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METHOD FOR ELECTROLYTIC REFINING OF METAL, SUCH AS COPPER

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ABSTRACT OF THE DISCLOSURE

Method and cathode for electrolytic refining of metal, such as copper, to produce cathodes of commerce wherein a substantial thickness of the metal is electrolytically deposited on both sides of thin starting sheets to produce intermediate cathodes which are then subjected to a pressing operation to stress the metal over the area of the intermediate cathode sheets to cold work the metal and stress it to beyond its elastic limit, after which the metal is electrolytically deposited on both sides of the intermediate cathode sheets to a thickness suitable for metal cathodes of commerce.

This invention relates generally to copper refining by electrolysis for producing cathode copper by the so-called multiple system. More particularly, the invention relates to the cathode sheets and method for their manipulation at the beginning of and during the intermittent stages of the process which is carried out to produce the finished copper cathodes of commerce.

It has been conventional practice in electrolytic production of the cathodes of commerce to produce cathode starting sheets by electro-depositing copper from copper anodes in an electrolytic tank containing an electrolyte comprising an aqueous copper sulfate acid solution. The starting sheets conventionally have been prepared by plating the copper from the anode onto a metallic plate (sometimes called a "mother" plate or starting sheet blank) of copper or other suitable metal, the surface of which is smooth and has been lubricated, greased or treated in such fashion that after a thin layer of copper is deposited on the mother plate, it may be removed from the electrolyte solution, stripped off, and straightened to produce a sheet of cathode copper of suitable size and thickness to serve as a starting sheet or starting cathode in the commercial electrolytic tank.

In most electrolytic copper plants, the electrolytic tanks in which the thin starting sheets are produced are referred to as "stripper" tanks. The electrolytic tanks to which the thin starting sheets are transferred and in which the electrolytic process is continued for building up a deposit of copper from copper sulfate solution from the corrosion of copper anodes onto both sides of the starting sheet cathode to a thickness desirable for finished commercial cathodes, are referred to as "commercial" tanks. Usually, the composition of the electrolyte solution used in the stripper tanks differs from the composition of the electrolyte solution used in the commercial tanks.

In the conventional practice, the starting sheets that are placed in the commercial tank have been thin, and the size may vary. The thickness in certain plants commonly has been about 0.030" to about 0.035". But it may be thicker or thinner in some plants. Also, the overall dimensions in different plants may differ. A size of 37½" x 37½" is quite common and is extensively used. The starting sheets, after being stripped from the mother plate and straightened, by hand or mechanically, are provided with loops made of strips of similar material; the loops being fastened to the upper edge portion of the sheets

to provide means for supporting the starting sheets on rods of conductor material. The rods, usually of copper, have end portions which rest upon conductor members, conventionally supported on the walls of the electrolytic tank with the starting sheet suspended in the electrolytic solution in the tank. It will be understood that there is a large number of starting sheets suspended in the commercial tanks alternately with the copper anodes, which are to be dissolved and the copper deposited on the cathode sheets to form the copper cathodes of commerce. The anodes are suspended on conductor members, as known in the art.

It is well known that after the thin prepared starting sheets are placed in the commercial electrolytic tanks, current applied, and the electrolytic process has begun, the starting sheets have a tendency to warp, bend or get out of flat shape, resulting in uneven deposits of copper on the cathode sheets or causing short circuits with adjacent anodes. Prior practice has required adjustment of the sheets in the tanks or removal of the cathode sheets during their early life in the commercial tank and laborious manual work to straighten the sheets or to adjust the position of the distorted cathode sheets in the tank. It was once common practice to remove the warped or bent sheets after they had been on circuit for a day or so and they were wet-flapped by hand by placing an individual sheet on a flat, inclined table and striking the sheet with a flapping paddle. This wet-flapping could straighten the sheet only at localized areas and blows with a paddle at localized areas resulted in setting up undesirable strains in the sheet at other areas, so the wet-flapping methods of straightening such sheets that were removed from the commercial tank did not prevent further warping when the sheets were replaced in the commercial tank. The practice of manual wet-flapping has been largely abandoned because of drawbacks.

Various approaches have been made to avoid or eliminate this arduous work of wet-flapping or of adjusting the position of the cathode sheets in the commercial tank to avoid short circuits, or uneven copper deposition. Various kinds of mechanical levelers or straighteners have been used for straightening or levelling the starting sheets after they have been stripped from the mother plates on which they were formed. Various crimps, ridges in various patterns have been applied to the thin starting sheets to stiffen them or to rigidize them prior to placing them in the commercial tanks where the copper is deposited from a copper sulfate solution from the corrosion of copper anodes onto the cathode sheets for producing the finished cathodes. Although this levelling and straightening of the thin starting sheets has been long practiced, it has not been an entirely satisfactory solution to the problem of maintaining the sheets straight in the commercial tanks during the rather lengthy process to carry the starting sheets to finished cathodes.

Notwithstanding the levelling, straightening and so-called rigidizing of the thin starting sheets before they are placed in the commercial tanks, a large number of them develop warpage or other bending or distortion so that short circuits result soon after they are loaded into the commercial tanks. Although hand wet-flapping has been applied to the sheets by removing the cathode sheets from the electrolyte after they have received a commercial deposit for a day or two and beating them individually with a paddle, short circuits still develop in the commercial tanks, due to warping or distortion of the cathode sheets. The electrolytic process must be kept under control to avoid the short circuits, so far as it is possible to do so. That is, individual sheets where short circuits develop, or are likely to develop, must be manipulated and maintained in proper position in the commercial tank to