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FLUORINE CELL ANODE ASSEMBLY

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This invention relates to electrolytic cells and more particularly to electrolytic cells suitable for the production of hydrogen and fluorine from a molten electrolyte comprising hydrogen fluoride absorbed in an alkali metal fluoride.

Hydrogen and fluorine gases may be produced in a suitable cell by the electrolysis of an electrolyte comprising a mixture of hydrogen fluoride and an alkali metal fluoride. The cell may comprise a plurality of cathodes and anodes immersed in the electrolyte and the cell is constructed to collect the hydrogen and fluorine gases separately. Electrolytes for this purpose are well known in the art and one such cell is described in U.S. Patent No. 2,544,285 to Kenneth E. Stuart and Sidney G. Osbourne. The anodes of cells of this character may comprise carbon which are at least partially immersed in the electrolyte and which are held in position by a suitable metal support above the surface of the electrolyte.

In electrolytic cells of this general character, considerable difficulty has been experienced in the corrosion of the anode assembly by the fumes associated with the operation of the cell. The carbon anodes are normally clamped to a common metal hanger or bus bar by means of bolts and pressure plates. During operation of the cell, the corrosion, at the metal to carbon contact, builds up a high resistance deposit which results in a reduction of the power efficiency and of the life of the cell and eventually requires shutdown in the operation of the cell and expensive overhauls of the anode assembly. In addition, the corrosion of the heads of the bolts, which fasten the carbon anodes to the metal bus bar, will eventually cause the carbon anodes to loosen from the bus bar, resulting in a limited operation life for the cell due to failure of the cell at this point.

The cell life of the anode assembly may be materially increased by increasing the size of the clamping bolts, but this has the disadvantage of materially increasing the corrosion products in the cell that could cause internal electrical shorts. This would necessitate occasional de-sludging to remove corrosion products so that maximum cell current efficiency could be maintained.

With a knowledge of the factors which limited the cell life of prior anode assemblies, it is a primary object of this invention to provide an electrolytic cell anode assembly in which corrosion of the assembly is kept to a minimum.

It is another object of this invention to provide an electrolytic cell anode assembly in which the quantity of corrosion products formed during operation of the cell is kept to a minimum.

It is another object of this invention to provide an electrolytic cell anode assembly with a low anode joint resistance and with a substantially long operating life.

These and other objects and advantages of this invention will become apparent upon a consideration of the following detailed specification and the accompanying drawings wherein:

The single FIGURE illustrates one embodiment in which the principles of this invention may be carried out.

The above objects have been accomplished in the present invention by protecting the clamping bolts from corrosion by placing them in recessed holes in the carbon anode and covering the heads of the bolts with carbon plugs.

This arrangement has increased the cell life to $85 \times 10^6$ ampere-hours, as compared to a cell life of $16 \times 10^6$ ampere-hours for a conventional anode assembly, and to a cell life of $32 \times 10^6$ ampere-hours when larger, exposed clamping bolts were employed.

The single FIGURE in the drawing illustrates the manner in which the carbon anodes are affixed to a metal bus bar in accordance with the principles of this invention.

A common copper metal hanger or bus bar 1 is supported by a metallic rod 7 which is affixed to bus bar 1 by any suitable means. Rod 7 is provided with a reduced portion 8 and with screw threads as shown in the drawing. The threaded portion of rod 7 extends through an opening in the top of the electrolytic cell, not shown, and is employed in combination with a tap nut for securing the rod 7 to the top of the cell. The portion 8 of the rod 7 is used for connecting the rod 7 to a source of electrical power.

A plurality of two-inch thick carbon anodes 2 are affixed to the bus bar 1 by means now to be described. Each of the anodes 2 has a plurality of $9/16$ inch diameter holes drilled completely therethrough. Each of these holes is counter-bored to a depth of $1/4$ inch by a hole $1.384$ inch in diameter, thus providing a shoulder or land for the head of a bolt 3. Each of the bolts 3 is $3/4$ inch by $25/32$ inches with a slot-head. A $3/16$ inch thick, copper washer 4 is inserted under the head of each of the bolts 3 for protection of the carbon anode. Each of the bolts 3 is provided with screw-threads which engage the internal threads of a hold 6 in the bus bar 1 for thus securing the anodes 2 to the bus bar 1, as clearly shown in the cut away portion of the drawing. Each of the bolts 3 is torqued to 120 ft. lbs. to produce an anode joint resistance of 49-65 microhms as determined with a ductor low resistance ohmmeter.

The head of each of bolts 3 is protected from corrosion by a $1/4$ inch thick by $1.394$ diameter carbon plug 5. These plugs 5 may be slightly tapered to insure a tight fit in the recessed holes in which they are inserted. As discussed above, an anode assembly provided with corrosion protection plugs, as described above, has an average service life of about $85 \times 10^6$ ampere-hours before failure of the assembly will occur. This failure is caused by corrosion of the metal anode bus bar which resulted in high contact resistance between the bar and the carbon anodes. This corrosion is attributed to a combination of the corrosive action of active fluorine and electrolysis, particularly at sections of the bar experiencing high current densities.

The use of carbon plugs for protecting the clamping bolts will materially reduce the quantity of corrosion products formed during operation of the cell with the result that the cell will have to be desludged only once before cell failure. An electrolytic cell in which the anode assembly of this invention is used has to be desludged at approximately half life ($45 \times 10^6$ ampere-hours) due to the corrosion of the metal bus bar and the cell tank.

It should now be apparent that the provision of means for protecting the clamping bolts of an anode assembly from corrosion during service operation of the assembly in an electrolytic cell has effectively increased the service life of the assembly and materially reduced the number of shutdowns required for desludging or overhauling of the anode assembly.

This invention has been described by way of illustration rather than limitation and it should be apparent that this invention is applicable in fields other than those described.

What is claimed is:

1. In a cell for generating fluorine, a long-lived anode assembly having improved corrosion resistance and low anode joint resistance, comprising a copper post, a copper...
hanger connected to and supported by said post, a plurality of carbon anode members, each of said anode members provided with a plurality of counterbored bolt-receiving apertures, means for clamping a first group of said anode members to one side of said hanger and for clamping the remaining members to the opposite side of said hanger, said anode members depending from said hanger, said clamping means including respective metal bolts and respective copper washers under the heads of each of said bolts, said counterbored apertures each being provided with a shoulder for the head and washer of each of said respective bolts and washers, said counterbores providing respective recesses beyond the exterior ends of said bolts, said metal bolts extending through said apertures and into said hanger for tightly clamping a portion of the walls of said anode members against said hanger, and shield members comprising carbon plugs inserted into each of said recesses to protect said bolts from corrosion.