ELECTROPLATING BARREL WITH INTERNAL ANODE AND CATHODE

Foreign Patents or Applications

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ABSTRACT

An electroplating barrel having a rotary plating drum with one or more plating chambers containing anode and cathode electrodes to reduce the inter-electrode distance and thereby adapt the barrel to plating applications, such as aluminum plating, using a plating solution of relatively low electrical conductivity.

13 Claims, 4 Drawing Figures
ELECTROPLATING BARREL WITH INTERNAL ANODE AND CATHODE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the electrolytic deposition of metal, and more particularly to a novel electroplating barrel.

2. Prior Art

Electroplating barrels, or barrel platers as they are sometimes called, are used to batch plate relatively small work parts, such as bolts, nuts, screws, washers, rivets, and the like. Simply stated, such a plating barrel comprises a rotary plating drum having at least one interior plating chamber for containing the work parts to be plated. The drum is rotated submersed in a plating solution while a voltage is impressed across the plating electrodes. As the drum rotates, the plating solution circulates through the plating chamber via passages in the chamber walls, and the work parts undergo a tumbling motion. The tumbling motion establishes random contact of the work parts with one another and with a cathode electrode in the barrel to effect electro-deposition of the anode metal on the parts.

The prior art is replete with a wide variety of such plating barrels as evidenced by the following patents:

3,400,174
3,330,753
3,282,819

These and other prior art plating barrels have one disadvantage which the present invention overcomes. This disadvantage resides in the fact that the anode is located externally of the plating drum and is commonly suspended in the plating tank some distance from the drum. The distance between this external anode and the cathode or cathodes within the drum is thus quite large.

Because of this large anode-cathode distance, the existing plating barrels are ill-suited to plating applications which involve the use of a plating solution having low electrical conductivity, such as aluminum plating with the aluminum hydride plating solution described in U.S. Pat. No. 2,651,608. The conductivity of this latter plating solution, for example, is so low that plating current flow between the external anode and internal cathode or cathodes of the existing plating barrels is very small. As a consequence, the plating time and hence costs are too high to warrant use of the existing plating barrels for such plating applications, except in very special or unusual circumstances.

SUMMARY OF THE INVENTION

The improved electroplating barrel of the present invention has a plating drum rotatable support on a frame. The drum contains one or more plating chambers for receiving work parts to be plated. One wall of each chamber has an access opening with a closure or door which may be opened to insert parts into and remove parts from the chamber. The barrel has passages for circulating plating solution through each drum chamber. In use, the plating drum is submerged in plating solution and rotated to tumble the parts in the drum while the solution is circulated through the drum chambers.

According to a primary feature of the invention, each plating chamber of the plating drum contains both anode and cathode electrodes. The anode of each plating chamber is exposed for contact by the plating solution in the chamber but is shielded against contact by work parts in the chamber. The cathode of each plating chamber is exposed for contact by both the plating solution and work parts in the chamber as the parts tumble during rotation of the plating drum.

Location of both the anode and cathode within each plating chamber substantially reduces the anode-cathode distance and effects a corresponding increase in plating current flow for a given plating voltage. This increase in current flow is sufficient to reduce the plating time and hence cost of a plating operation, such as the aluminum plating operation mentioned earlier, using a low conductivity solution to economically feasible values. Accordingly, the present plating barrel is particularly suited to such plating operations. It will become evident as the description proceeds, however, that barrel is not limited to these plating operations and may be used to advantage for virtually any barrel plating operation including those which use a high conductivity plating solution.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevation of an improved plating barrel according to the invention;
FIG. 2 is a side elevation of the plating barrel;
FIG. 3 is an enlarged section taken on line 3—3 in FIG. 1; and
FIG. 4 is an enlarged half-section taken on line 4—4 in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention provides an electroplating barrel including a plating drum for containing work parts to be plated. Drum 12 is rotatably supported on a frame and driven by a motor through gearing with the drum submerged in a plating solution to tumble the work parts in the drum. During this drum rotation, the plating solution is circulated through the drum via passages means. Drum 12 contains both anode and cathode electrodes. The anode electrodes are exposed for contact with the plating solution in the drum but are shielded against contact by the work parts. The cathode electrodes are exposed for contact by both the plating solution and the work parts as the latter tumble in the drum, whereby the parts are plated with the anode metal.

As noted earlier and will be better understood from the following description, this location of both the anode and cathode electrodes within the plating drum constitutes a major feature of difference between the present plating barrel and the plating barrels of the prior art. This internal electrode location reduces the distance between the anode and cathode electrodes and thereby achieves two important benefits. First, reduction of the interelectrode distance permits economically feasible use of the plating barrel for plating applications, such as aluminum plating, which involves a plating solution of relatively low electrical conductivity.

Secondly, reduction of the interelectrode distance accelerates plating operations involving high conductivity plating solutions.
Referring now in greater detail to the illustrated plating barrel 10 of the invention, the plating drum 12 is a cylindrical drum having three radially spaced cylindrical wall members 24, 26, and 28 concentrically arranged about the rotation axis of the drum and generally flat end wall members 30, 32 joined to the ends of the cylindrical wall members. The central opening through the innermost cylindrical wall member 24 provides a passage 34 which, and radial passages 36 through the cylindrical wall members 24, 26 and 28, comprise part of the passage means 18 for circulating plating solution through the plating drum. Attention is direction to the fact the radial passages 36 are uniformly distributed, with the spacing shown, over the entire surface area of the wall members, but only a few of the passages in each wall member have been shown. The three cylindrical wall members define therebetween radially inner and outer concentric annular plating chambers 38, 40 for receiving work parts to be plated. The center and outer cylindrical wall members 26, 28 have access openings 42 with closures or doors 44 which may be opened or removed to place parts in and remove parts from the plating chambers. The outer door is held in closed position within its access opening by a door clamp 46. The inner door is secured to the outer door by sector shaped endwalls 44a for removal of the doors as a single unit.

The innermost cylindrical wall member 24 comprises a pair of radially spaced electrical insulating sleeves 47, 48 and an intervening metallic sleeve 50. The center and outer cylindrical wall members 26, 28 each comprise center and radially inner electrical insulating sleeves 52 and 54. Extending longitudinally of the plating drum 12 between and spaced longitudinally about the sleeves 52, 54 are a plurality of metallic conductor bars 56 and intervening arcuate electrical insulating spacers 58. Each conductor bar 56 carries a number of metallic contact buttons 60 each having a shank 62 which is press fitted in the bar and extends radially inward through the adjacent inner insulating sleeve 54 and a head 64 on the inner end of the shank. Surrounding the central insulating sleeve 52 of the center and outer cylindrical wall members 26, 28 is a metallic sleeve 66. An electrical insulating sleeve 68 surrounds the metallic sleeve 66 of the wall member 26.

The metallic sleeve 50, 66 of the cylindrical wall members 24, 26 and 28 constitute the anode electrodes 20 of the plating drum 12. The conductor bars 56 and contact buttons 60 of the cylindrical wall members 26, 28 constitute the cathode electrodes 22 of the drum. It will be observed that the anode electrodes or anodes 20 are located about the radially inner sides of the plating chambers 38, 40 and are exposed to the adjacent chamber through the passages 36 in the cylindrical wall members 24, 26 for contact by the plating solution in the chambers. The radially outer insulating sleeves 47, 68 of the latter wall members shield the anodes against contact by work parts in the chambers. The cathode electrodes or cathodes 22 are located about the radially outer sides of the plating chambers and are exposed for contact by both the plating solution and work parts in the chambers.

The plating drum end wall members 30, 32 are essentially identical and each comprises axially inner and outer electrical insulating plates 70, 72. Each outer plate 72 has an annular flange 74 about its edge which projects axially inward over and is sealed to the edge of its inner plate 70. Between the plates 70, 72 of each endwall is a metallic conductor plate 76. The conductor plate 76 of endwall member 30 comprises the same metal as and is mechanically and electrically joined by screws 78 to the anode sleeves 50, 66. The conductor plate 76 of the endwall member 32 comprises the same metal as and is mechanically and electrically joined by screws 80 to the cathode bars 56.

Extending coaxially from the ends of the plating drum 12 are metallic bearing shafts 82. Each shaft has an inner hub 84 which is mechanically and electrically joined by screws 86 to the adjacent end wall conductor plate 76. The plating barrel frame 14 has an upper plate 90 which extends across the top of the plating drum 12 and hanger arms 92 which straddle the drum endwise. These hanger arms carry electrical insulating bushings 94 which rotatably receive the bearing shafts 82 to support the plating drum for rotation on its rotation axis. Attached to the upper frame plate 90 are rings 96 for attachment to a hoist cable by which the plating barrel 10 may be lowered into and raised from a plating tank containing plating solution.

The ends of the plating drum shafts 82 project beyond the hanger arms 92. Rotatably mounted on the projecting shaft ends are metallic bushings 98 which have sliding electrical contact with the shafts. Mechanically and electrically joined to these bushings are conductor rods 100 having upper terminals 102 for connection to cables leading to a plating voltage source (not shown). Conductor rods 100 are secured by brackets 106 to the frame hanger arms 92 and serve to retain the bushings 98 on the drum shafts 82. The bushings and conductor rods are covered with an electrical insulating sheath or jacket 108.

Connected by elbows 110 to the bushings 98 are conduits 112. The passages in the conduits communicate to the passage 34 through the inner wall member 24 of the plating drum 12. Conduits 112 connect to a pump (not shown) for circulating plating solution from the plating tank through the drum.

In operation of the plating barrel 10, the work parts to be plated are placed in the plating chambers 38, 40 of the plating drum 12. The barrel is then lowered into a plating solution and the motor 16 is energized to drive the drum in rotation. Rotation of the drum causes the work parts to undergo a tumbling motion in the plating chambers, thereby establishing random contact of the work parts with one another and with the cathode contacts 60 to effect plating of the parts with the metal of the anodes 50, 66. The anodes, when consumed, are replaced by removing the ends of the plating drum.

As noted earlier, the present plating barrel is designed primarily for plating applications using a plating solution of relatively low electrical conductivity, such as aluminum plating with the aluminum hydrate plating solution described in U.S. Pat. No. 2,651,608. The existing plating barrels are ill-suited to such plating applications owing to the location of the anode externally of the plating drum. This external anode location results in a relatively large distance between the anode and cathode and a correspondingly small plating current flow because of the low conductivity of the plating solution. The plating time is thus so long as to make it economically unfeasible to use the existing barrels for anything other than very specialized plating applications.
This disadvantage of the existing barrels is avoided in the present plating barrel because of the internal location of the anode and cathode within each plating chamber of the plating drum. The distance between the anode and cathode is substantially reduced by this internal anode location and the plating current flow is correspondingly increased to a point which permits aluminum plating and other plating operations using low conductivity plating solutions to be accomplished in reasonable time and at a reasonable cost. It will be understood that for a plating drum of given size, this advantage of the present plating barrel is enhanced by increasing the number of plating chambers in the drum and thereby further reducing the distance between the anode and cathode of each chamber. The anode and cathode arrangement also results in a superior metal plate on the finished parts. While the plating barrel of the invention is particularly suited to aluminum plating and other plating applications using a low conductivity plating solution, the barrel also may be used for plating with high conductivity solutions. In these latter plating applications, the advantage achieved by the plating barrel is a substantial reduction in plating time.

While the invention has been described in connection with a plating barrel having a cylindrical plating drum with two concentric annular plating chambers, it will be understood that the internal electrode feature of the invention may be embodied in plating drums of other shapes and having other than two plating chambers and/or plating chambers of other annular shape.

1. An electroplating barrel for plating work parts comprising:
a plating drum having at least one plating chamber for containing said parts, means for placing parts in and removing parts from each chamber, cathode and soluble anode means within said drum adjacent each chamber with said anode means exposed for contact by plating solution in the chamber and said cathode means exposed for contact by both plating solution and work parts in the chamber, said cathode and anode means being rigidly fixed to and forming structural elements of the drum;
means for shielding said anode means of each chamber against contact by work parts in the chamber;
electrical terminals connected to said cathodes and anode means and accessible externally of said drum for connection to a d-c voltage source; and
means supporting said drum for rotation.

2. An electroplating barrel according to claim 1 wherein:
said anode and cathode means of each chamber are mounted on walls of the chamber.

3. An electroplating barrel according to claim 1 wherein:
each chamber has radially inner and outer walls relative to the rotation axis of said drum; and the inner and outer walls of each chamber mount said anode and cathode means, respectively, of the chamber.

4. An electroplating barrel according to claim 3 wherein:
said inner and outer walls extend about said axis;
said anode means of each chamber comprises a metallic sleeve fixed to the inner chamber wall;
said shielding means of each chamber comprises one electrical insulating sleeve between said anode sleeve and the chamber; and
said cathode means of each chamber comprises metallic contacts fixed to and projecting into the chamber from the outer chamber wall.

5. An electroplating barrel according to claim 1 including:
means for circulating plating solution through each chamber including passages through the chamber walls.

6. An electroplating barrel according to claim 1 wherein:
said drum contains a plurality of said plating chambers.

7. An electroplating barrel according to claim 6 wherein:
said chambers are concentric annular chambers.

8. An electroplating barrel according to claim 7 wherein:
each chamber has radially inner and outer walls mounting said anode and cathode means, respectively, of the chamber.

9. An electroplating barrel according to claim 8 wherein:
said anode means of each chamber comprises a metallic sleeve fixed to and concentric with the inner chamber wall;
said shielding means of each chamber comprises an electrical insulating sleeve between said anode sleeve and the chamber; and
said cathode means of each chamber comprise metallic contacts fixed to and projecting into the chamber from the outer chamber wall.

10. An electroplating barrel for plating work parts comprising:
a rotary plating drum having an axis of rotation, radially spaced annular wall members concentrically surrounding said axis, and wall members joined to the ends of said annular wall members to define a central plating solution passage within the inner most annular wall member and annular plating chambers between the adjacent annular wall members, metallic bearing shafts secured to and extending coaxially from said wall members, closure means which may be opened to place parts in and remove parts from said chambers, and passages extending longitudinally through said shafts to said central passage and radially through said annular wall members for circulating plating solution through said chambers;
a frame having bearings receiving said shafts to support said drum for rotation on said axis;
said innermost annular wall member comprising a pair of radially spaced electrical insulating sleeves and a metallic sleeve between said insulating sleeves;
each remaining annular wall member comprising a central electrical insulating sleeve, a radially inner electrical insulating sleeve, metallic bars extending endwise of said drum between and spaced circumferentially about the latter sleeves, metallic contacts fixed to said bars and extending radially inward through the adjacent inner insulating sleeve.
3,850,737

into the adjacent plating chamber, and a metallic sleeve about said central sleeve;
each remaining annular wall member which separates two adjacent plating chambers further comprising an electrical insulating sleeve about the respective metallic sleeve;
each endwall member comprising a central metallic end plate electrically joined to the adjacent barrel shaft and electrical insulating plates enclosing said metallic plate;
said metallic sleeves comprising soluble anodes and said bars and contacts forming cathodes;
means electrically joining one metallic end plate to said anodes;
means electrically joining the other metallic end plate to said cathodes;
electrical terminals for connection to d-c voltage source; and
means electrically connecting said terminals and shafts, respectively.
11. An electroplating barrel according to claim 10 including:
means including a motor on said frame for driving
said drum in rotation.
12. An electroplating barrel for plating work parts comprising:
a plating drum having a plurality of plating chambers for containing said parts, means for placing parts in and removing parts from each chamber, cathode and anode means within said drum adjacent each chamber with said anode means exposed for contact by plating solution in the adjacent chamber and said cathode means exposed for contact by both plating solution and work parts in the adjacent chamber;
means shielding said anode means of each chamber against contact by work parts in the chamber;
electrical terminals connected to said cathodes and anode means and accessible externally of said drum for connection to a d-c voltage source; and
means supporting said drum for rotation.
13. An electroplating barrel according to claim 12 wherein: said chambers comprise concentric annular chambers.