

[54] **METHOD OF COPPER PLATING GRAVURE CYLINDERS**

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[56] **References Cited**

UNITED STATES PATENTS

1,918,627	7/1933	Ballard.....	204/25
2,494,121	1/1950	Grainger.....	204/DIG. 9
2,541,954	2/1951	Bonnet.....	204/25 X
2,678,909	5/1954	Jernstedt.....	204/41 X
2,776,256	1/1957	Eulner et al.	204/25

3,616,289 10/1971 Ellis et al. 204/26

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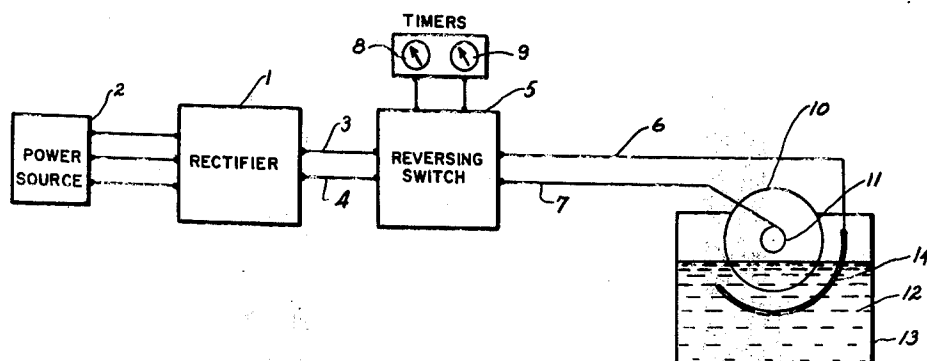
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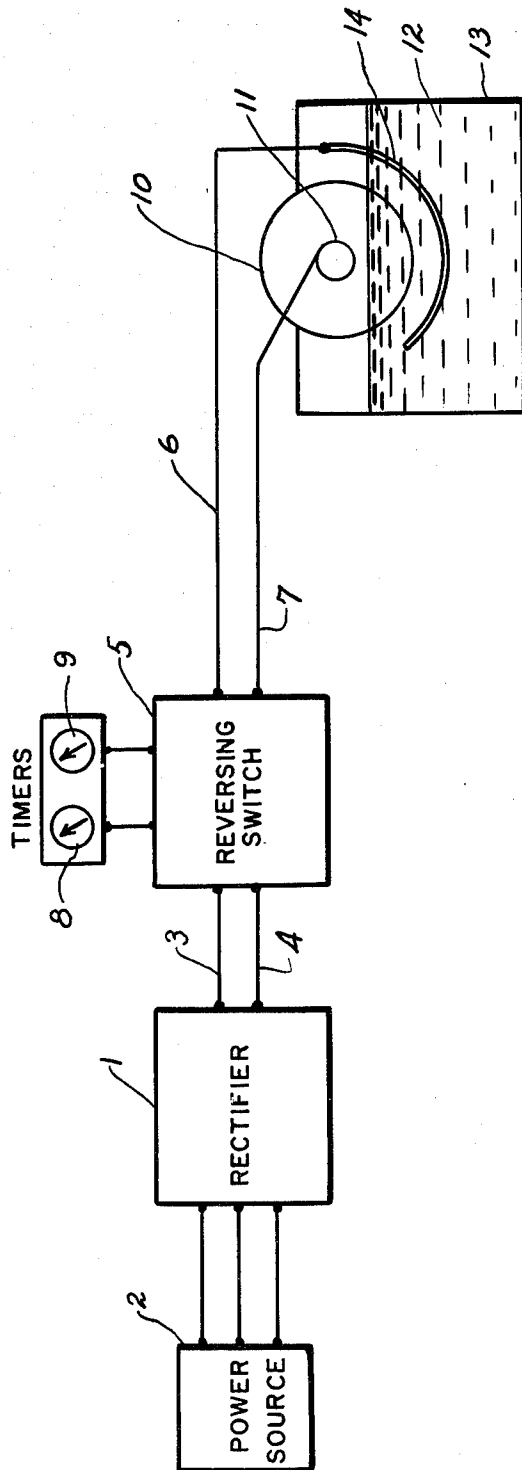
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ABSTRACT

Used gravure cylinders are reconditioned by electrolytic methods using a conventional electroplating machine. During a first stage of the method, copper is alternately and repeatedly removed from and applied to the cylinder by repeatedly reversing the direction of flow of current, with the predominant flow being in a direction to remove copper. In a second stage of the method, copper is also alternately and repeatedly removed from and applied to the cylinder by repeatedly reversing the direction of flow of current, but with the predominant flow being in a direction to apply copper. In a third stage, repeated reversal of flow of current may be discontinued, and sustained flow of current in a direction to apply copper to the cylinder may be continued until a layer of the desired thickness is reached.

7 Claims, 1 Drawing Figure





METHOD OF COPPER PLATING GRAVURE CYLINDERS

This invention relates to methods of reconditioning used gravure cylinders having an intaglio image etched into the cylindrical surface thereof.

Gravure cylinders that are commonly used in roto-gravure printing processes usually consist of steel or aluminum tubing of a wide range of lengths and diameters. Some cylinders are solid throughout rather than tubing for greater strength to resist bending. In some cylinders, the tubing is permanently mounted on a shaft on which the cylinder may be rotated. Other types of cylinders are provided with a removable shaft which may be inserted into the tubing and locked in place.

In all such gravure cylinders, the steel or aluminum cylinder forms a substrate which provides a support for a layer of copper which is usually electroplated onto the outside cylindrical surface of the substrate by conventional methods of electrolytic deposition. After a layer of the desired thickness has been deposited, the surface is leveled by grinding or by cutting with a lathe, and is then polished to a very smooth finish. The thickness of the layer of copper is usually approximately twenty thousandths of an inch, but may vary between fifteen and thirty thousandths.

In the use of such cylinders in roto-gravure printing, an ink-carrying intaglio image consisting of a multiplicity of small cells is etched into the smooth, polished surface of the cylinder by conventional methods. After the cylinder has served its purpose, as by completion of the printing job for which it had been etched, it is usually reconditioned for use in another job. Heretofore, this has usually been done by placing the cylinder in a precision lathe or grinding machine and either cutting or grinding off copper to a depth slightly exceeding the depth of the deepest cells which had been formed in the copper. Then the cylinder has been replaced by usual methods of electrolytic deposition to restore the copper layer to the desired thickness. Thereafter, the surface is leveled by grinding or cutting, after which it is again polished to a very smooth finish adapted to receive a new intaglio image. Cylinders may be thus reconditioned an unlimited number of times. Such methods, however, are time consuming and expensive, and require the use of a precision lathe or grinding machine. They also result in waste of considerable quantities of copper.

It is an object of the present invention to provide a method of reconditioning used gravure cylinders which is entirely electrolytic in nature, except for a final polishing step.

In performing the method of the present invention a conventional copper plating machine may be used, consisting of a vat containing an electrolyte and means for mounting a cylinder therein with its cylindrical surface exposed to the electrolyte, usually consisting essentially of a solution of copper sulphate and sulphuric acid in water. If desired, one or more known reagents may be added to regulate the formation of the desired copper crystalline structure and composition as known in the art. During the practice of the invention the cylinder is rotated in the conventional manner to expose all portions of the surface uniformly to the electrolyte.

The method of the invention comprises three stages of operation, (1) a stage during which copper is alternately and repeatedly removed from and applied to the

cylinder electrolytically, but in which the removal of copper predominates, and (2) a stage during which copper is alternately and repeatedly removed from and applied to the cylinder electrolytically, but in which the application of copper predominates and (3) a stage during which copper is applied continuously to the cylinder electrolytically until a layer of copper of the desired thickness has been deposited.

It is well understood in the art that direct current is used in electrolytic plating processes and that whether copper is removed from or applied to the surface of the cylinder depends on the direction of flow of the current through the electrolyte. When the polarity of the current is so arranged that the immersed surface of the cylinder is cathodic and the solid copper immersed in the electrolyte in the conventional manner is anodic, the flow of current will cause electro-deposition of metallic copper onto the surface of the cylinder. For convenience, flow of current in this manner will be referred to hereinafter as forward flow. On the contrary, when the polarity of the current is reversed so that the immersed surface of the cylinder is anodic and the immersed solid copper is cathodic, the flow of current will cause removal of metallic copper from the surface of the cylinder. For convenience, flow of current in this manner will be referred to hereinafter as reverse flow.

During the progress of the first stage of the method of the invention, reverse flow of current predominates but relatively long periods of reverse flow are alternated with relatively short periods of forward flow. Preferably the ratio of the duration of reverse flow to the duration of forward flow during this stage is approximately 6 to 1. During the second stage of the method forward flow of current predominates, but relatively long periods of forward flow are alternated with relatively short periods of reverse flow. Preferably the ratio of forward flow to the duration of reverse flow during this stage is approximately 8 to 1. Thus, during the first stage, more copper is removed by reverse flow than is added by forward flow, while during the second stage, more copper is added by forward flow than is removed by reverse flow. However, for reasons which are not completely understood, the repeated and frequent reversal of the direction of flow of current during both the first stage and the second stage causes the intaglio cells to fill with copper until, during the second stage, they disappear almost entirely. When this occurs, and as a third stage of the method, repeated reversal of the direction of flow of current may be discontinued, and forward flow may be continued until the copper layer reaches the desired thickness.

It has been found that the intaglio cells cannot be eliminated merely by subjecting the cylinder to reverse flow of current to remove copper, followed by a single reversal of the direction of flow to forward flow to apply copper to the cylinder. The success of the method depends on the frequent reversal of the direction of flow of current during both stages.

The single FIGURE of the drawing is a schematic diagram showing the electrical circuit and the essential components of the apparatus.

EXAMPLE

A specific example of the practice of the method for the reconditioning of a used cylinder 68 inches in length, having an outside circumference of 22 $\frac{1}{4}$ inches, follows:

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Prior to placing a used cylinder bearing an intaglio image into the plating machine, the cylinder should be thoroughly cleaned to remove all traces of residual ink, oil, grease and dirt. The cleaning is done by first washing the surface with a suitable solvent, and then by scrubbing the surface with a detergent soap solution. Cleaning should be continued until, after rinsing with water, there are no breaks in the water film covering the surface.

The cleaned cylinder is then placed in the plating machine with approximately one third of its cylindrical surface area immersed in the electrolyte. The electrolyte preferably consists of a solution of copper sulphate and sulphuric acid in water in the proportions of 30 ounces of copper sulphate and 10 ounces of sulphuric acid to a gallon of water. The electrolyte should preferably be maintained at a temperature of from 90° to 110°F. and filtered and agitated continuously in accordance with conventional practice during the operation of the machine. The cylinder should preferably be rotated at a peripheral speed of approximately 150 feet per minute. Solid copper, preferably phosphorized copper, should be immersed in the electrolyte and electrically connected to a source of current. The cylinder is also electrically connected to a source of current. A rectifier and reversing switch are interposed in the circuit between the line source of alternating current and the electrodes (cylinder and copper) in order to provide direct current and to facilitate the reversal of the direction of flow of current during the operation. Also, to further facilitate the operation, two timers may be provided to control the operation of the reversing switch, one to regulate the duration of forward flow, and the other to regulate the duration of reverse flow. The rectifier is set to provide direct current at 6 to 12 volts and to supply a current density of about 225 amperes per square foot of immersed cylinder surface area.

At the start of the operation, the reversing switch is set for reverse flow of current and the timers are set to provide periods of 30 seconds of reverse flow, then 5 seconds of forward flow, then 30 seconds of reverse flow and so on. This mode of operation should be continued for a period of 30 minutes, at which time approximately 0.0015 inch of copper will have been removed from the cylinder. The current is then switched off and the cylinder should be brushed and inspected. Inspection should show that the intaglio cells have virtually disappeared.

The current is then switched on again after resetting the timers to provide 40 seconds of forward flow, then 5 seconds of reverse flow, then 40 seconds of forward flow and so on. This mode of operation is continued for a period of approximately 30 minutes, after which the current may be switched off, preferably during a period of forward flow. Inspection of the cylinder should show that the intaglio cells have completely disappeared.

The diameter or circumference of the cylinder is then measured, and the timers should then be set for continuous forward flow. The current is then again switched on and allowed to continue until a copper layer of the desired thickness had been deposited.

The cylinder may then be removed from the plating machine and placed in a polishing machine to remove any excess copper and to polish the surface. Grinding or cutting to remove excess copper are usually unnecessary.

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Referring to the drawing, the apparatus comprises a rectifier 1 for converting alternating current such as may be available from any convenient power source 2, preferably three phase, 60 cycle current at 220 volts. Such current may be converted by the rectifier into direct current of low voltage and high amperage. The rectifier 1 is electrically connected by leads 3 and 4 to a reversing switch 5 capable of reversing the polarity of the current exiting from the reversing switch so that current passing through leads 6 and 7 may be plus and minus or minus and plus, respectively, as desired. Preferably, a pair of automatic timers 8 and 9 may be connected to the reversing switch, which said timers may be set to actuate the reversing switch to reverse the current at desired intervals.

The cylinder 10 which is to be reconditioned is mounted on a shaft 11 by means of which the cylinder may be supported in conventional manner for rotation in the electrolyte 12 contained in the vat 13. As shown, the cylinder is only partially immersed in the electrolyte, but rotation of the roller exposes all portions of the surface of the cylinder to the electrolyte. If desired, of course, the cylinder may be completely immersed in the electrolyte.

The lead 7 is in electrical contact with the cylinder shaft 11 and the lead 6 is electrically connected to a member 10 which is supported in the electrolyte in any suitable manner and which may either be made of copper or may serve as a basket or pan containing solid copper. It will be understood that all of the components of the apparatus above described, including the rectifier, the reversing switch, the timers and the plating machine are conventional and well known in the art.

What is claimed is:

1. A method of reconditioning used gravure cylinders consisting of a cylindrical substrate having a layer of copper deposited thereon and having an ink carrying intaglio image consisting of a multiplicity of cells etched into the surface of said layer of copper, which said method comprises the steps of:

- a. exposing the surface of said cylinder to an electrolyte,
- b. passing direct current through said electrolyte and cylinder,
- c. removing copper from said layer during a first stage of operation in which the direction of flow of direct current through said electrolyte is reversed repeatedly so that forward flow of current through said electrolyte is alternated with reverse flow and in which the duration of reverse flow of current exceeds the duration of forward flow, and
- d. applying copper to said layer during a second stage of operation in which the direction of flow of direct current through said electrolyte is reversed repeatedly so that forward flow of current through said electrolyte is alternated with reverse flow and in which the duration of forward flow of current exceeds the duration of reverse flow.

2. The method claimed in claim 1 in which the flow of current during said second stage of operation is terminated while the flow of current is in the forward direction.

3. The method claimed in claim 1 which includes applying copper during a third stage of operation in which the direction of flow of direct current through said electrolyte is continuously in the forward direction.

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4. The method claimed in claim 1 in which, during said first stage of operation, the ratio of duration of reverse flow to forward flow is approximately 6 to 1.

5. The method claimed in claim 1 in which, during the said second stage of operation, the ratio of duration of forward flow to reverse flow is approximately 8 to 1.

6. The method claimed in claim 1 in which, during the said first stage of operation, the ratio of duration of reverse flow to forward flow is approximately 6 to 1, 10

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and in which, during said second stage of operation the ratio of duration of forward flow to reverse flow is approximately 8 to 1.

7. The method claimed in claim 1 in which, during the said second stage of operation, the ratio of duration of forward flow to reverse flow exceeds the ratio of reverse flow to forward flow during the said first stage of operation.

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