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ELECTROPOLISHING OF METALS

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Fig. 1.

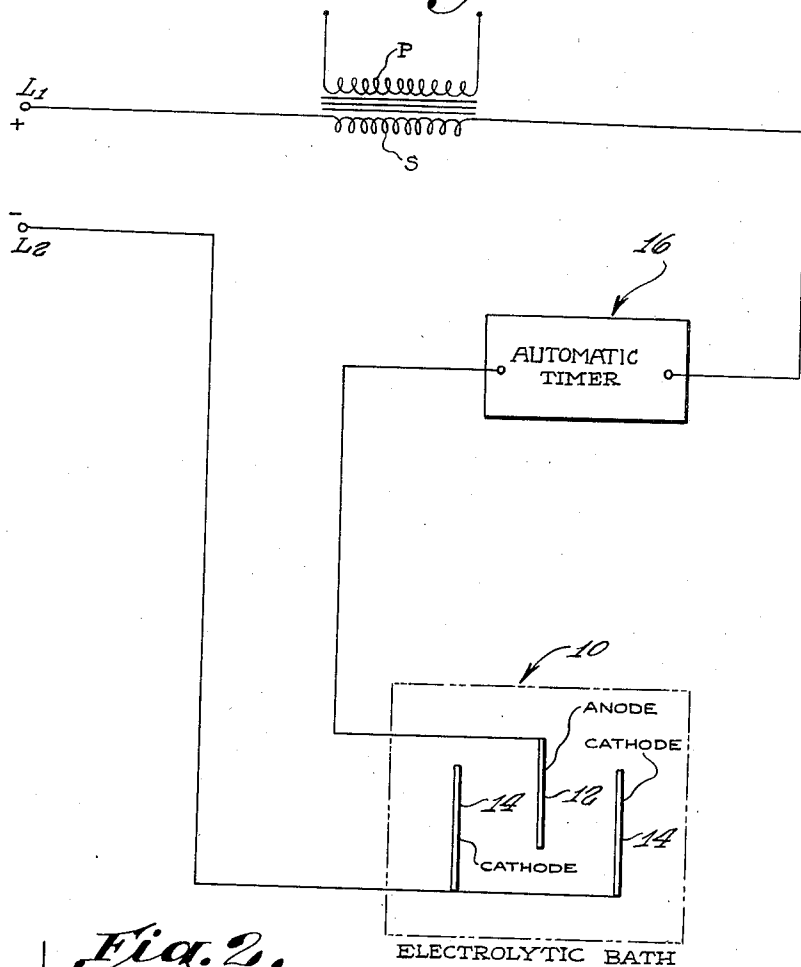
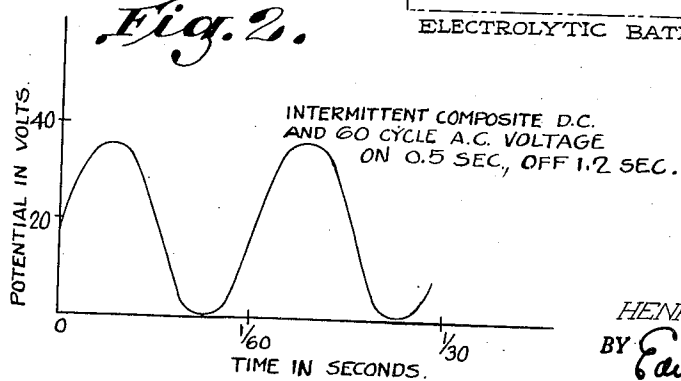


Fig. 2.



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ELECTROPOLISHING OF METALS

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6 Claims. (Cl. 204—140.5)

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This invention relates to the electropolishing of silver plate, copper, and brass.

The primary object of this invention is to provide an electropolishing method which produces a highly brilliant polish or high luster on the surfaces of such metals.

Heretofore, in order to attain brightness of electrolytically deposited silver, the use of addition agents or brighteners in the plating solution, during the plating operation, has been resorted to but that method has not been entirely satisfactory because, among other things, the results were not always uniform as to the brightness of the silver plate produced by the method and the desired degree of brightness or high brilliance was not attainable. Moreover, mechanical polishing operations which were comparatively expensive were required to attain the available degree of brightness of the silver plate. The method of the present invention produces a luster on electrolytically deposited silver which is brighter or more brilliant than the luster heretofore attainable by the use of addition agents or brighteners in the plating solution. As a result, mechanical polishing and finishing operations are minimized, thereby reducing the finishing costs.

I have discovered that a polish or luster of high brilliance may be provided on the surface of silver plate, copper or brass by electropolishing this surface anodically in an electrolyte under conditions according to which a composite voltage or potential made up of a direct current potential and an alternating current potential is intermittently applied to the electrodes. The electrolyte employed in the present process for polishing silver plate may be either a simple soluble cyanide bath or one containing silver in solution with an excess of free cyanide. Wide ranges of concentration of silver and free cyanide are suitable for carrying out my process. Excellent results have been obtained with electrolytes of composition of conventional silver plating solutions with which the art is familiar in connection with the use thereof in the electroplating of silver. The electrolyte employed in polishing copper or brass is hereinafter set forth.

The alternating current voltage component of the potential applied to the electrodes is of the same value or lower than the direct current voltage component and the said two components are in series circuit relation. The varying positive potential composed of said two component voltages has a substantially sine wave form, cor-

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responding to the 60 cycle frequency of the A. C. potential. Said composite potential is applied anodically to the silver surface in the electrolytic bath. Preferably the silver surface to be polished is disposed in the bath as an anode between two cathodes. The surfaces of these cathodes are preferably of silver but any clean surface which conducts an electric current and does not react with the aforementioned electrolyte will suffice. I have discovered that the periodic interruption of the flow of current in the electrolytic bath in conjunction with the application of the composite alternating current and direct current potentials to the electrodes greatly improves the luster of the silver surface. Accordingly, in accordance with my method the composite potential is applied intermittently to the electrodes.

Excellent results have been obtained by the proper control of the variables of direct current voltage component, alternating current voltage component, time of application of the composite potential to the electrodes (the "on" time) and the interval between successive applications of the composite potential (the "off" time). The first three mentioned variables must be so controlled that a film forms on the anodic silver surface which dissolves when the composite potential is interrupted. This film is of such nature that the high points or protrusions of the irregular silver surface are removed in preference to the low spots or valleys and consequent smoothing and brightening occurs. If the relationship of the variables is such as to form a film which does not dissolve when the composite potential is removed, polishing will not occur. The "off" time need only be of sufficient duration to permit complete dissolution of the soluble anodic film in the main body of the electrolyte. "Off" times longer than are required for the above mentioned dissolution of anode film have no beneficial or deleterious effect. The number of intermittent applications of the composite potential required for producing a bright silver surface depends on the degree of roughness of the original surface and on the brightness or brilliance desired. Generally, the rougher the original surface or the brighter the surface desired, the greater is the number of intermittent applications of the composite potential required. The minimum "on" time should be long enough to produce a polarization film that covers the entire surface to be polished. The maximum "on" time is limited by the solubility of the film in the solution. The film must dissolve when the

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current is interrupted. The minimum "off" time should be long enough to result in a complete solution of the soluble polarization film. These times will vary with the composite voltage, composition of electrolyte, and temperature. For example: With 17.5 v. D. C. and 12 v. A. C. and with the solution referred to in the example hereinafter set forth:

Optimum "on" time -----	Sec. 0.5
Maximum "on" time -----	0.9
Minimum "off" time -----	0.6
Optimum "off" time -----	1.2

In the drawings, Fig. 1 shows a circuit diagram and illustrates more or less diagrammatically the method of the present invention; and

Fig. 2 is a potential-time curve according to said method.

Referring to the drawing the electrolytic bath or tank is shown in dot-and-dash lines and designated by the numeral 10. The anode 12 is constituted by the silver surface which is to be polished and which is immersed in the electrolyte and the cathodes 14 are formed of silver. The direct current component of the composite potential is supplied from a direct current generator or from any other suitable source to the positive and negative line terminals L1 and L2 respectively. The alternating current potential is supplied by the transformer having the primary P and the secondary S. As shown in the drawing the secondary is in series circuit relation with the direct current supply. An automatic timer or time-controlled circuit make and break device 16 is in series circuit relation, as shown, so as to periodically interrupt the application of potential to the electrodes 12 and 14. It will be understood that said timer is adjustable to provide for the "on" and "off" periods of current flow.

In practicing the above described method of the present invention the articles to be polished are immersed in the electrolyte as the anode on a suitable rack. The method is presently performed without relative movement of the anode and the electrolyte during the electropolishing operation but it will be understood that it is within the scope of the present invention to move either the articles in the electrolyte or to cause movement of the electrolyte in relation to said articles.

The following is an example of the conditions which produced a highly brilliant polish or luster on a silver plated soup spoon representing approximately 12 square inches of surface area immersed on a rack into a conventional silver plating solution at room temperature and of the following composition with water in an amount to make one gallon of the solution:

	Ounces
Silver -----	5.1
Free potassium cyanide -----	8.2
Potassium carbonate -----	7.9

The silver is incorporated in the bath of the above example, in the form of potassium silver cyanide.

The tank was a cylinder 12" in diameter and 12" high, with cathode 65 square inches in area placed on either side of the anode at a distance of 4½" from it. No agitation whatsoever was employed during electropolishing. The composite varying potential was composed of 17.5 volts direct current potential component and 12

volts R. M. S. (root mean square) meter reading alternating current potential component and was applied intermittently. "On" times less than a second, preferably approximately 0.5 second and "off" times of about 2 seconds were employed.

For polishing copper or brass, an electrolyte which is of the following composition, may be employed:

	Ounces
Free sodium cyanide -----	15
Copper (metallic) -----	.08
Sodium carbonate -----	1.75
Water sufficient to make up one gallon of solution.	

The copper is incorporated in the bath of the above example, in the form of copper cyanide.

The composite potential which is intermittently applied in polishing copper or brass is composed of a direct current potential of about 11 to 15 volts and an alternating current potential of about 5.5 to 11 volts, it being understood that the A. C. voltage is in any case not higher, but preferably lower, than the D. C. voltage. The "on" and "off" times and current density values are about the same as those which obtain in the polishing of silver, as set forth above.

While I have shown and described the preferred embodiments of my invention, it will be understood that various changes may be made therein without departing from the underlying idea or principles of the invention within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is:

1. In the anodic polishing of a metal of the group consisting of copper, brass and electrically deposited silver in a cyanide bath, the method which comprises immersing the metal in said bath and subjecting the metal in the bath to the electrolytic polishing action resulting from the intermittent application of a positive potential of varying value to said metal, as the anode, and to a companion cathode, said varying potential being composed of a direct current potential in series with an alternating current potential and applied for a plurality of time-spaced periods of about 0.5 second each with intervening periods of about 1.2 seconds each, the peak alternating-current potential being not greater than the direct-current potential.

2. The method of polishing the silver plated surface of a metal member, comprising immersing said member in a cyanide electrolytic bath and subjecting said member in the bath to the electrolytic polishing action resulting from the intermittent application of a positive potential of varying value to said member, as the anode, and to a companion cathode, said varying potential being composed of a direct-current potential in series with an alternating-current potential and applied for a plurality of time-spaced periods of about 0.5 second each with intervening periods of about 1.2 seconds each, the peak alternating-current potential being not greater than the direct-current potential.

3. In the anodic polishing of a metal of the group consisting of copper, brass and electrically deposited silver in a cyanide bath, the method which comprises immersing the metal in said bath and subjecting the metal in the bath to the electrolytic polishing action resulting from the intermittent application of a positive potential of varying value to said metal, as the anode, and to a companion cathode, said varying potential being composed of a direct-current potential in

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series with an alternating-current potential and applied for a plurality of time-spaced periods of about 0.5 second each with intervening periods of about 1.2 seconds each, the peak alternating-current potential being not greater than the direct-current potential, the direct-current potential having a value of about 17.5 volts and the alternating-current potential having a root mean square value of about 12 volts.

4. The method of polishing the silver plated surface of a metal member, comprising immersing said member in a cyanide electrolytic bath comprising a silver plating aqueous solution containing about 5.1 ounces silver, about 8.2 ounces free potassium cyanide and about 7.9 ounces potassium carbonate per gallon of solution and subjecting said member in the bath to the electrolytic polishing action resulting from the intermittent application of a positive potential of varying value to said member, as the anode, and to a companion cathode, said varying potential being composed of a direct-current potential in series with an alternating-current potential and applied for a plurality of time-spaced periods of about 0.5 second each with intervening periods of about 1.2 seconds each, the peak alternating-current potential being not greater than the direct-current potential.

5. In the anodic polishing of a metal of the group consisting of copper, brass and electrically deposited silver in a cyanide bath, the method which comprises immersing the metal in said bath and subjecting the metal in the bath to the electrolytic polishing action resulting from the intermittent application of a positive potential of varying value to said metal, as the anode, and to a companion cathode, said varying potential being composed of a direct current potential in series with an alternating current potential and applied for a plurality of time-spaced periods

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between about 0.5 second and about 0.9 second each with intervening periods of at least about 0.6 second each, the peak alternating current potential being not greater than the direct current potential.

6. The method of polishing the silver plated surface of a metal member, comprising immersing said member in a cyanide electrolytic bath and subjecting said member in the bath to the electrolytic polishing action resulting from the intermittent application of a positive potential of varying value to said member, as the anode, and to a companion cathode, said varying potential being composed of a direct-current potential in series with an alternating-current potential and applied for a plurality of time-spaced periods between about 0.5 second and about 0.9 second each with intervening periods of at least about 0.6 second each, the peak alternating-current potential being not greater than the direct-current potential.

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