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ELECTROLYTIC POLISHING OF METALS

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My invention relates to an electrolytic composition and a method for the anodic or electrolytic polishing of metals.

It is an object of my invention to provide electrolytic compositions which can readily be prepared for polishing and used directly in the polishing of certain specific metals with a minimum amount of control of operating conditions.

Other objects and advantages of my invention will in part be obvious and in part appear hereinafter in the following detailed description of its principles and a few of its embodiments.

My invention, accordingly, comprises the electrolytic compositions possessing the relationship of one or more of the components of the baths to each of the others thereof which will be described herein as electrolytic compositions possessing markedly superior properties for the polishing of specific types of metals and the method of employing such electrolytic compositions in the polishing of such metals which includes the relationship of each of the steps to the others thereof, and my invention is not to be limited except as indicated in the appended claims. In the examples to be given herein, several preferred embodiments of the invention will be described but my invention is not to be limited except as defined in the claims appended to this specification.

In my copending application Serial Number 600,630, I have discussed some of the underlying theory of electrolytic polishing and have there pointed out that among the requirements necessary for polishing conditions to be attained in the solution are the production of polarization within the cell, high current carrying capacity for the electrolyte, a degree of solvent capacity of the bath for the anode metal being polished, provision for the liberation of oxygen at the anode and the promotion of conditions which will induce concentration polarization within the cell. In the description of the compositions and processes of the copending application, I pointed out how the various factors affecting electrolytic polishing of metals can be controlled by selecting ingredients, adjusting the pH of the solution to be used and controlling the temperature of the metal being polished. In general, I pointed out that salts such as the alkali metal salts of the mineral acids, that is, nitric, hydrochloric, hydrobromic, hydriodic, hydrofluoric, chromic, sulfuric and phosphoric acids are sufficiently soluble and have properties which make them well suited to adjustment of their solutions to the proper polishing condition.

I have found, additionally, that many of the inorganic and organic salts which have natural buffering action, either as weak alkalis or weak acids, give solutions having pH's which are

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ideally adapted to the polishing of certain metals. For example, such salts as the alkali metal acetates, citrates, tartrates, salicylates, benzoates, oxalates, and salts of other common organic acids, when in solution act as buffers and maintain the solution within a very narrow range of pH, usually in the alkaline range, during the electrolytic polishing. The buffering property is not an exclusive one of alkali metal salts of organic acids but is also possessed by a number of inorganic salts, such as, the alkali metal borates, phosphates and thiosulfates.

The alkali metal salts, i. e., sodium, potassium and lithium, of the organic acids and inorganic acids, which act as buffers, in general are alkaline in solution.

Buffering agents or salts which will maintain acid conditions in solution, in general, are the ammonium salts or the weak base salts of the strong acids as represented by the ammonium phosphates, ammonium sulphates and the acid salts of the polybasic acids.

I have found that such metals as cuprous metals and alloys, as represented by brasses, bronzes and copper itself, and such metals as cobalt, nickel and iron polish best in alkaline media. Knowing approximately the conditions of the electrolyte best adapted to develop a lustrous polish on a metal, it is a relatively simple matter to prepare an electrolytic solution ideally adapted to developing the polish. The method of practicing my invention will be readily understood from a consideration of the following description of a few embodiments thereof.

Example I

A specimen of 18–8 stainless steel was polished at a current density of 1.0 ampere per square centimeter in a bath consisting of 100 milliliters of methyl alcohol, 50 milliliters of water and enough sodium thiosulfate to make a substantially saturated solution. The solution was maintained at room temperature and the sample was chilled with a freezing mixture comprising solid carbon dioxide and ether during the polishing.

Example II

Phosphor bronze was polished with a solution consisting of a mixture of 15 milliliters of acetone, 70 milliliters of water and enough sodium borate substantially to saturate the mixture. A current density of about 0.15 ampere per square centimeter was used in the polishing which included chilling the anode by contacting it with a freezing mixture.

Example III

A sample of 70–30 brass was polished with a solution consisting of 200 milliliters of glycerine, 100 milliliters of water and enough trisodium

phosphate to saturate the mixture. A current density of about 1 ampere per square centimeter was used. The specimen was chilled with solid carbon dioxide during the polishing.

In general the method of polishing, as can be seen from the examples, comprises making the metal to be polished an anode in an electrolytic cell having as an electrolyte a substantially saturated solution of a selected salt in a solvent comprising water and a relatively large proportion of completely water-miscible organic solvent. The salt used as the electrolyte should be one which in solution gives a pH of about the value desired for polishing the specific metal and should also be sufficiently soluble in the solvent medium used to carry a current of polishing density. The specimen being polished is chilled during the process.

I have found that various baths, of which the ones given above are typical, when made up and used as described will polish. The alkaline baths are exemplified by those noted in the examples and slightly acid baths are readily made up by using corresponding ammonium salts.

These examples and descriptions have been given to illustrate the method and the general nature of the bath used in the practice of the method. In general, as stated in my copending application, Serial Number 600,630, filed of even date herewith, the best conditions for obtaining the most lustrous polish exist in the solution when its composition is such that a uniform gelatinous precipitate forms over the surface of the sample being polished.

Since certain changes in carrying out the polishing may be made in the steps of the method and wide modifications in the composition of the bath which embody the invention can be made without departing from the scope of the invention, it is intended that all matter contained in the above discussion, description and examples shall be interpreted as illustrative and not in a limiting sense.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of electrolytically polishing a metal selected from the group consisting of brasses, bronzes, copper, cobalt, nickel and ferrous metals comprising, making a specimen of the metal the anode of an electrolytic cell in which the electrolyte consists essentially of a solution, substantially saturated at room temperature, in which the solute is an alkali metal salt of an acid selected from the group consisting of boric, thiosulfuric and orthophosphoric acids and the solvent is water, and a completely water miscible organic alcohol, which electrolyte is self-buffering at a pH suitable for polishing, maintaining the anode at a temperature below that of the electrolyte, and passing an electric current through said cell whereby a metallographic polish is effected on said specimen.

2. The method of electrolytically polishing a metal selected from the group consisting of brasses, bronzes, copper, cobalt, nickel and ferrous metals comprising, making a specimen of the metal the anode of an electrolytic cell in

which the electrolyte consists essentially of a solution, substantially saturated at room temperature, in which the solute is an alkali metal salt of an acid selected from the group consisting of boric, thiosulfuric and orthophosphoric acids and the solvent is water, and a completely water miscible organic liquid selected from the group consisting of methyl alcohol, acetone, and glycerine, which electrolyte is self-buffering at a pH suitable for polishing, maintaining the anode at a temperature approximately that of a solid carbon dioxide-ether mixture, and passing an electric current through said cell whereby a metallographic polish is effected on said specimen.

3. The method of electrolytically polishing a specimen of steel comprising, making a specimen of the metal the anode of an electrolytic cell in which the electrolyte consists essentially of methyl alcohol and a solution, substantially saturated at room temperature, in which the solute is an alkali metal salt of thiosulfuric acid and the solvent is water, maintaining the anode at a temperature below that of the electrolyte, and passing an electric current through said cell, whereby a metallographic polish is effected on said specimen.

4. The method of electrolytically polishing a specimen of bronze comprising, making a specimen of the metal the anode of an electrolytic cell in which the electrolyte consists essentially of acetone and a solution, substantially saturated at room temperature, in which the solute is an alkali metal salt of boric acid and the solvent is water, maintaining the anode at a temperature below that of the electrolyte, and passing an electric current through said cell, whereby a metallographic polish is effected on said specimen.

5. The method of electrolytically polishing a specimen of brass comprising, making a specimen of the metal the anode of an electrolytic cell in which the electrolyte consists essentially of glycerine and a solution, substantially saturated at room temperature, in which the solute is an alkali metal salt of orthophosphoric acid and the solvent is water, maintaining the anode at a temperature below that of the electrolyte, and passing an electric current through said cell, whereby a metallographic polish is effected on said specimen.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,093,824	Woronoff	Sept. 21, 1937
2,096,309	Pullen	Oct. 19, 1937
2,154,468	Oplinger	Apr. 18, 1939
2,375,394	Tosterud	May 8, 1945
2,378,002	Drummond et al.	June 12, 1945
2,428,141	Burkhardt	Sept. 30, 1947

FOREIGN PATENTS

Number	Country	Date
12,030	Great Britain	of 1886
550,176	Great Britain	Dec. 28, 1942

OTHER REFERENCES

"Handbook of Chemistry and Physics," 28th edition (1944), pages 1283, 1286.