripped away rapidly. However, the beneficial action of the antimony trioxide is not without detriment, since in the process crystals of elemental antimony form on the surface of the steel base metal in the form of a smut, which adheres tenaciously to the steel base metal. The article, covered with this smut, is removed from the tin stripping bath. The tin stripping solution is allowed to drain from the article and the article is then rinsed thoroughly in water.

The article is next immersed in a copperizing bath containing an aqueous acid-copper sulphate solution designed to form a thin film of copper upon the surfaces of the steel base metal and the antimony crystals. The article is kept immersed in this copperizing bath until its surfaces have acquired a slight copper-red color. The article is then removed from the copperizing bath and allowed to drain. Subsequently it is rinsed thoroughly in water.

Thereafter, the copperized article is immersed in a hot, aqueous copper stripping bath containing a sodium sulphide-elemental sulphur suspension. The temperature of the copper stripping bath may range from about 70° F. to about 180° F. for optimum results. The elemental sulphur in the copper srtipping bath reacts with the copper on the surfaces of the steel base metal and the antimony crystals to form insoluble cupric sulphide. The cupric sulphide precipitate adheres as a crusty film to the surfaces of the steel base metal and the antimony. The article is kept immersed in the copper stripping bath until the copper-red color has completely disappeared, and is then removed, allowed to drain, and subsequently rinsed thoroughly in water.

The article is next immersed in a bath of a hot, aqueous solution of an alkali cyanide, such as sodium cyanide or potassium cyanide. The temperature of the bath should preferably be within a range from about 120° F. to about 180° F. The alkali cyanide dissolves the insoluble cupric sulphide on the article, forming a soluble double cyanide, i. e. sodium cuprocyanide or potassium cuprocyanide. The remaining elemental antimony crystals forming the smut are removed from the surface of the steel base metal along with the cupric sulphide, leaving the base metal clean and free of the smut. The article is kept immersed in the alkali cyanide bath until it is observed that the base metal is clean.

If it should happen that slight traces of the smut still remain on the surface of the base metal, such traces may be removed by repeating the steps of the process beginning with the immersion of the article in the copperizing bath.

As a final step, the article, after being taken from the alkali cyanide bath, is rinsed thoroughly in water, dipped in a bath of hot water having a temperature of from about 160° F. to about 180° F., and then is dried completely in a stream of air.

Example

In the removal of tin from an article made of a steel base metal, the article was immersed initially in a room temperature, tin stripping bath consisting of 2.0 oz. av. of antimony trioxide and 25.0 cc. of Enthone acid addition agent (wetting agent) in solution with 1 gallon of hydrochloric acid (20° Baumé strength). The article was kept immersed in the tin stripping bath for about five to ten minutes, or until no reaction could be detected, indicating that the steel base metal was stripped of the tin solder.

Subsequently the article was given a thorough water rinse which failed to remove a smut of elemental antimony that adhered tenaciously to the surface of the steel base metal. The article was immersed next in a room temperature, copperizing bath consisting of 4.0 oz. av. of copper sulphate, 2.0 oz. fl. of concentrated sulphuric acid (66° Baumé strength) and sufficient water to make 1 gallon. The article was kept immersed in the copperizing bath until it had acquired a slight copper-

red color. The article was then removed from the copperizing bath and thoroughly rinsed with water.

The article was then immersed in a bath consisting of 25.0 oz. av. of sodium sulphide, 7.0 oz. av. of finely divided sulphur, and sufficient water to make 1 gallon. The temperature of the last-mentioned bath was maintained at about 160° F., and the article was kept immersed in this bath for approximately 1 to 3 minutes, during which time the surfaces of the article turned completely black. The article was then removed from the bath and rinsed thoroughly with water.

The rinsed article was immersed in a bath consisting of 16.0 oz. av. of sodium cyanide, 4.0 oz. av. of sodium hydroxide, and sufficient water to make 1 gallon. The temperature of the last-mentioned bath was maintained at about 160° F. The article remained immersed until it was observed that the surface of the steel base metal was entirely clean. The article then was thoroughly rinsed with room temperature water, and then was dipped in hot water having a temperature of from about 160° F. to about 180° F., and was then dried completely in a stream of air.

As a result of the above-described procedure, the article was stripped cleanly of all of the tin with substantially no affect on the surfaces of the steel base metal and without trace of a smut film.

It is manifest that the invention is not limited to the specific example set forth hereinabove merely as an illustration of the broad principles of the invention. It has been found that the invention may be practiced in the stripping of tin, or of alloys consisting principally of tin, such as tin-lead or tin-zinc alloys, from various types of base metals, such as ferrous base metals and copper alloy base metals.

It will be understood further, that, although the smut which forms on the base metals has been described primarily as a deposit of elemental antimony crystals, there may be other constituents present, such, as for example, metallic salts and the like.

What is claimed is:

1. The process of stripping a surface coating consisting principally of tin from an article made of a metal of the group consisting of iron, steel and alloys of iron and steel, which comprises immersing such a coated article in an acid tin-stripping bath containing antimony trioxide until the coating has been stripped from the article whereby an antimony containing smut capable of penetration by copper ions forms on the article, treating the article with a solution of a copper salt whereby copper is precipitated from the solution on the smut so as to form a copper film on the surface of the article under the smut by copper ion penetration therethrough, converting the precipitated copper into a copper sulphide, and treating the article in an alkali cyanide bath to dissolve the copper in the copper sulphide, whereby the surface of the article is caused to be clean and substantially smut-free.

2. The process of stripping a surface coating consisting principally of tin from an article made of a metal of the group consisting of iron, steel and alloys of iron and steel, which comprises immersing such a coated article in a stripping bath comprising hydrochloric acid and antimony trioxide until the coating has been stripped from the article whereby an antimony-containing smut capable of penetration by copper ions forms on the article, treating the article with a solution of a copper salt whereby copper is precipitated from the solution on the smut so as to form a copper film on the surface of the article under the smut by copper ion penetration therethrough, converting the precipitated copper into a copper sulphide, and treating the article in an alkali cyanide bath to dissolve the copper in the copper sulphide, whereby the surface of the article is caused to be clean and substantially smut-free.

3. The process of stripping a surface coating consisting principally of tin from an article made of a metal of the group consisting of iron, steel and alloys of iron and steel, which comprises immersing such a coated article in a stripping bath comprising hydrochloric acid and antimony trioxide until the coating has been stripped from the article whereby an antimony-containing smut capable of penetration by copper ions forms on the article, treating the article with an acid solution of copper sulphate whereby copper is precipitated from the solution on the smut so as to form a copper film on the surface of the article under the smut by copper ion penetration therethrough, converting the precipitated copper into a copper sulphide, and treating the article in a solution of an alkali cyanide to dissolve the copper in the copper sulphide, whereby the surface of the article is caused to be clean and substantially smut-free.

4. The process of stripping a surface coating consisting principally of tin from an article made of a metal of the group consisting of iron, steel and alloys of iron and steel, which comprises immersing such a coated article in a stripping bath comprising hydrochloric acid and antimony trioxide until the coating has been stripped from the article whereby smut consisting primarily of antimony capable of penetration by copper ions forms on the article, treating the article with an acid solution of copper sulphate whereby copper is precipitated from the solution to form a film of copper under the smut, converting the precipitated copper into a copper sulphide, and treating the article in a solution of an alkali cyanide of the group consisting of sodium cyanide and potassium cyanide to dissolve the copper in the copper sulphide, whereby the surface of the article is caused to be clean and substantially smut-free.

5. The process of stripping a metallic surface coating of the group consisting of tin, tin-lead alloys and tin-zinc alloys, from an article made of a metal of the group consisting of iron, steel and alloys of iron and steel, which comprises immersing such a coated article in a stripping bath comprising 2.0 oz. av. of antimony trioxide in solution with one gallon of approximately 20° Baumé hydrochloric acid until the coating has been stripped from the article whereby a smut consisting primarily of antimony capable of penetration by copper ions is formed on the article, treating the article with a solution comprising 4.0 oz. av. of copper sulphate, 2.0 fl. oz. of approximately 66° Baumé sulphuric acid and water sufficient to make one gallon so as to precipitate copper from the solution to form a copper film on the surface of the article and under the smut, immersing the article in a hot, aqueous mixture comprising 25.0 oz. av. of sodium sulphide, 7.0 oz. av. of finely divided sulphur and water sufficient to make one gallon whereby the precipitated copper is converted into a copper sulphide, and then treating the article in a hot solution comprising 16.0 oz. av. of an alkali cyanide of the group consisting of sodium cyanide and potassium cyanide, 4.0 oz. av. of sodium hydroxide and water sufficient to make one gallon so as to dissolve the copper in the copper sulphide, whereby the surface of the article is caused to be clean and substantially smut-free.

References Cited in the file of this patent

UNITED STATES PATENTS

1,620,580	Smith	Mar. 8, 1927
1,837,118	Elder	Dec. 15, 1931
2,721,119	Bauch	Oct. 18, 1955

FOREIGN PATENTS

225,499	Great Britain	Feb. 19, 1925
698,285	Great Britain	Oct. 14, 1953

OTHER REFERENCES

"The Hydrometallurgy of Copper" (Greenawalt), published by McGraw-Hill Book Co. (New York), 1912. Pages 162 and 167 relied on.