Controlling Thickness Distribution To Improve Quality—Part II

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This is the fifth in a series of reviews looking back on past practical articles. It continues the 25 year-old series, entitled "AES Update," written by Dr. Donald Swalheim (now deceased). These excerpts are intended to resurrect very relevant material that has been buried over the years. Some of it is obvious, but much of it may inspire a "Eureka!" or two. The following is an excerpt of this material, occasionally punctuated with my own words or revisions in brackets [ ], but still remaining faithful to the original article.

This review is the second half of the very first of the AES Update series, on the relationship between thickness distribution and part quality. Last month, we covered the basic factors influencing thickness distribution, including potential lines, plating efficiency, polarization and geometric factors, including anode-to-cathode spacing and part spacing. This second part considers and discusses techniques for improving metal distribution.

Once again, the article abstract is repeated here:

"Failure to acknowledge factors affecting the thickness distribution on plated parts is a major contributor in production of poor quality work. In many cases, abnormally long plating cycles are called for in order to meet thickness requirements on recessed areas. This not only adds to the cost, but wastes metals. After discussing the more important factors influencing plate distribution, methods and steps which can be taken to improve the distribution will be presented.

Improving Metal Distribution

"Corrective measures must sometimes be taken to obtain satisfactory deposits, particularly in chromium plating. The bright plating range is restricted and the deposits are "burned" or dull when plated at excessively high current densities. The technique of self shielding is frequently employed, as illustrated in Fig. 6.

"Articles with sharp points or edges can frequently be racked in a position to prevent burning. Shown in the figure are two letter openers racked with the points adjacent to each other. Where practical, this is the most economical method of preventing burning, since no current robbers are used.

"Current robbers or "thieves" are used quite extensively in chromium plating to prevent burning. [The uninsulated wire or auxiliary cathode (light-colored wire connected to the bolt below the part; not the black ring) is positioned around the upper rim of the cylinder to protect the edges by "drawing off" excess current. The wire is removable and is easily replaced when it becomes heavily plated. Variations on this theme are limited only by the imagination of the process engineer.]

"[The use of current "thieves" has been used to good effect in many applications. In one case study in a large automotive plant, the engineers] had a problem of obtaining an adequate thickness of cadmium within a hole in the plating time allotted. [Since this article was written, however, environmental and health concerns have virtually eliminated the use of cadmium from the automobile.] The parts were racked with the left side facing the anodes. Although the drawing does not show the detailed construction, the left end of the hole is surrounded by a collar which extends out beyond the end of the hole. Visualize the collar as a short piece of pipe, which functions as a thief and directs current away from the hole. [It was] decided to reverse the part on the rack with the right side facing the anode. Thickness within the hole had been increased about 18 percent and [specifications were being met.] Solutions

Fig. 6

Fig. 7

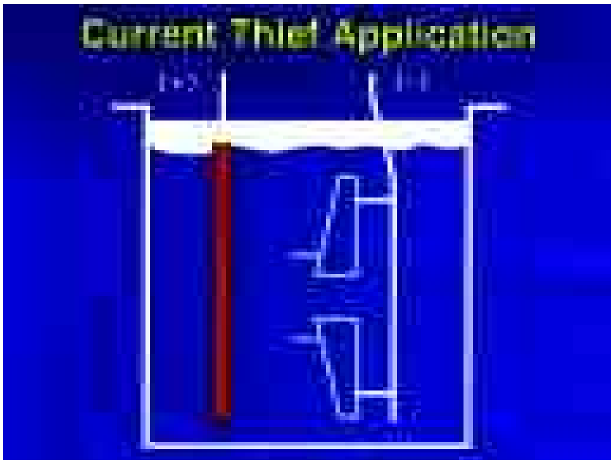

Fig. 8

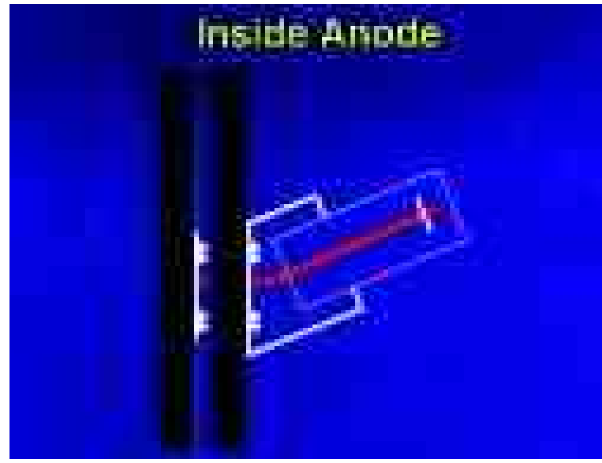

Fig. 9

Fig. 10

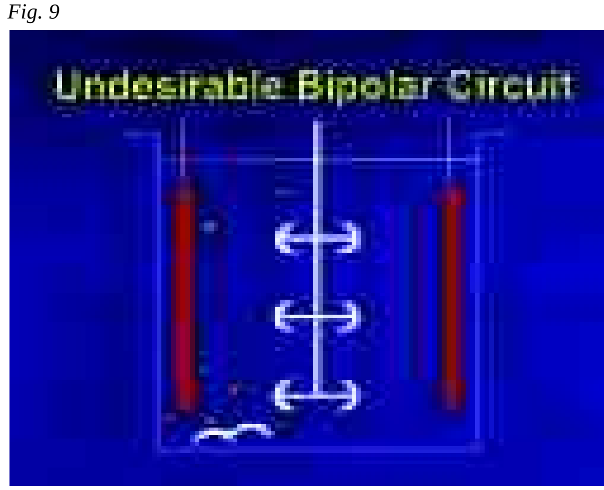

Fig. 11

to major problems may be relatively simple if one has a basic understanding of principles.

"Frequently, we must employ other measures to obtain adequate thickness on difficult-to-plate areas, such as the inside of tubes.

"Plating the inside of cylindrical or other tubular shapes requires an auxiliary anode. The anode is connected electrically to the main anodes. Either soluble or insoluble anodes may be used. In nickel plating high volumes of parts, platinized titanium is used. Without the very thin coating of platinum, the titanium will not carry current. Precautions must be taken to prevent direct contact between the tube and the anode. An insulating ring attached to the anode, as shown in the figure, prevents direct contact.

"Bi-polar and auxiliary anodes are also used extensively, particularly in nickel and chromium plating to improve plating on recessed areas.

"Shown on the left is a bi-polar anode. Note that the bi-polar anode is not connected electrically to either the main anodes or the cathode rack. Usually an electrode of this type is supported on the cathode rack, but the electrode is insulated from the electrical circuit. In the circuit on the left, the current can follow two paths: some of the current will flow directly from the anode to the cathode; because of the high electrical conductivity of the metallic bi-polar electrode, some of the current flows through this electrode. Note that one side of the electrode is negative and the other side is positive. In other words, we have a + - + - path, which is a bi-polar circuit. A circuit of this type gives improved distribution of deposit in the recesses, but the degree of control is not as effective as with an auxiliary anode shown on the right. The auxiliary anode is very similar in operation or principle to the inside anode previously discussed. Unlike the bi-polar anode, it is connected electrically to the main anode.

"Figure 11 illustrates a bi-polar circuit which should be avoided.

"It is sometimes impractical to place the parts rigidly on the rack. In handling the racks, a part will occasionally fall to the bottom of the tank. This results in altering the path of the current, as shown in the figure. Since metals have a much higher conductivity than electrolytes, excessive metal will deposit on the part positioned on the bottom of the rack because the overall resistance to flow of current has been reduced. If the parts on the rack are not firmly supported and do not make good electrical contact, similar bi-polar circuits are encountered on the racked parts. Bi-polar circuits should be avoided, particularly in plating zinc die castings, because portions of parts are anodic and dissolve electrochemically. This results in serious contamination of the solution with dissolved zinc metal.

Summary

"The flow of current must be controlled in order to produce high quality plated parts. Failure to do this can be wasteful and costly. Examine your operations critically. You may find that you can make improvements with relatively simple changes and save money." P&SF