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ELECTRICAL CONNECTIONS FOR METAL ELECTRODES

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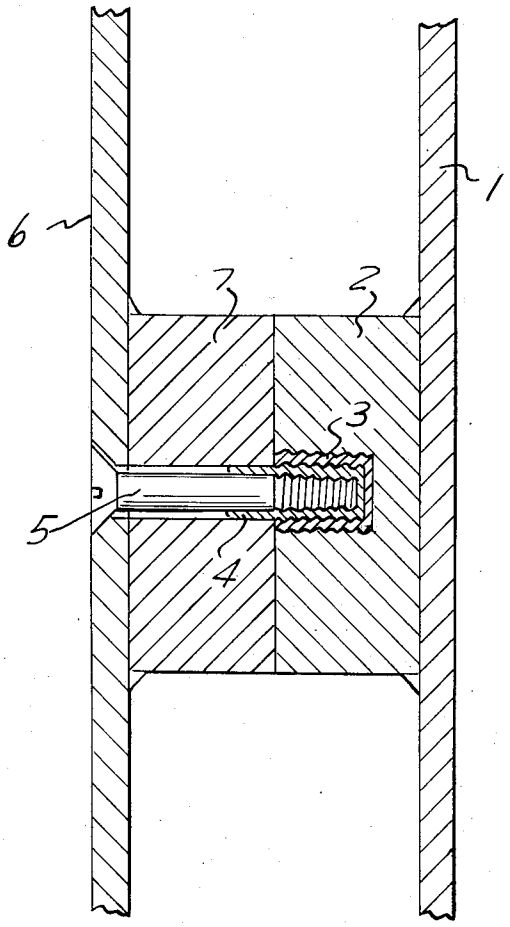

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3,788,966

ELECTRICAL CONNECTIONS FOR METAL ELECTRODES

Orlando W. Stephenson III, Ann Arbor, and John E. Schmidt, Southgate, Mich., assignors to BASF Wyandotte Corporation, Wyandotte, Mich.

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U.S. Cl. 204—256 6 Claims

ABSTRACT OF THE DISCLOSURE

The joining in electrical connection under corrosive conditions of a part made of titanium and a part made of steel by the use of engaging threads or lugs is difficult. However if each part is first coated with a layer of softer but compatible non-oxidizing metal, then the two parts can be joined together in a tight electrical/mechanical joint. A typical system is a platinum coating for titanium and either silver or nickel under copper for steel.

BACKGROUND

(1) Field of the invention

This invention relates to electrolytic cells having both a metal anode and a metal cathode and particularly to electrolytic cells for the production of chlorine and caustic. A new method of making electrical and mechanical connection between the metal cathode and metal anode is provided.

(2) Description of the prior art

Typically the electrolytic cell used in the production of chlorine and caustic from an aqueous alkali metal chloride solution has been a diaphragm cell with a graphite anode. More recently dimensionally stable metal anodes of a practical nature have been developed for use in the diaphragm cell. These metal anodes have additionally made it possible to consider the filter press construction for the diaphragm cell. However, to develop a practical filter press cell, internal electrical connections are necessary in order to obtain a compact unit. It is readily recognized that the internal conditions of these cells is very corrosive to many metals thereby requiring strong electrical/mechanical connections which can be easily protected.

SUMMARY OF THE INVENTION

In accordance with this invention there is provided in a bipolar electrolytic filter press cell for the production of chlorine from an aqueous alkali metal chloride solution wherein the anode is made of a valve metal and the cathode is made of a ferrous metal said anode and said cathode being in electrical connection by bolting one to another, the improvement which comprises inserting through one of the foregoing electrodes a bolt having thread engaging means and made of substantially the same metal as the electrode, the other electrode having female thread engaging means said ferrous metal threads being coated with a coinage metal plating and said valve metal threads being plated with at least one platinum group metal whereby when the electrical connnection is made the softer platinum group metal and the coinage metal are driven into solid contact with each other thereby making a solid electrical connection and a strong mechanical connection under shearing stress.

DESCRIPTION OF THE DRAWING

The drawing is a cutaway view along the length of the engaging bolt showing a ferrous metal cathode and valve metal anode in electrical and mechanical connection according to this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In this invention as shown in the accompanying drawing there is provided a metal anode **1** which according to the art can be either a sheet (solid or with various configurations of openings) or an expanded mesh made from a valve metal. A metal cathode **6** of a ferrous metal, preferably iron, is provided to make the second electrode for the bipolar cell. As with the anode **1**, the cathode **6** can be either a sheet (solid or with various configurations of openings) or an expanded mesh. For convenience the cell separator between and parallel to anode **1** and cathode **6** has not been shown in the drawing since the present invention is not concerned with any particular cell, the use of cell separators are well known and greater clarity of details of the present invention is obtained by its omission.

To one of the electrodes there must be attached, typically by welding, etc., a boss having thread engaging means for receiving and engaging bolt **5**. In view of the thinness of the typical electrode, it is desirable that each electrode be equipped with a boss which when the anode **1** and cathode **6** are properly aligned, the two bosses will mate with each other and properly space the electrodes at the desired distance from the anolyte and catholyte compartment separators. The female bolt receiving boss can be attached to either electrode.

As shown in the drawing the anode boss **2** is the female bolt receiving boss. Boss **2** has threads or thread engaging means which has been coated or plated with a thin but continuous coating **3**. The anode **1** boss **2** is made of a metal which is substantially the same as the anode, that is the boss **2** is also made of a valve metal. The coating **3** is a platinum metal which has been applied according to usual methods for platinizing objects. One convenient method is to brush on an application of a thermally reducing platinizing solution which can then be reduced to an adherent deposit by using a small hand torch. As illustrated the other boss is the cathode boss **7** which is made of a metal substantially the same as that of the cathode **6**, namely a ferrous metal.

Again boss **7** is attached by welding or other suitable means. Boss **7** contains an aperture or hole in axial alignment with a corresponding hole in cathode **6** through which bolt **5** is inserted preliminary to making the electrical/mechanical connection of this invention.

The bolt **5** has the usual head with pressure receiving shoulder, shank and threads at the other end. For this invention the threads are coated or plated with a metal **4** to complete the present invention. The bolt is made of a metal similar to the electrode through which it is inserted. As shown in the drawing the bolt is inserted through the cathode **6** and cathode boss **7**, therefore the bolt **5** is made of a ferrous metal and the plating **4** is a coinage metal. For the purpose of this invention the bolt **5** head may be slotted for moving the bolt **5** with a blade instrument as shown or prepared to use an Allen wrench or some other key type instrument. The bolt head pressure shoulders have been shown as conical but other configurations such as a flat shoulder can be used depending on the thickness of the electrode and if each electrode has a corresponding boss. It will, of course, be immediately recognized that when the bolt **5** is fully connected with the female boss the shoulder of the bolt **5** head must be engagingly seated against the electrode and/or boss so that the electrode (cathode **6** as shown) is held securely.

As the bolt **5** is engaged in the female boss **2** the bolt thread coating **4** and boss thread coating **3** yield just enough to allow passage of bolt **5** yet make a tight solid electrical connection and mechanical connection under stress. Thus, the loss of electrical energy due to resistance

of the joint is reduced to negligible. The tightness of the joint also insures a firm unyielding mechanical connection.

It follows from the foregoing that the anode boss **2** must be mated with the cathode **6** (or cathode boss **7** if so provided) to insure that the bolt **5** head does in fact exert pressure on and retain the cathode in place.

Those familiar with this type of art will readily recognize from the foregoing description that the benefits of this invention will be obtained regardless of whether the bolt passes through and joins to the anode **1** and its boss **2** or the cathode **6** and its boss **7**. In all cases the bolt is made of metal like the electrode through which it passes. In each case the ferrous metal threads or engaging means are coated or plated with a coinage metal. In each case the valve metal threads or engaging means are coated or plated with a platinum metal.

In describing this invention the phrase valve metal has been used to describe a class of metals well known in the electrochemical art. For convenience it suffices to say that by valve metals it is meant the metals of titanium, zirconium, tungsten, tantulum and niobium. Preferably titanium or tantulum is employed and it is normally a commercially pure grade such as electrolytic grade. Alloys of titanium may be employed as long as the alloy meets the criterion of passivity, metal alloys which become passivated when polarized anodically can remain passive well beyond the anodic potential needed to convert a chloride ion to chlorine. The phenomenon of passivity in this connection is discussed in an article by Greene appearing in the April 1962 issue of Corrosion, pages 136-t to 142-t wherein reference may be made to FIG. 1 of the article which describes typical active-passive transition of a metal towards a corrosive medium. Titanium alloys of aluminum, vanadium,, palladium, chromium or tin can be employed in which the latter metals are present as less than 10 percent of the alloy.

The plating for the ferrous metal is a coinage metal, i.e., copper, silver, gold. Because of solution conditions required in the direct plating of these metals to ferrous metal, it is sometimes desirable to first plate with a step of metal such as nickel which has a more desirable electroplating solution and then plate with the desired coinage metal. For instance, the use of nickel and the copper avoids the use of a cyanide bath. Thus, describing such two step plating nickel copper metal means the copper was plated over a thin layer of nickel. Other intermediate layers are similarly described. The two layer soft metal arrangement retains the advantages of the present invention while permitting the use of more desirable plating solutions. Such two step system is to be considered within the scope of this invention.

The platinum group metals include platinum, ruthenium, osmium, rhodium, iridium and palladium and alloys of two or more of the foregoing metals. It has been convenient to refer to the group as platinum since platinum is the preferred metal in the group.

Many other modifications and ramifications will naturally suggest themselves to those skilled in the art based on this disclosure. These ramifications and modifications are intended to be comprehended as within the scope of this invention.

Having thus described the invention, what it is desired to claim and secure by Letters Patent is:

1. In a bipolar electrolytic filter press cell for the production of chlorine from an aqueous alkali metal chloride wherein the anode is a valve metal and the cathode is a ferrous metal said anode and said cathode being in electrical connection by bolting one to another by inserting through one of the foregoing electrodes a bolt having thread engaging means and made of substantially the same metal as the said one electrode, the other electrode having female thread engaging means, the improvement comprising the thread engaging means made of a ferrous metal being coated with a coinage metal plating and thread engaging means made of a valve metal being plated with at least one platinum group metal whereby when the electrical connection is made the softer platinum group metal and the coinage metal are driven into solid contact with each other thereby making a solid electrical connection and a strong mechanical connection under shearing stress, said female thread engaging means being a metal boss containing female bolt engaging threads, said boss being adhered to said other one electrode on the side facing said electrode.

2. In a bipolar electrolytic filter press cell for the production of chlorine from aqueous alkali metal chloride solutions wherein the anode is a valve metal and the cathode is a ferrous metal, said anode and cathode being in electrical connection by bolting one to the other, the improvement which comprises making the electrical connection by adhering to said anode on the side facing said cathode a valve metal boss containing female bolt engaging threads wherein said threads of said boss have been coated with at least one metal from the platinum group of metals, inserting through said cathode a ferrous metal bolt for engaging said boss in tight electrical and rigid mechanical connection, said bolt having a copper over nickel copper plating on the engaging threads whereby when the electrical connection is made the softer platinum group metal and the nickel copper metal are driven into solid contact with each other thereby making a solid electrical connection and a strong mechanical connection under shearing stress.

3. The electrical connection of claim **2** wherein adhered to the cathode in mating position with respect to said boss on said anode is a ferrous metal boss through which said bolt will be inserted.

4. The electrical connection of claim **2** wherein the platinum group metal is platinum.

5. The electrical connection of claim **2** wherein the ferrous metal of the cathode is steel.

6. The electrical connection of claim **2** wherein the valve metal of the anode and anode boss is titanium.

References Cited

UNITED STATES PATENTS

3,441,495	4/1969	Colman	204—268
3,271,289	9/1966	Messner	204—286
1,365,875	1/1921	Ward	204—256
3,242,065	3/1966	DeNora et al.	204—256
3,511,766	5/1970	Kisner et al.	204—286

FOREIGN PATENTS

1,054,430	4/1959	West Germany	204—256

TA-HSUNG TUNG, Primary Examiner

W. I. SOLOMON, Assistant Examiner

U.S. Cl. X.R.

204—254, 255, 268, 286

PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,788,966 Dated January 29, 1974

Inventor(s) Orlando W. Stephenson III and John E. Schmidt

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, Claim 1, line 17, after the word "other", please delete "one".

Column 4, Claim 1, line 18, after the word "said", please insert --one--.

In the Drawing, patentee's first initial in his name should be changed from "C" to --O--.

Signed and sealed this 11th day of June 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents