

[54] **ELECTROLYTIC CELL WITH IMPROVED BIPOLAR ELECTRODE CONNECTION**

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[58] **Field of Search** 204/254, 256, 268, 279, 204/290 F, 286, 266

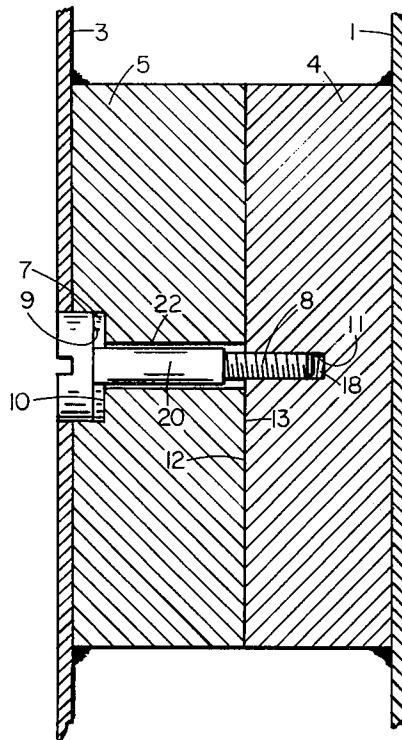
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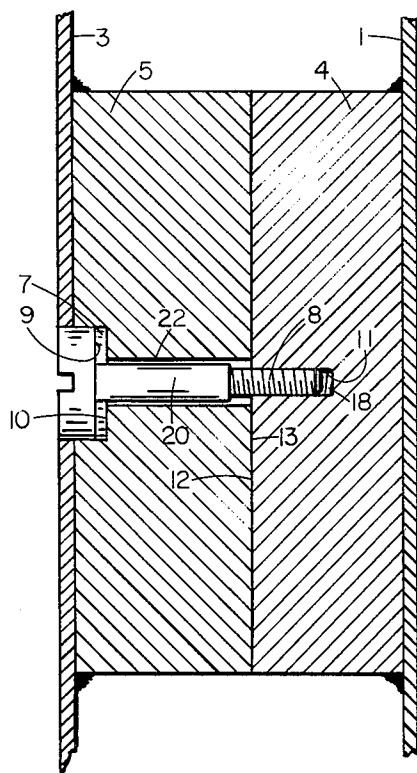
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[57] **ABSTRACT**

In a bi-polar filter press electro dialysis cell the adjacent electrode pair is provided with attached bosses positioned to allow the pressure receiving area of each boss to mate with each other and surround the threaded bolt engaging means. An improved electrical contact is made between the mating surfaces of the anode and cathode bosses by coating the valve metal anode boss surface with platinum and the ferrous metal or a nickel cathode boss surface with a soft metal such as copper. A soft metal gasket is placed between the bolt head and the pressure receiving shoulder of the boss through which the bolt passes.

6 Claims, 1 Drawing Figure





ELECTROLYTIC CELL WITH IMPROVED BIPOLAR ELECTRODE CONNECTION

This invention relates to bi-polar electro dialysis cells for caustic-chlorine production and particularly to cation selective membrane or diaphragm filter press type cells employing improved means for electrically and mechanically inter connecting the adjacent pair of metal anode and cathode bi-polar electrodes.

Bi-polar electrolytic filter press diaphragm cells for caustic-chlorine production employing dimensionally stable metal anodes require an internal electrical connection between the metal bi-polar electrodes. Such a connection is disclosed in U.S. Pat. No. 3,752,757 wherein the metal anode and cathode of adjoining cells are electrically connected with each other by thread engaging means with the anode and cathode maintained in space relationship to each other by a non-conductive plastic barrier sheet therebetween. The use of internal electrical connections of the bi-polar electrodes through the barrier sheet subjects the connection to a corrosive environment thereby necessitating the need for improved and better protected electrical and mechanical connections.

In accordance with the present invention there is provided a bi-polar electrolytic filter press cell wherein a valve metal anode and a ferrous metal or nickel cathode of each electrolysis cell is separated by an ion selective membrane of the cation type and wherein the anode and cathode of the adjoining or contiguous cells are maintained in space relationship by an electrically non-conductive sheet between them; the anode and cathode being in direct electrical connection with each other through said sheet by attaching metal bosses or lugs on one side of each of said anode and cathode, said bosses positioned to allow the pressure receiving area of each adjacently disposed anode and cathode boss to mate with each other to surround thread engaging means, the metal composition of the bosses being substantially the same as the respective electrode to which it is attached, one boss having a female thread engaging means for receiving a threaded bolt which bolt passes through the other boss into the said one boss, said bolt having a composition substantially the same as the boss through which it passes, the said other boss having a pressure receiving shoulder which mates with the pressure receiving shoulder of the bolt head, the improvement comprising having the pressure receiving and mating area of the said (cathode) boss plated with a highly conductive and easily reduced metal selected from the group consisting of copper, silver and gold and the said pressure receiving and mating area of the said valve metal (anode) boss plated with a platinum group metal whereby under mechanical pressure from the bolt thread engaging means the two highly conductive soft mating surfaces of the said bosses are squeezed into intimate contact with each other to form an improved electrical connection thereby.

The drawing is a fragmented cutaway view of the improved bi-polar electrode joint taken at the middle of and along the length of the threaded bolt joining the metal electrodes together according to this invention.

In this invention as shown in the drawing is a typical bi-polar metal electrode connection provided with a metal anode (1) and an adjacently disposed metal cathode (3). The anode is preferably foraminous in structure such as an expanded sheet of a valve metal material such as titanium. The cathode is fabricated of a fer-

rous metal such as iron or nickel and as with the anode is preferably of the expanded mesh type. The plastic barrier or separator sheet which is located between the electrodes to form the adjacent cell walls in a filter press type membrane cell is not shown since it is not concerned with the present invention. The use of such separators in bi-polar electrode cells is fully disclosed in U.S. Pat. No. 3,752,757 and need not further be described herein. To facilitate the bolting of the anode 1 with the cathode 3 an anode boss or button 4 is attached to the anode 1 and a corresponding cathode boss or button 5 is attached to the cathode 3 as by welding or other means. The anode boss 4 contains a hole 18 having thread engaging means 11 and acts as the female receiving boss for engaging threaded male bolt 20. The threaded bolt hole 18 of the anode boss 4, the cathode boss bolt hole 22 and the cathode 3 are in alignment with one another so that the bolt 20 can be inserted and engaged readily. The mechanical and electrical connection is made by inserting the bolt 20 through an electrode such as the cathode 3 and cathode boss 5 and into the adjacent other boss or anode boss 4 which as illustrated is the female bolt receiving boss. The bolt 20 is turned until there is tight contact exerted by the bolt head pressure receiving shoulder 9 against the cathode boss pressure receiving shoulder 10 and further by the anode boss pressure receiving area 12 against the cathode boss pressure receiving area 13. To insure good contact and a leak proof seal between the surfaces of the bolt head pressure receiving shoulder 9 and the cathode pressure receiving shoulder 10, it becomes advantageous to place a soft metal gasket or washer 7 therebetween made of a material such as copper or lead. The pressure receiving shoulders and areas 9, 10, 11 and 12 respectively are preferably flat but may be of other shapes, the main consideration being the proper mating engagement with firm contact to provide both a strong mechanical joint and solid electrical contact.

In accordance with this invention an improved electrical contact is provided especially in the mating engagement between the pressure receiving areas 13, 12 of the anode boss 4 and the cathode boss 5 by coating the said engaging or mating surfaces or by applying therebetween a highly conductive material which will withstand the conditions encountered in caustic-chlorine production. The anode 1 and anode boss 4 attached together by appropriate means are fabricated from the same valve metal or an alloy thereof which metal is preferably titanium. The anode boss pressure receiving area or mating surface 12 is coated or plated with at least one platinum group metal or metal compound. The coating is preferably platinum and is applied by any of several methods well known in the art. The platinum coating may also be extended to cover the thread engaging means 11 of the anode boss hole 18 if so desired but such coating of the treads is not critical to the present invention since the much larger butting area covered by the mating surfaces of the anode and cathode bosses is the major source of good electrical contact. Thread engaging means generally have insufficient cooperating mating surfaces for the required contact area. The cathode 3, cathode boss 5 and bolt 20 are preferably made of the same or similar metal; a ferrous metal such as steel or iron being preferred. The cathode boss pressure receiving area of mating surface 13 can also be coated or plated with a

continuous coating of copper, silver or gold which coating can be further coated over with platinum if so desired. It may also be advantageous to coat the thread engaging means 8 of the bolt 20 in a similar manner although this is not critical in the present invention for reasons stated hereinabove. The manner of coating ferrous metals with the aforesaid metals is well known in the art and is not within the scope of the present invention. U.S. Pat. No. 3,627,561 discloses a process for metallurgically bonding platinum to iron by first plating the iron with a layer of easily reduced metal such as copper and thereafter depositing the platinum, ideally by flame-spray or plasma jet spray.

Where the mating surfaces of both the cathode and anode boss pressure receiving areas contain a coating or layer of a metal which is softer than that metal of which the base surface is composed, it then becomes possible to join the plated parts together into an improved electrical joint connection. Under mechanical pressure, a strong electrical connection is made when the softer metals on the mating surface of the anode and cathode boss are squeezed or driven into intimate contact with each other.

Other means of providing good electrical contact between the pressure or mating surface of the anode and cathode boss is to plate the valve metal surface with a platinum group metal as described above while maintaining the iron or nickel surface intact. Prior to bringing the two mating surfaces together, an electrically conductive epoxy compound is applied there between. Such a compound is commercially available from Epoxy Technology Inc. of Watertown, Massachusetts under the designation Epo-Tek 415G. This compound is described as a two component (part A and B) pure silver epoxy thixotropic paste. Part A the silver epoxy and part B the silver hardener may each be employed above or mixed in approximately equal parts and allowed to cure at room temperature. Another electrically conductive preparation usable in the same manner is designated as Catalog No. 21059 obtainable from the Thomas & Beth Company of Elizabeth, New Jersey. This compound is a mixture of fine metallic zinc particles suspended in a high temperature grease. This compound also seals out corrosive liquids from surface joints and additionally lowers the electrical resistance therebetween.

Based on the disclosure herein, various modifications will be suggested to those skilled in the present art. Such modifications are to be understood to be within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a bi-polar electrolytic filter press cell wherein a metal cathode and a valve metal anode of each electrolysis cell is separated by a cation selective ion-exchange membrane and wherein the anode and cathode of the adjoining or contiguous cells are maintained

in space relationship by an electrically non-conductive barrier sheet between them; the anode and cathode being in direct electrical connection with each other through said barrier sheet by attaching metal bosses on one side of each of said anode and cathode, said bosses being positioned to allow the pressure receiving area of each anode and cathode boss to mate with each other to surround thread engaging means, the composition of the bosses being substantially the same as the respective electrode to which it is attached, one boss having female thread engaging means for receiving a threaded bolt which bolt passes through the adjacently disposed other boss and into the said one boss, said bolt having a composition substantially the same as the boss through which it passes, the said other boss having a pressure receiving shoulder which mates with the pressure receiving shoulder of the bolt head, the improvement comprising having the pressure receiving and mating area of the said cathode boss plated with a highly conductive and easily reduced metal selected from the group consisting of copper, silver and gold and the said pressure receiving and mating area of the said valve metal anode boss plated with a platinum group metal and further having metal gasket means for providing a leak proof seal and electrical contact between the said bolt head pressure receiving shoulder and the pressure receiving shoulder of the said other boss whereby under mechanical pressure from the bolt thread engaging means the two highly conductive soft mating surfaces of the said bosses and the said mating shoulders of the said bolt head and other boss are squeezed into intimate contact with each other to form an improved electrical connection and a leak proof seal thereby.

2. The electrolytic cell of claim 1 wherein the metal cathode and attached boss are selected from the group consisting of iron, steel and nickel and a plating of copper is on the pressure receiving and mating area of said boss.

3. The electrolytic cell of claim 1 wherein the female thread engaging means of one boss are also plated with substantially the same coating composition as that of the pressure receiving and mating area of the said one boss.

4. The electrolytic cell of claim 1 wherein at least the thread portion of the said bolt are also plated with a metal coating substantially the same as the coating on the pressure receiving and mating area of the boss through which the said bolt passes.

5. The electrolytic cell of claim 1 wherein the metal of said gasket means is selected from the group consisting of copper and lead.

6. The electrolytic cell of claim 1 wherein the pressure receiving and mating area of the said cathode boss is coated with a highly conductive silver epoxy thixotropic compound.

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