

[54] UNIFORM PLATING CURRENT APPARATUS AND METHOD

[75] Inventor: Eugene C. Smith, Elk Grove Village, Ill.

[73] Assignee: GTE Automatic Electric Laboratories Incorporated, Northlake, Ill.

[22] Filed: Sept. 24, 1973

[21] Appl. No.: 399,894

2,675,348	4/1954	Greenspan	204/297
2,751,340	6/1956	Schaefer	204/23
2,859,166	11/1958	Grigger	204/279

FOREIGN PATENTS OR APPLICATIONS

986	1896	Great Britain	204/DIG. 7
587,445	3/1931	Germany	204/DIG. 7

Primary Examiner—T. M. Tufariello
Attorney, Agent, or Firm—James V. Lapacek

[52] U.S. Cl. 204/27, 204/279, 204/DIG. 7
[51] Int. Cl. C23b 5/58, B01k 3/00
[58] Field of Search 204/297 W, DIG. 7, 15, 204/14, 23, 27, 279

[56] References Cited

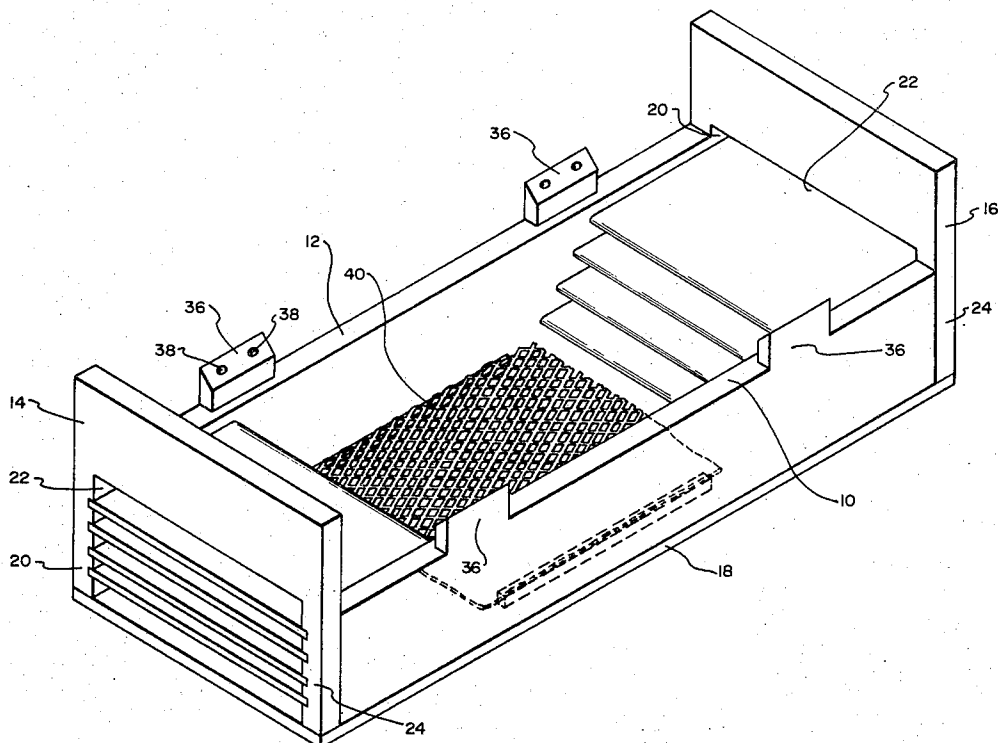
UNITED STATES PATENTS

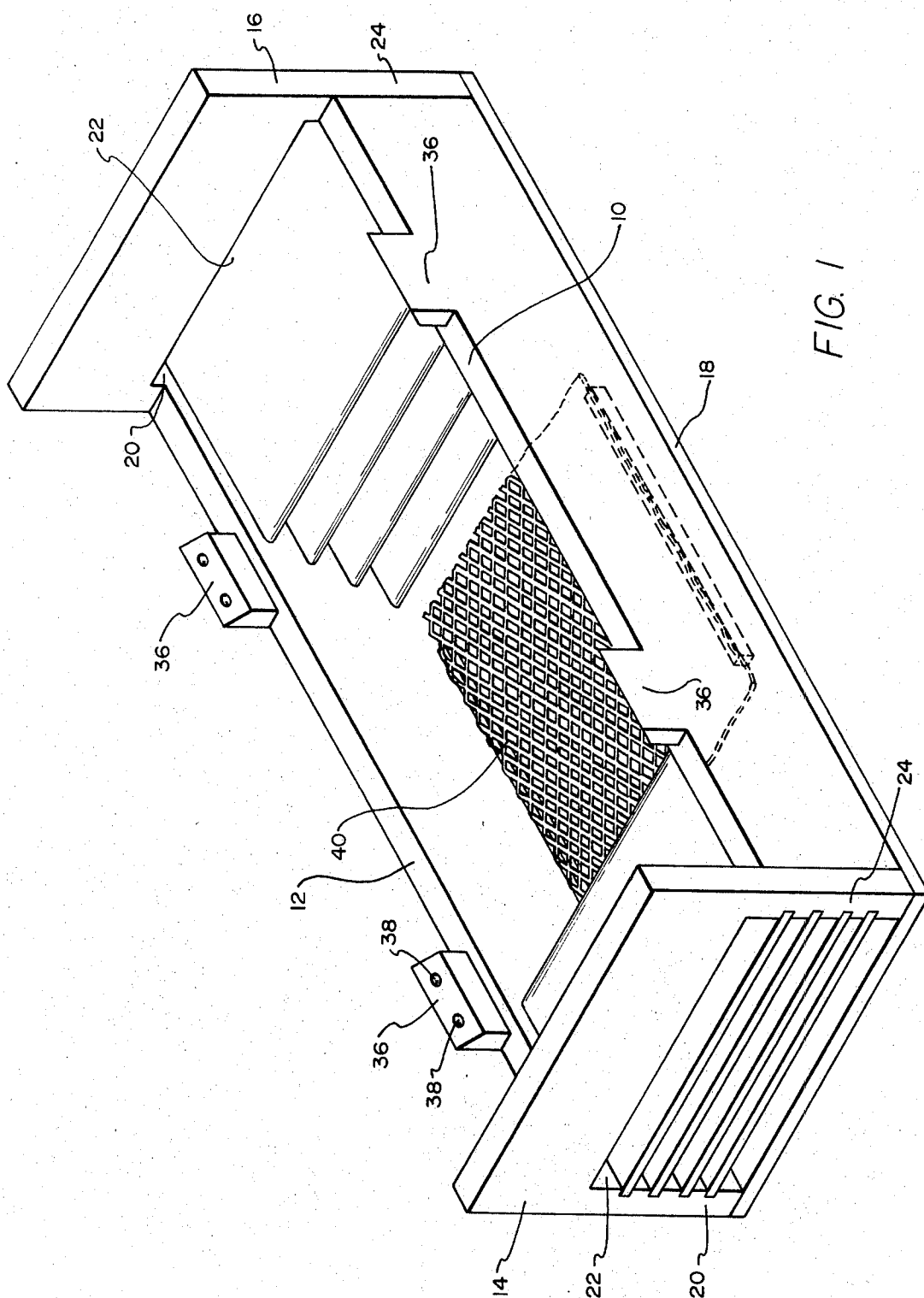
1,519,572 12/1924 Wolf 204/DIG. 7

[57] ABSTRACT

A uniform plating current apparatus and method for providing a nearly uniform flow of plating current within a plating tank containing plating solution between a work piece to be plated and an anode surface.

6 Claims, 7 Drawing Figures





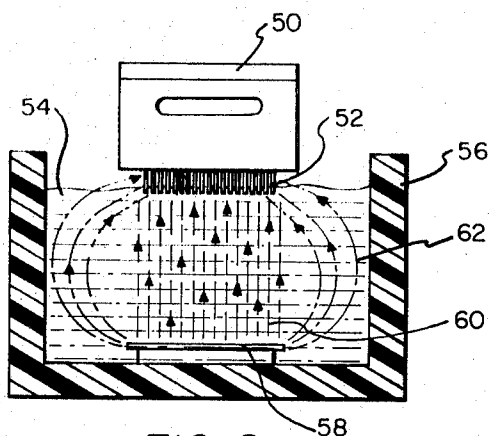


FIG. 2

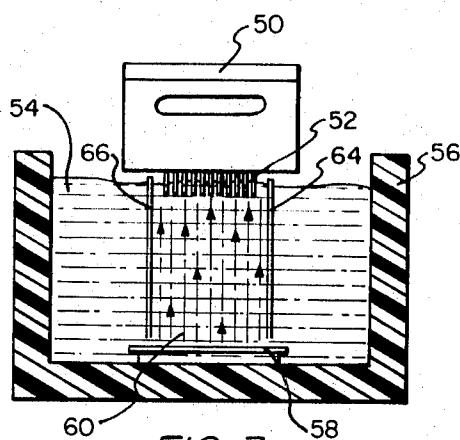


FIG. 3

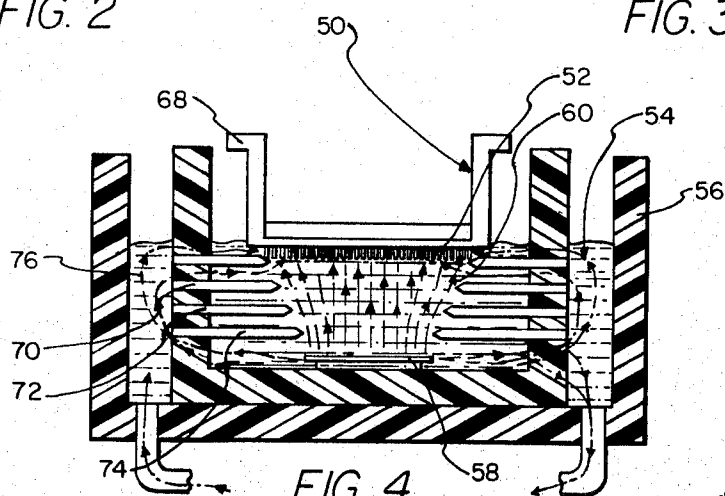


FIG. 4

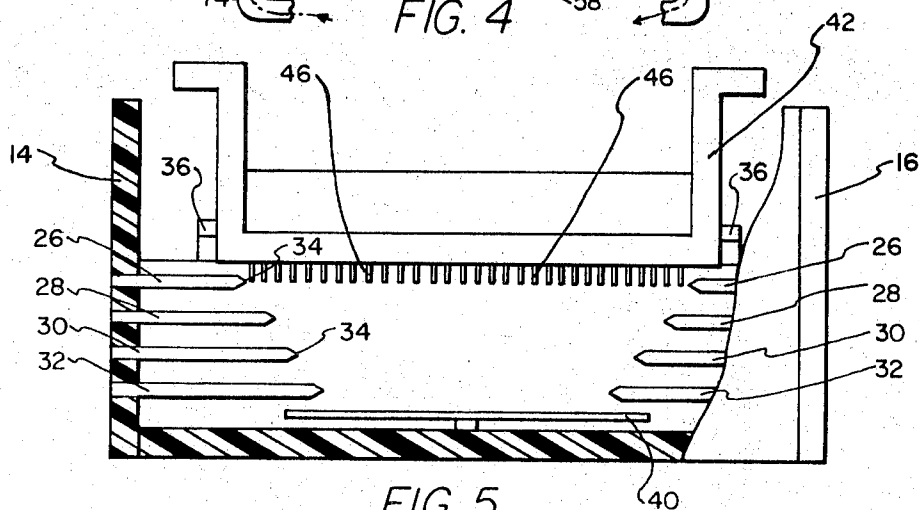
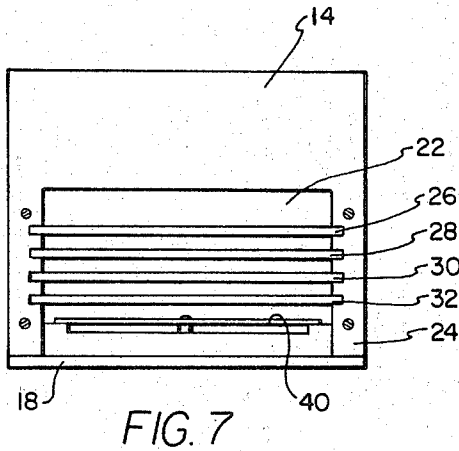
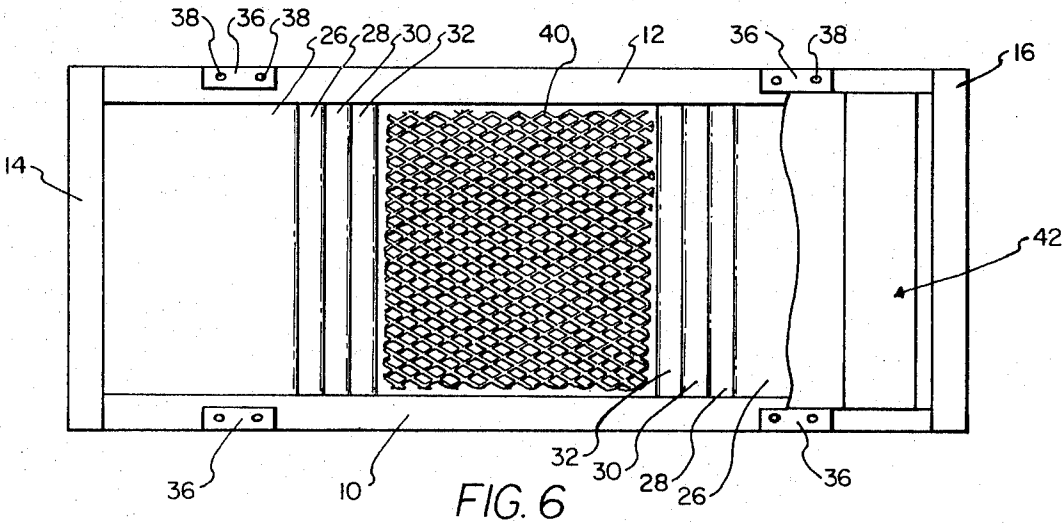


FIG. 5



UNIFORM PLATING CURRENT APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the field of electroplating and more particularly to a new and improved uniform plating current apparatus and method.

2. Description of the Prior Art

In the plating of objects, particularly where the objects have a large surface area or wherein a large number of components are plated simultaneously in a single plating rack, the uniformity of the plating thickness is difficult to control. The plating thickness is especially important when plating such objects as reed blades for reed relay capsules. The plating thickness distribution in the electroplating process is a function of the plating current that each particular component or portion of the object to be plated receives from the anode. Uniformity of current flow and preventing extraneous currents flowing near the periphery of the work piece is essential where equal plating thickness is required. A variety of approaches have been attempted in order to eliminate unequal plating distribution utilizing shields and robber or thief elements to absorb the extraneous current flows. Typical of a shielding arrangement near the object to be plated is that described in U.S. Pat. No. 2,675,348 which issued to L. Greenspan on Apr. 13, 1954. Shielding means in order to affect uniform plating is also described in U.S. Pat. No. 2,859,166 which issued to J. C. Grigger on Nov. 4, 1958. A method and apparatus for obtaining uniform plating on the bearing surfaces of semi-cylindrical flanged bearings by the use of shields or baffles positioned between the bearing and a slot communicating with the anode is described in U.S. Pat. No. 2,751,340 which issued to R. A. Schaefer et al. on June 19, 1956. The various attempts to obtain uniform plating by means of shields and thief or robber elements are not desirable where an extremely high degree of uniformity over a large plating rack or object is desired. Uniform plating methods utilizing shields cause blockage of the natural flow of electrolyte solution with resultant turbulence effects which disturbs uniformity of plating distribution. Further shielding techniques of the prior art are very critical in their placement due to the fact that shielding very near the surface of the object to be plated causes complex current flow patterns which are difficult to measure and maintain.

OBJECTS AND SUMMARY OF THE INVENTION

Accordingly it is a principal object of the present invention to provide a uniform plating current apparatus and method for providing a nearly uniform flow of plating current to obtain a uniform plating distribution (throughout) the surface area of a plating rack.

Another object is a uniform plating current apparatus that provides unrestricted flow of the electrolyte solution in a plating tank thereby eliminating turbulence conditions affecting the plating process.

These and other objectives of the present invention are achieved by providing two generally parallel surfaces of nonconductive composition positioned along two sides of the anode surface that extend upwardly from the anode to the plating rack area or object to be plated. Further the apparatus comprises a first and sec-

ond plurality of flow-blades running transversely between the parallel surfaces and generally along the opposite edges of the anode surface. The flow-blades are spaced one above the other along the distance between the anode surface and the plating rack area or object to be plated.

Other objects will appear from time to time in the ensuing specification drawings and claim.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the uniform plating current apparatus of the present invention;

FIG. 2 is a front view of a plating tank in which no means is provided for uniform current flow;

FIG. 3 is a front view of a plating tank in which two shields or surfaces have been provided to obtain uniform current flow;

FIG. 4 is a front view of a plating tank in which flow-blades similar to the present invention have been provided in order to obtain uniform current flow;

FIG. 5 is a front elevational view of the plating apparatus of the present invention;

FIG. 6 is a plan view of the apparatus shown in FIG. 5; and

FIG. 7 is a side elevational view of the apparatus in FIG. 5.

DESCRIPTION OF PREFERRED EMBODIMENT

The uniform plating current apparatus of the present invention illustrated in FIGS. 1, 5, 6 and 7 includes a front retaining wall 10, a rear retaining wall 12, side walls 14 and 16 and a base 18. Each of the side walls 14 and 16 includes a rectangular opening bounded by edges 20, 22 and 24 as best shown in FIG. 7. Flow-blades 26, 28, 30 and 32 are carried by each of the side walls 14 and 16 and by the front retaining wall 10 and the rear retaining wall 12. The flow-blades 26, 28, 30 and 32 may be secured by means of slots in the material of the side wall 14, 16 and front retaining wall 10 and rear retaining wall 12 and/or by means of cement. The flow-blades, as best shown in FIG. 5, are rectangular sheets of varying lengths with the top flow-blade 26 mounted nearest the upper most portion of the side walls 14 and 16 being the shortest in length or overhang and each successive flow-blade 28, 30 and 32 being each of successively increasing length over the preceding flow-blade. The leading edge or tip 34 of each of the flow-blades 26, 28, 30 and 32 is generally beveled or V-shaped. The function and purpose of the leading edge 34 will be explained in detail hereinafter.

Two plating rack guide pieces 36 are each mounted on the upper most edge of the front retaining wall 10 and the rear retaining wall 12 whose function will be explained in detail hereinafter. The guide pieces 36 are mounted to the front and rear retaining walls 10 and 12 by means of screws 38 although they may also be cemented. Similarly the front retaining wall 10, the rear retaining wall 12, the side walls 14, 16 and the base 18 may be secured by screws or otherwise bonded together such as by means of cement. The uniform plating current apparatus including walls 10, 12, 14 and 16 base 18, flow-blades 26, 28, 30 and 32, and guide pieces 36 may be fabricated entirely from plastic or BAKELITE material although it should be noted that other nonconductive material are also suitable.

A conventional rectangular anode structure 40 is mounted on the base 18 approximately midway be-

tween the side walls 14 and 16. A conventional plating rack assembly 42 is supported by the uniform plating current apparatus along the side walls 14 and 16 and the front and rear retaining walls 10 and 12. The plating rack guide pieces 36 including beveled surfaces 44 guide the plating rack into position on the front and rear retaining wall surfaces. The plating rack 42 and the uniform plating current apparatus are constructed with appropriate dimensions so that the plating rack is positioned securely between the side walls 14 and 16 and the guide blocks 36. The plating rack 42 is designed to retain the object to be plated or workpiece which may be a plurality of reed blades 46 as shown in FIG. 5.

The various plating apparatus shown in FIGS. 2, 3 and 4 demonstrate the various current paths found in plating tanks. The apparatus of FIG. 4 shows the concept of the present invention to obtain a uniform current plating distribution. The apparatus of FIG. 2 includes a plating rack 50 with a plurality of reed blades 52 to be plated positioned in an electrolyte solution 54 contained by the plating tank 56. A conventional anode structure 58 is mounted near the bottom of a plating tank 56. A potential is applied between the anode surface 58 and the reed blades 52 causing an ionic transfer of plating current from the anode to the reed blades. The current distribution of plating current is shown by straight current paths 60 between the anode 58 and the reed blade 52 and also by curved paths 62 which swing out or curve from the anode surface to the reed blades causing an unequal plating distribution due to additional plating current delivered to the outer rows of the plating rack 50 thus causing excessive plating.

To eliminate these extraneous currents, boundary planes 64 and 66 as shown in FIG. 3 may be added at each boundary of the plating work piece or reed blades 52. This results in a current distribution of straight current paths 60 and a uniform plating current distribution with the extraneous current paths 62 of FIG. 2 being eliminated. While the addition of boundary walls or planes such as 64 and 66 eliminates extraneous current paths, this also causes turbulence and blocks the flow of the plating solution or electrolyte which normally in constant agitation to provide for consistent plating techniques.

The concept of the present invention as shown in FIG. 4 provides uniform plating current distribution while allowing circulation of the electrolyte solution without turbulence. Flow-blade surfaces 68, 70, 72 and 74 are utilized to provide a uniform current plating distribution by means of a tapered arrangement and are positioned to compensate for extraneous currents such as 76 that travel around the anode 58 and the flow-blades and reach the reed blades 52. The extraneous current paths are of minimal consideration due to their increased resistance path. The overhanging arrangement of the lower flow-blades 74 partially blocking the direct path from the anode surface 58 to the reed blades 52 also provides compensation for the small contribution of extraneous current paths to the overall plating distribution.

The uniform plating current apparatus of the present invention as shown in FIGS. 1, 5, 6 and 7 provides an equal plating distribution along a work piece by means of maintaining a uniform plating current distribution in an electrolyte solution without preventing the free flow of the electrolyte solution. A plurality of flow-blades

are provided to accomplish the uniform current distribution. Front and rear retaining walls are provided along those surfaces of the plating rack to maintain a uniform current plating distribution in that dimension.

In a specific application of the present invention to plate a rack of reedblades, the total range of plating thickness resulting among the reedblade plating thickness was 80 to 90 microinches. The use of conventional plating apparatus resulted in a range of plating thickness of 80 to 130 microinches across the plating rack.

Whereas the preferred form of the invention has been shown and described herein, it should be realized that there may be many modifications, substitutions and alterations thereto without departing from the teachings of this invention.

Having described what is new and novel and desired to secure by letters patent, what is claimed is:

1. A uniform plating current apparatus for providing a uniform flow of plating current in an electrolyte solution between a plating rack carrying a work piece to be plated that forms a cathode and a quadrangular anode structure, comprising:

two generally parallel surfaces of nonconductive composition positioned along two opposite sides of the anode surface and extending upwardly from the anode to the plating rack area; and

a first and second plurality of flow-blades running transversely between said parallel surfaces and along the remaining two edges of the anode structure, said first plurality of flow-blades spaced one above the other along the distance between the anode surface and the plating rack area and said second plurality of flow-blades spaced one above the other along the distance between the anode structure and the plating rack area.

2. The uniform plating current apparatus of claim 1 further characterized in that said first and second plurality of flow-blades are generally equally spaced one from the other.

3. The uniform plating current apparatus of claim 1 further characterized in that each successive flow-blade in the direction from the object to be plated to the anode structure of said first and second plurality of flow-blades is of increasing length so as to extend farther toward the opposite plurality of flow-blades and the opposite anode edge.

4. The uniform plating current apparatus of claim 1 further characterized in that the leading edges of said first and second plurality of flow-blades extending into the electrolyte solution are generally arcuately shaped so as to provide a smooth flow of the electrolyte solution past the leading edge of each flow blade.

5. The uniform plating current apparatus of claim 1 further characterized in that the work piece carries a plurality of reed blades.

6. A method for providing uniform plating current flow in an electrolyte solution between an anode structure and an object to be plated which forms a cathode surface including the steps of: positioning two generally parallel surfaces of nonconductive composition along two sides of the anode structure extending upwardly from the anode to the object to be plated; and arranging a first and second plurality of flow-blades transversely between said parallel surfaces and along the remaining two edges of the anode surface, said first plurality of flow-blades spaced one above the other along the distance between the anode structure and the object to be plated and said second plurality of flow-blades spaced one above the other along the distance between the anode surface and the object to be plated.

* * * * *