May 2, 1972 T. M. KANGAS 3,660,265

TANK FOR METAL PLATING CYLINDERS

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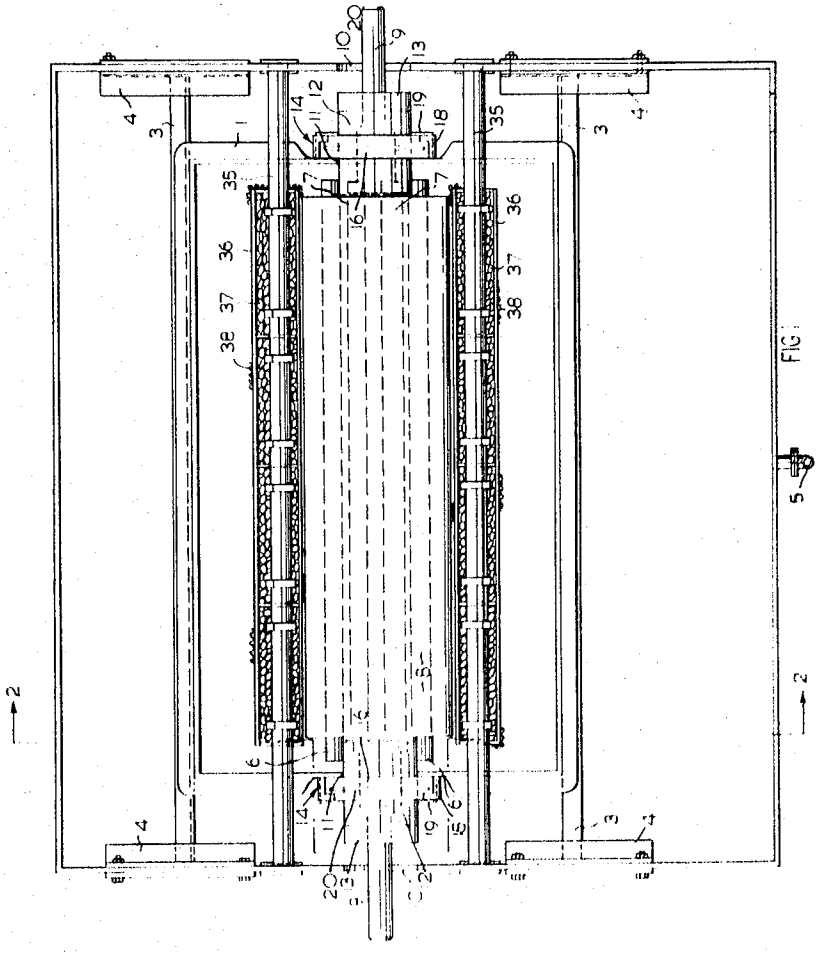


FIG. 1

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TANK FOR METAL PLATING CYLINDERS

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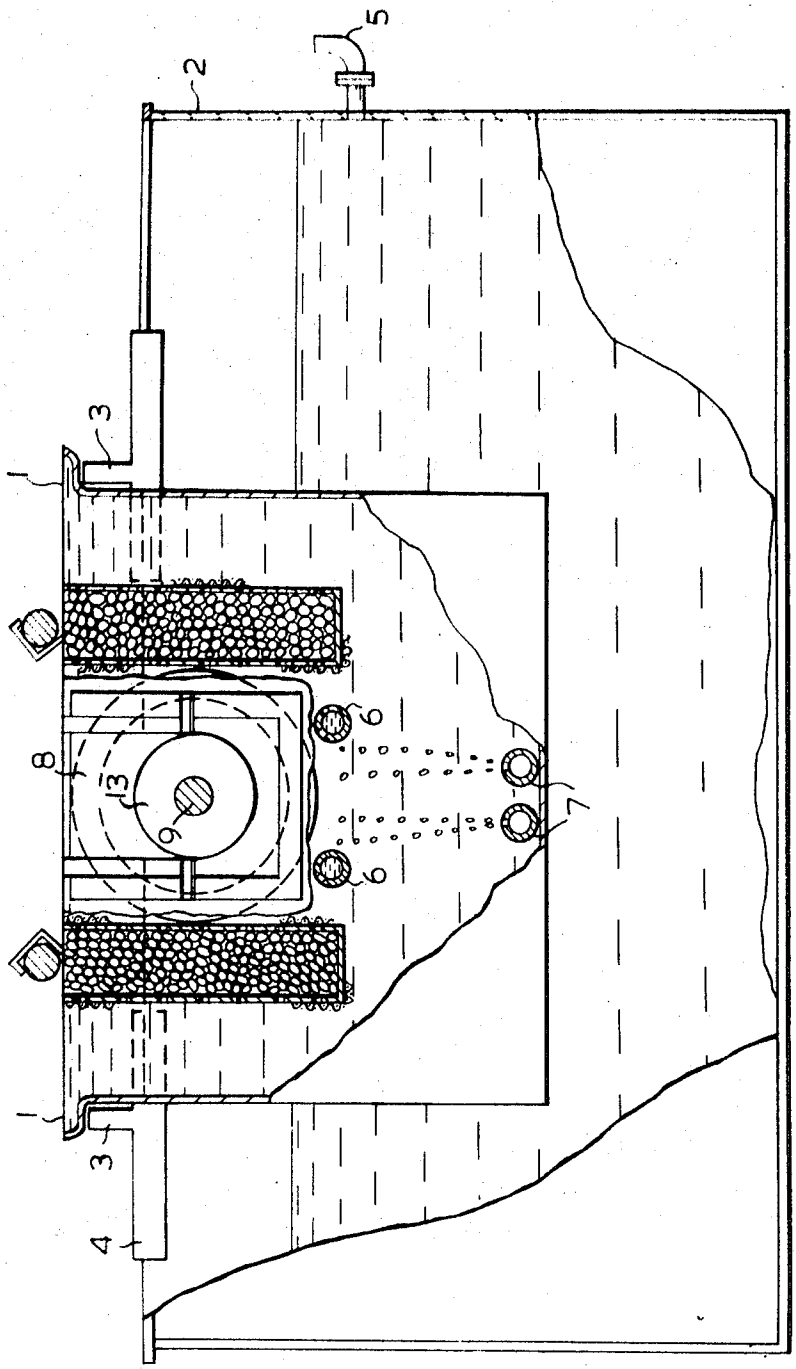


FIG. 2

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TANK FOR METAL PLATING CYLINDERS

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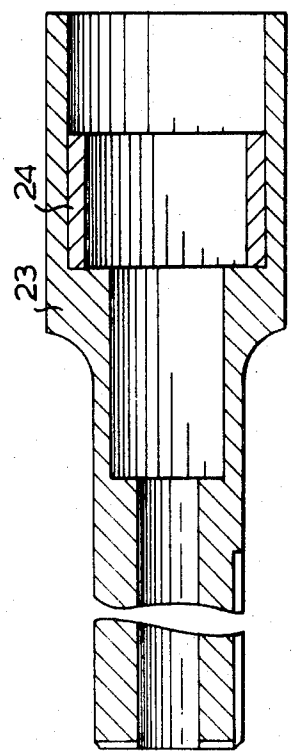


FIG. 3

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TANK FOR METAL PLATING CYLINDERS

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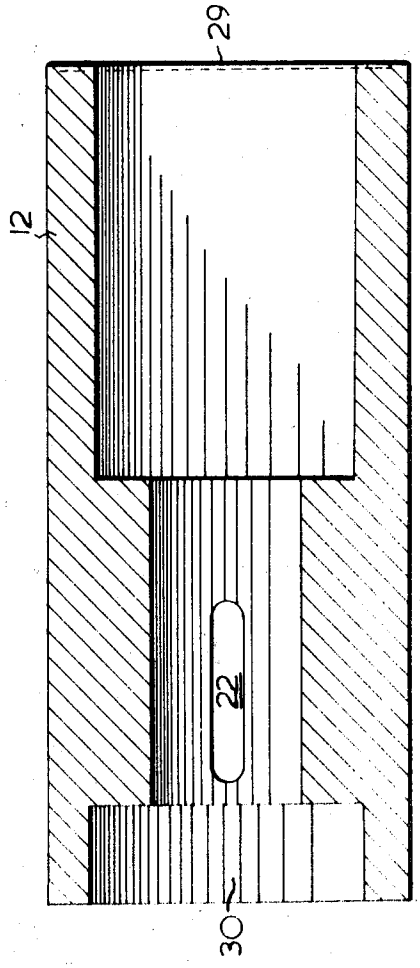


FIG. 4

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TANK FOR METAL PLATING CYLINDERS

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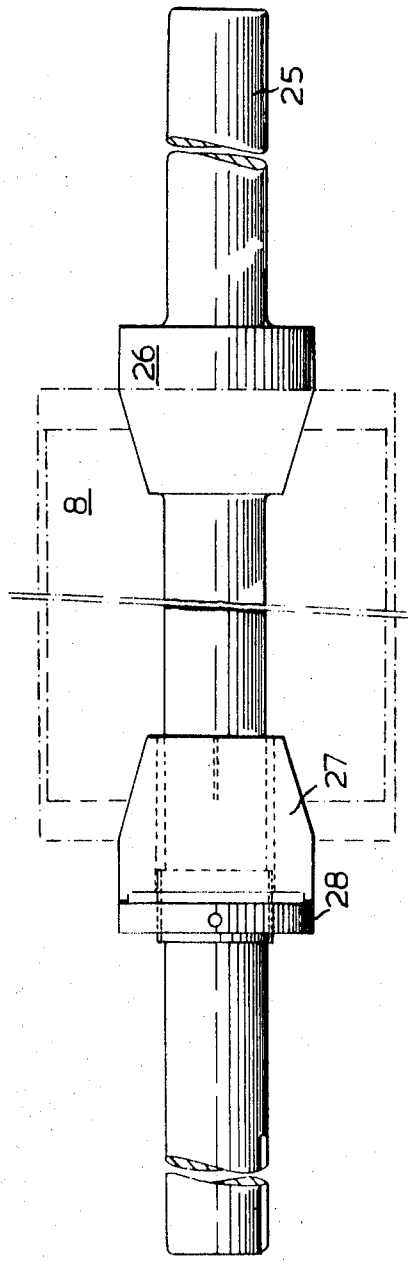


FIG. 5

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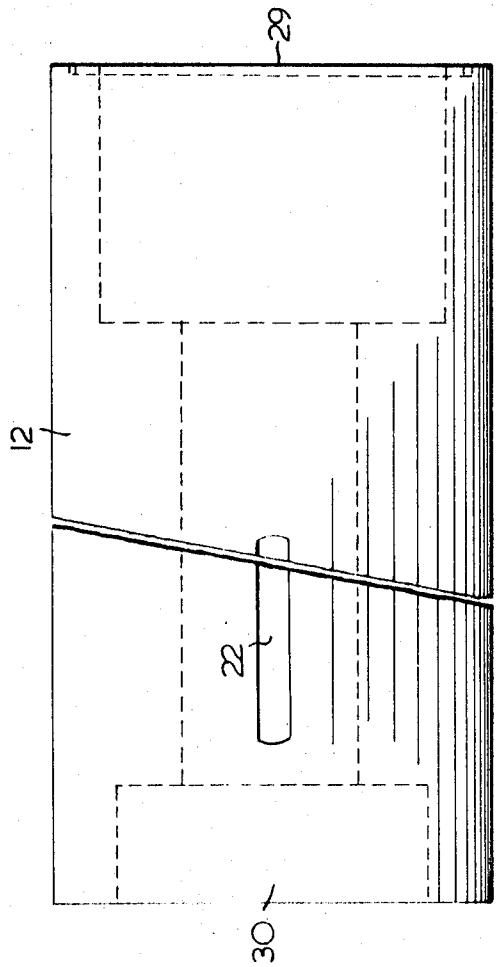


FIG. 6

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TANK FOR METAL PLATING CYLINDERS

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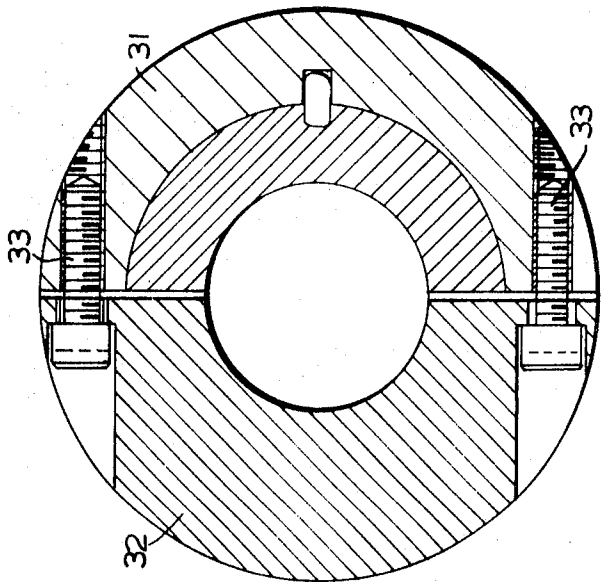


FIG. 8

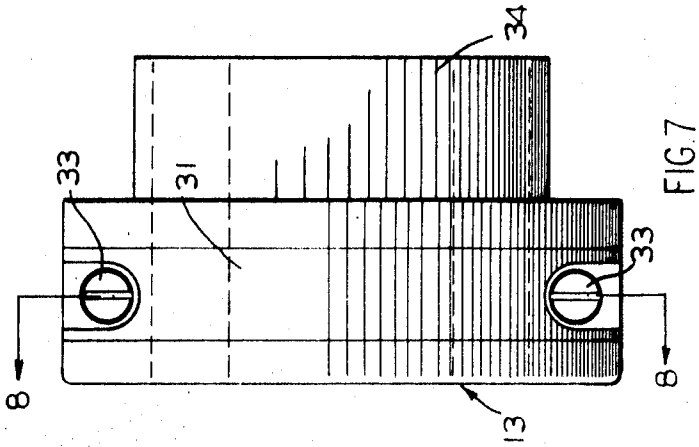


FIG. 7

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TANK FOR METAL PLATING CYLINDERS

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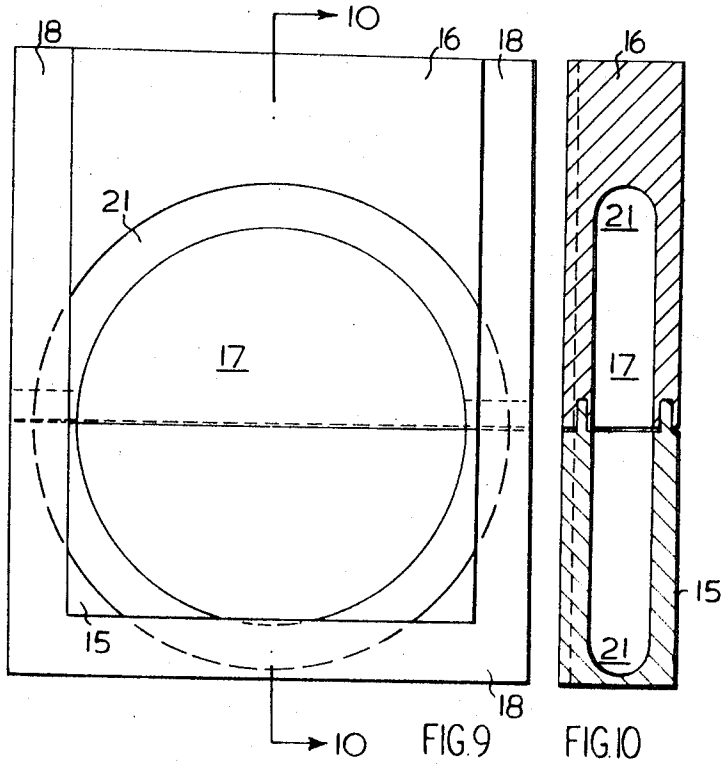


FIG. 9 FIG. 10

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3,660,265

TANK FOR METAL PLATING CYLINDERS

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Int. Cl. C23b 5/68, 5/56
U.S. Cl. 204—212 4 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for use in electroplating a metal onto the surface of a cylinder having a shaft extending from either end thereof, said apparatus comprising a tank for containing electrolyte, a cylindrical sleeve resistant to attack by said electrolyte adapted for releasable fixed location on each shaft with one end thereof in leak-proof abutment with an end of said cylinder, each sleeve being of a length such that the total distance between the remote ends of the sleeves on said shafts is greater than the distance between a pair of opposite walls of said tank, each of said opposite walls of said tank having a recess in the upper edge thereof dimensioned to releasably accommodate the sleeves extending therethrough with the cylinder located for rotation in said tank to form the cathode during the electroplating, each recess being adapted to releasably receive dam means to close said recess such that the level of the electrolyte in said tank may be raised to completely immerse the cylinder during the electroplating, said dam means including mutually separable bottom and top members defining a circular opening dimensioned for slidable fit with the sleeve extending therethrough and anode means for containing said metal to be plated.

The present invention relates to the electroplating of metals onto cylinders and in particular the present invention relates to an improved apparatus for use in the electroplating of metals, such as copper, onto cylinders, in which apparatus the cylinders may, during electroplating, be completely immersed in the electrolyte.

The rotogravure process of printing requires a cylinder which is engraved by the intaglio method. In the preparation of such a cylinder, a base cylinder which may be fabricated from cast iron, cast steel or aluminum, and is usually made from extruded steel tubing, is electroplated with copper to produce on the cylinder a dense deposit of copper of fine grain structure in the form of a coating. The copper coating is then etched with acid and the engraved cylinder so obtained is finally chrome plated for protection against abrasion. Subsequent to its use in printing and for re-use the etched surface is mechanically ground down, suitably on a lathe or grinder, and the cylinder is then replated with copper, etched and chrome plated.

In the conventional copper plating of the cylinder, the cylinder is rotated in the electrolyte, which is usually a solution of copper sulphate and sulphuric acid with various additives therein, with the shafts extending from the ends of the cylinder by which the cylinder is axially rotated extending through recesses in opposite walls of the cylinder to a drive mechanism. Spaced from and extending parallel to the cylinder on either side thereof in the electrolytic tank are copper anodes. These anodes can take the form of titanium baskets containing pieces of copper, which baskets are suspended from bus bars located above the electrolytic tank. To reduce sludging of the anodic material in the tank the baskets are usually surrounded by filter aid such as an electrolyte resistant fabric, e.g. a polypropylene fabric. However, in order to avoid corrosion of the shafts on either end of the cylinder which are usually made of steel or iron during electroplating, and because of the recesses in the walls of the tank through which the shafts extend, it has not heretofore been possible with such an apparatus to completely immerse the cylinder in the electrolyte. Heretofore it has only been possible commercially depending upon the diameter of the cylinder to immerse a maximum of about 30% of the curved surface of the cylinder in the electrolyte at any particular time and the efficiency of the electroplating process is relatively poor. It is found that with such apparatus to obtain the desired copper coat on the cylinder for use in the rotogravure process of printing to effect electroplating for a period of the order of 6 or more hours.

The present invention provides an apparatus for use in electroplating of metal onto the surface of a cylinder such as those useful in the aforesaid rotogravure process in which during the electroplating process the cylinder to be electroplated may be completely immersed in the electrolyte without subjecting the shafts of the cylinder to significant contact with the electrolyte with its attendant corrosion problems and in which unacceptable substantial leakage of the electrolyte from the tank is avoided. In particular, the present invention provides such an apparatus in which due to the complete immersion of the cylinder in the electrolyte the time for electroplating a given thickness of metal is substantially reduced. In particular for electroplating copper the electroplating period may be reduced from a period of the order of 6 hours to about an hour to obtain a copper coating sufficient for use in the rotogravure process of printing.

It has been found according to the present invention that when the structure of the cylinder assembly is modified by releasably fixedly locating on each of the shafts a cylindrical sleeve formed from a material resistant to attack by electrolyte, e.g. polypropylene, with one end of the sleeve in leak-proof abutment with the end of the cylinder, such that the total distance between the remote ends of the sleeves is greater than the distance between the pair of opposite walls of the tank having the recesses and the recesses in the tank are of a size to releasably accommodate the sleeves which extend therethrough and when such recesses are closed by a dam means, which includes mutually separable bottom and top members defining an opening dimensioned for a slidable fit with the sleeve extending through the recess, then it is possible to raise the level of the electrolyte in the tank to such an extent that the cylinder to be electroplated may be rotated in the tank in a completely submerged condition with the improved efficiency of plating of the metal onto the cylinder in such a submerged condition.

The present invention also provides an improved apparatus which is adapted to accommodate any size of cylinder and maintain such cylinder in submerged condition during the electroplating process with the commensurate improved efficiency in electroplating.

According to the present invention therefore there is provided an apparatus for use in electroplating a metal onto the surface of the cylinder having a shaft extending from either end thereof, said apparatus comprising a tank for containing electrolyte, a cylindrical sleeve resistant to attack by said electrolyte adapted for releasable fixed location on each shaft with one end thereof in leak-proof abutment with an end of said cylinder, each sleeve being of a length such that the total distance between the remote ends of the sleeve on said shafts is greater than the distance between a pair of opposite walls of said tank, each of said opposite end walls having a recess in the upper edge thereof dimensioned to releasably accommodate the sleeves extending therethrough with the cylinder located for rotation in said tank to form the cathode during the electroplating, each recess being

adapted to releasably receive dam means to close said recess such that the level of the electrolyte in said tank may be raised to completely immerse the cylinder during the electroplating, said dam means including mutually separable bottom and top members defining an opening dimensioned for a slidable fit with the sleeve extending therethrough and anode means for containing said metal to be plated.

Thus, by providing an electrolyte-resistant sleeve on each of the shafts extending from the cylinder and by providing a dam means which according to a preferred embodiment of the present invention comprises a pair of mutually separable plates which may be slidable into and out of the recess in the walls of the tank by means of channel members such as to provide a circular aperture therein dimensioned to have a slidable fit with the sleeve, there is minimum leakage of the electrolyte out of the tank due to the presence of the dam members in combination with the sleeve and there is minimal contact of the electrolyte with the shaft of the cylinder due to the protection provided by the electrolyte-resistant sleeve. In order to further reduce any leakage of electrolyte from the tank through the dam means the sleeve is suitably provided on its exterior surface with a ring which is also resistant to attack by the electrolyte which is located and rotates in a channel formed in the edges of the plate members of the dam means forming the circular apertures.

It will be readily realized that in order to be fully effective the sleeve member and the dam means and the tank should be resistant to attack from the electrolyte in the tank to avoid unnecessary corrosion problems and, as such, they are suitably formed of a natural or synthetic resin having the aforesaid electrolyte resistance such as polyolefin, e.g. polyethylene or polypropylene. For example a rubber lined steel tank may be used.

Cylinders for use in the rotogravure printing process usually come in two forms namely, integral shafted cylinders which have shafts extending therefrom and sleeve type cylinders which do not have shafts extending therefrom. With the latter sleeve type cylinders in the process it is conventional to provide a shaft which extends completely therethrough with adjustable chucks thereon for locating the shafts and usually these shafts are sufficiently long to accommodate the cylindrical sleeves in accordance with the present invention. However, with integral shafted cylinders having shafts extending therefrom, in many cases the shafts are too short to accommodate the cylindrical sleeves in acordance with the present invention, and, therefore, in order that the cylinders can be electroplated in the apparatus of the present invention it may be necessary to releasably attach to the shafts, suitably by means of bushings, extension shafts to provide the necessary length.

When operating the apparatus according to the present invention with current densities similar to those used in the conventional electroplating apparatus, due to the large increase in surface area which is being electroplated at any paricular time, i.e. the whole of the cylindrical surface area of the cylinder as opposed to at most 30% of it, the electrolyte is very quickly depleted and it has been found desirable in order to maintain the concentration of the electrolyte to recirculate the electrolyte between the tank and a larger tank in which the electrolytic tank is suitably located during which recirculation the electrolyte is replenished before return to the tank. Suitably pump means are provided for pumping the electrolyte from the larger tank to the electrolytic tank and the electrolyte returns to the larger tank by overflow from the electrolytic tank. The pump means suitably includes a filter means for removing solid or foreign matter from the recirculating electrolyte.

While the present invention has been described primarily with respect to the electroplating of copper onto a cylinder it will be readily realized that the apparatus of the present invention is applicable to any electroplating process where it is desired to electroplate a metal onto a cylinder as for efficiency of operation it is always desirable that the cylinder be completely immersed in the electrolytic solution. Thus, for example, the apparatus of the present invention may, with suitable modification of the materials to allow for the electrolyte in the electroplating process and the anodes, be used to chrome plate cylinders.

The present invention will be further illustrated by way of the accompanying drawings in which:

FIG. 1 is a plan view of a copper electroplating apparatus according to a preferred embodiment of the present invention,

FIG. 2 is a section taken along the line **2—2** in FIG. 1,

FIG. 3 is a vertical section through an extension shaft for use in the apparatus of FIG. 1,

FIG. 4 is a vertical section taken through a sleeve for use with the extension shaft of FIG. 3,

FIG. 5 is a top elevation of a shaft for use in electroplating sleeve type cylinders in the apparatus of FIG. 1,

FIG. 6 is a top view of a sleeve for use with the shaft of FIG. 5,

FIG. 7 is a detail of a clamp for fixedly releasably locating the sleeve of FIGS. 4 and 6 on the shafts of FIGS. 3 and 5, respectively,

FIG. 8 is a section taken along the line **8—8** of FIG. 7.

FIG. 9 is a detail of the dam means in FIG. 1, and

FIG. 10 is a section taken along the line **10—10** of FIG. 9.

Referring firstly to FIGS. 1 and 2, the apparatus comprises a tank **1** formed or lined with an electrolyte resistive material such as rubber, located in a larger tank **2** by means of cross members **3** and brackets **4**. Electrolyte is continuously by recirculated between the tanks **1** and **2** by means of a pump (not shown) which withdraws electrolyte from the tank **2** through outlet conduit **5** and pumps it via a filter (not shown), which removes suspended solid matter from the recirculating electrolyte, through inlet conduits **6** to the tank **1**. Electrolyte which has been substantially stripped of its components during the electrolysis overflows from the tank **1** to the tank **2** where the electrolyte is replenished with the components and in the tank **1** mixing of the electrolyte is facilitated by means of air agitation pipes **7**.

A cylinder **8** to be electroplated with copper is mounted for rotation in the tank **1** on steel shafts **9** which extend through a recess **10** in the tank **2** and a recess **11** in the tank **1**. Rotation of the cylinder **8** is effected from a motor means (not shown) through the shaft **9**. Each shaft **9** has releasably fixedly mounted thereon a cylindrical sleeve **12** formed from an electrolyte resistant material such as polypropylene, the sleeve **12** being maintained in position by a steel clamp **13** so as to form a liquid-tight seal with the end of the cylinder **8**. Each recess **11** is closed by a dam means generally indicated at **14** such that the sleeve **12** extends through the dam means **14** whereby the cylinder **8** may be completely submerged in the electrolyte in the tank **1** suitably by two or three inches or even more during rotation thereof with a minimum of leakage of the electrolyte through the dam means **14**, i.e. through the recess **11**.

Referring particularly to FIGS. 1, 9 and 10, the dam means comprises a bottom plate **15** and a top plate **16** formed of electrolyte-resistant material, such as high density polypropylene, the plates **15** and **16** in combination defining a circular opening **17** dimensioned to accommodate the sleeve **12** with a slidable fit. The plates **15** and **16** are located in position on the ends of the tank **1**, to close the recess **11**, in channel shaped members **18** and plate members **19** which are also formed of high density polypropylene fixedly attached to the ends of the tank **1**. To further reduce leakage of the electrolyte between the sleeve **12** and the plates **15** and **16** through the opening **17**, the sleeve **12** is provided with a ring **20** on its outer surface, suitably formed from polypropylene, which is accommodated in a recess **21** in the edges of the plates

15 and 16 defining the opening 17. Each sleeve 12 (see FIGS. 4 and 6) has a recess 22 in the surface thereof to allow for adjustment of the position of the ring 20 on the sleeve 12.

The cylinder 8 which may be electroplated in the apparatus of FIG. 1 may be an integral shafted cylinder or a sleeve type cylinder. When the cylinder 8 is an integral shafted cylinder, it is quite common for the shaft integral with the cylinder 8 to be too small to accommodate the sleeve 12 and as such an extension shaft 23 (FIG. 3) may be releasably fixedly attached to the shaft of the cylinder 8 by means of a steel bushing 24. When the cylinder 8 is a sleeve type cylinder, for use in the apparatus of FIG. 1, it is necessary to provide a removable shaft, such a shaft being for example that shown in FIG. 5 the shaft 25 having a fixed cone 26 and an adjustable cone 27 which is fixedly releasably located in position by a lock nut 28. The cylindrical sleeve 12 suitable for use with the extension shaft 23 is shown in FIG. 4 and the cylindrical sleeve 12 suitable for use with the shaft 25 is shown in FIG. 6. Both the sleeves 12 include a neoprene rubber sealing ring 29 on one end thereof for abutment with the cylinder 8 to form a leak-proof seal and a recess 30 at the opposite end thereof to accommodate a portion 34 of the clamp 13. The clamp 13 as shown in FIGS. 7 and 8 comprises a pair of clamping members 31 and 32 which may be tightened onto the shaft 23 or the shaft 25 by means of bolts 33 with the reduced portion 34 of the clamp being located in the recess 30 in the sleeve 12.

Suspended from copper bus bars 35 extending longitudinally of the tank 1 are titanium baskets 36 which contain pieces 37 of the metal, e.g. copper, to be plated onto the surface of the cylinder 8. The baskets 36 are surrounded by fabric 38, suitably formed of an electrolyte resistant material such as polypropylene, to reduce sludging in the tank 1. Power connections (not shown) are provided for supplying electricity to the copper bus bars 35 and the shaft 9 whereby the cylinder forms the cathode and the titanium baskets form the anode in the electrolytic cell in the tank 1.

For use in the electroplating of chromium onto the cylinder the electrolyte contains chromic acid which would attack polyethylene and polypropylene and thus a chromic acid resistant material is used such as polyvinyl chloride and further in chromium plating the anodes are conventionally lead and tin alloy anodes are used.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for use in electroplating a metal onto the surface of a cylinder having a pair of shafts, one extending from each end of said cylinder, said apparatus comprising a tank having walls for containing electrolyte, a pair of cylindrical sleeves resistant to attack by said electrolyte adapted for releasable fixed location on each shaft with one end thereof in leak-proof abutment with an end of said cylinder, each sleeve being of a length such that the total distance between the remote ends of the sleeve on said shafts is greater than the distance between a pair of opposite walls of said tank, each of said opposite walls of said tank having an upper edge and a recess in said upper edge dimensioned to releasably accommodate the sleeves extending therethrough with the cylinder located for rotation in said tank to form the cathode during the electroplating, each recess being adapted to releasably receive dam means to close said recess such that the level of the electrolyte in said tank may be raised to completely immerse the cylinder during the electroplating said dam means including mutually separable bottom and top members defining a circular opening dimensioned for slideable fit with the sleeve extending therethrough and anode means for containing said metal to be plated.

2. An apparatus as claimed in claim 1 in which said dam means comprises a bottom plate having a semi-circular recess in one edge thereof and dimensioned to provide a slideable fit with the bottom half of each respective sleeve and a top plate having a semi-circular recess in one edge thereof similar to the recess in the bottom member to provide a slideable fit with the top half of each respective sleeve, a ring member being disposed around each respective sleeve and arranged on rotation of said cylinder to rotate in a channel in the edge of said recesses in said plate adjacent each respective sleeve.

3. An apparatus as claimed in claim 2 in which the recesses in said walls include channel members dimensioned to accommodate said plate members for forming said dam means.

4. An apparatus as claimed in claim 3 in which said tank is located in a larger tank pump means being provided for circulation of electrolyte from said larger tank to the electrolytic tank.

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U.S. Cl. X.R.

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