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HELIX WIRE ANODE

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This invention relates generally to the electrowinning of copper in a system wherein there is provided an electrolytic cell having an insoluble metallic anode and a metallic cathode upon which the copper is deposited from the electrolyte upon the cathode; the invention relating more particularly to an improved anode for use in such a system.

In U.S. Patent No. 2,792,342, the application for which was filed by me January 26, 1956, I have described a system for the electrowinning of copper in which an anode in the form of a foraminous grid, and preferably in the form of a stainless steel woven wire mesh, is used; the electrolyte in the system comprising sulfuric acid, sulfates of copper and ferrous and ferric iron. The anode described in that patent provides an effective area wetted by the liquid electrolyte much larger than the effective area of an anode having a planar surface; some of the advantages of which, among others, are that the increased wetted area permits of operation of the electrolytic cell with a cell voltage below that which generates excessive oxygen and sulfuric acid at the anode. Also, the amount of electrical energy for copper electrowinning may be reduced over that required when planar anodes are used.

The present invention provides an improved anode for an electrolytic cell in a copper electrowinning system. The anode provided by the invention has an effective wetted area in the electrolytic cell which is materially greater than the effective wetted area of the anodes disclosed in the above mentioned U.S. Patent No. 2,792,342, with consequent materially increased electrical efficiency in operation of the electrolytic cell. According to this invention, the anode is made by mounting a number of wire helixes under tension in a frame suitable for suspending the helix wire anode in conventional manner in the electrolyte in the electrolytic tank. The helixes are made of stainless steel wire and the helixes are mounted in the frame preferably so that their long axes lie vertically in spaced parallel relation; with the turns of wire of successive helixes overlapping each other.

For convenience of description, the term "helix," as used herein, has reference to a length of wire in the form of spiral which is made of a number of turns or coils. That is, as used herein, the term "helix" has reference to a length of spirally formed wire, whereas the term "coil" has reference to the individual turns which form the helix.

In my preferred construction successive helixes mounted on the frame have coils turned in opposite angular directions. That is, each helix is wound in a direction opposite to that of its next adjacent helix. In this latter mentioned construction each turn of wire in any given helix crosses and contacts a corresponding turn of wire in the helix to each side of the said given helix with the result that the current introduced at one end of the coils is not constrained to flow through a single wire but the current has paths of flow provided by the junctures where the wires in the helixes cross and contact the wires

of their neighboring helixes with the result that the ohmic resistance to flow of current through the anode made up of a plurality of wire helixes is materially reduced. Hence the helix anode according to the invention not only has larger effective wetted surface per unit area (measured as a planar surface) and a larger wetted surface than a comparable area of a wire mesh electrode but its use also permits of a reduction in cell voltage; improved cathode current density and current efficiency characteristics; and also reduces the probability of anode corrosion under conditions of unwanted or accidental cessation of electrolyte circulation.

In one embodiment of my invention, I have used stainless steel wire 0.080 inch in diameter. The wire is preferably wound in a spiral coil of ½ inch outer diameter in a tight coil and then mounted in suitable lengths of helixes on a rectangular frame made of stainless steel structural members so that the helixes are stretched under tension to give the coils a pitch of about 0.09 inch. Successive helixes are mounted with their longitudinal axes in parallel spaced relation, spaced apart a distance equal to half the diameter of the coils, with coils of successive helixes turned in opposite angular directions. That is, any given helix, when mounted on the frame, has its coils of wire turned in the opposite angular direction from that of the coils in the helix on each side of that given helix. The result is that each turn or coil crosses and engages, or contacts, the corresponding turn or coil of its next adjacent neighbor, with consequent reduction of ohmic resistance to flow of current through the effective area of the anode.

Although the novel features which are believed to be characteristic of the invention are pointed out in the annexed claims, the invention itself as to its objects, and advantages, and the manner in which it may be carried out, may be better understood by reference to the following more detailed description taken in connection with the accompanying drawings forming a part hereof, in which:

Fig. 1 is a view in elevation of an anode embodying the invention;

Fig. 2 is an end view of the anode illustrated in Fig. 1;

Fig. 3 is a partial view to larger scale illustrating my preferred manner of mounting the wire helixes in the anode frame; and

Fig. 4 is a view on line **4—4** of Fig. 3.

Referring now to the drawings in which like reference characters indicate like parts throughout the several views, the anode A comprises, in general, a rectangular frame **10**, in which is mounted a plurality of wire helixes **11** sufficient to fill the entire area of the frame; the frame **10** being suspended on a suspension copper bar B by means of vertical stainless steel hanger members **13**. As in conventional practice the end **14** of suspension bar B rests on a copper bus bar **15**, in turn resting on the top edge of the wall **16** of the electrolytic tank T, shown conventionally in dotted lines. The other end of the bar B rests upon an insulation block **18**, in turn resting upon the top edge of wall **19** of the electrolytic tank T. It will be understood that the cathode (not shown) adjacent the anode A in the electrolytic tank, will be suspended in conventional fashion in the tank on a suspension cross bar similar to suspension bar B, one end of which will rest upon bus bar **20** and the other end of that cross bar of the cathode will rest upon an insulation block **21**. This is conventional and in this arrangement the direct current employed flows from the source, through the anode, through the electrolyte, through the cathode, back to the source.

The frame **10** of the anode is made of stainless steel bar stock and is constructed in rectangular shape to be suspended in the electrolyte in tank T. It comprises a