Jan. 10, 1967 HANS-WALTER SCHLEICHER 3,297,560
APPARATUS FOR ALKALI CHLORIDE ELECTROLYSIS
HAVING A CORROSION ASSISTANT ANODE
Filed Aug. 17, 1962 2 Sheets-Sheet 1

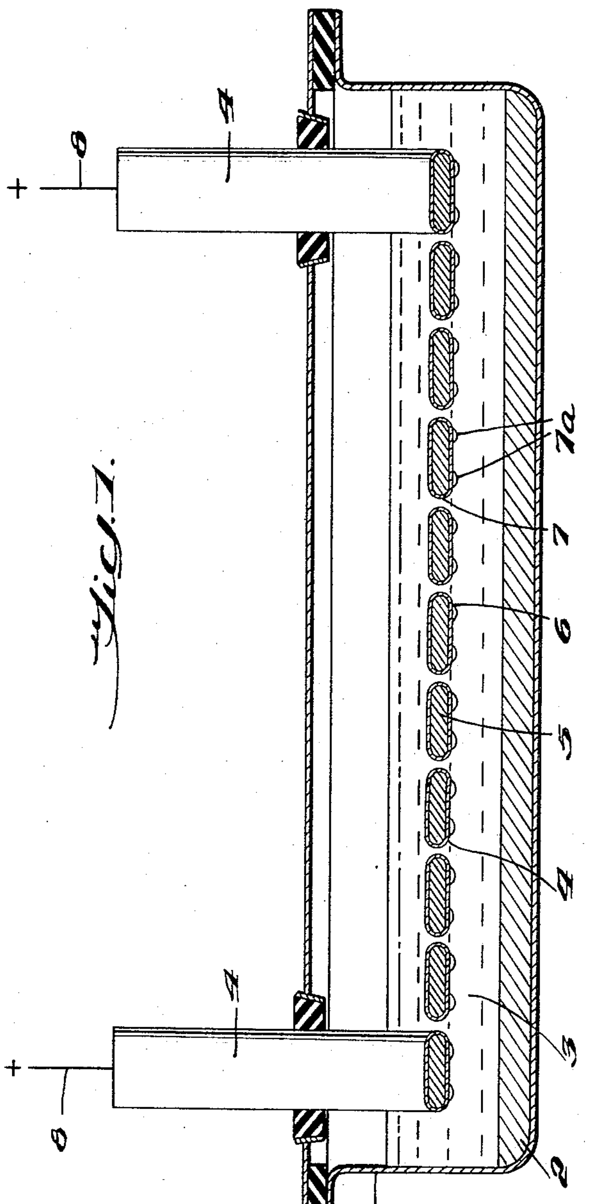


Fig. 1.

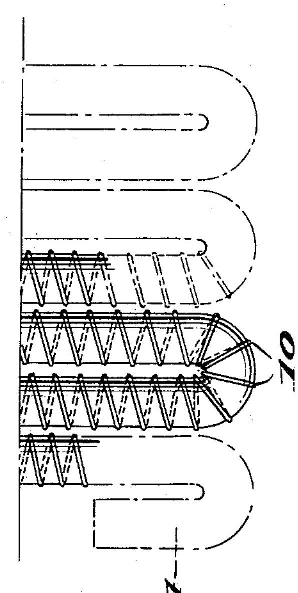


Fig. 4.

INVENTOR
HANS-WALTER SCHLEICHER

BY Bailey, Stephens & Huettig
ATTORNEYS

Jan. 10, 1967 HANS-WALTER SCHLEICHER 3,297,560

APPARATUS FOR ALKALI CHLORIDE ELECTROLYSIS HAVING A CORROSION ASSISTANT ANODE

Filed Aug. 17, 1962 2 Sheets-Sheet 2

Fig. 3.

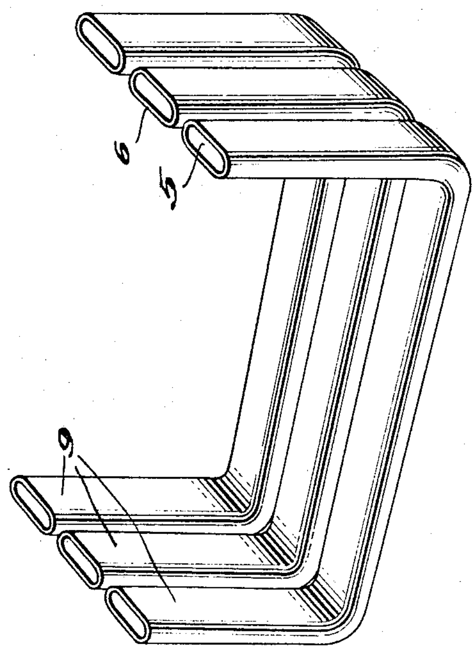
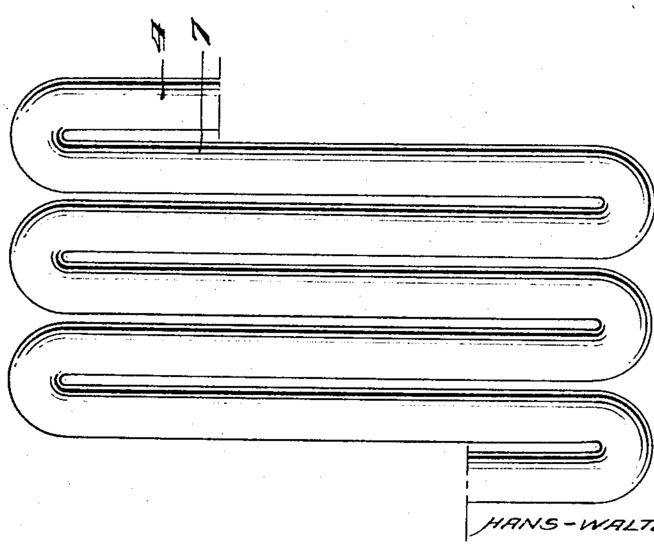


Fig. 2.



INVENTOR

HANS-WALTER SCHLEICHER

BY Bailey, Stephens & Huettig

ATTORNEYS

United States Patent Office 3,297,560
Patented Jan. 10, 1967

3,297,560

APPARATUS FOR ALKALI CHLORIDE ELECTROLYSIS HAVING A CORROSION ASSISTANT ANODE

Hans-Walter Schleicher, Chivasso, Turin, Italy, assignor to Metallgesellschaft Aktiengesellschaft, Frankfurt am Main, Germany

Filed Aug. 17, 1962, Ser. No. 217,706
2 Claims. (Cl. 204—250)

The present invention relates to improved electrodes and particularly to improved anodes employed in electrolytic cells, for example, those employed in the electrolysis of brine solutions.

Horizontally arranged electrodes are known for electrolytic processes, especially horizontally arranged anodes for alkali chloride electrolysis. These frequently consist of graphite and have individual bored holes in them for the escape of gases, especially chlorine. These anodes have a disadvantage however in that with the passage of time they corrode and from time to time must be replaced, since a very small distance should exist between the anode and the cathode.

Also anodes have already been used which consist of titanium, tantalum or an alloy of these metals or at least are provided with these metals on their outer surfaces. In addition, these may carry an outer coating of platinum since this causes a better current outlet. These anodes have the advantage that they exhibit good resistance to corrosion. However, these anodes must also be provided with bored holes in order to carry off the electrolysis gases. Nevertheless in addition it is necessary to produce them entirely out of corrosion resistant material such as titanium which is not economically feasible.

When such anodes contain, for example, a copper core, this copper is exposed to the attack of the electrolysis liquid or electrolyte through the bored holes. On the other hand it is uneconomical to provide a corrosion resistant coating on the walls of the bored holes.

Electrodes are also known which consist of wires consisting of a copper core clad with tantalum. These wires are coated with platinum or are covered with platinum wire. Such electrodes have a disadvantage in that they are not very suitable for use in larger units.

An object of the present invention is to provide an electrode, especially an anode, which eliminates the disadvantages of these electrodes heretofore employed, but has resistance to corrosion, provides a means by which the electrolysis gas can escape, and is economical to produce.

The individual elements of the anode of this invention consist of a rod or tubular shaped core of copper or another metal having good conductivity. This core is coated with a cladding of titanium, tantalum or an alloy of one of these metals such as manganese, vanadium, chromium and aluminum alloys, e.g., those containing up to 15% of the alloying metals. A typical example is an alloy containing 90% titanium and 10% aluminum. Several rods of copper coated with titanium form an electrode jointly by arranging them next to each other with close clearance. This clearance or intermediate space between the electrode elements is between about 0.1 and 10 mm., preferably about 5 mm.

The side of the electrode turned toward the opposite electrode, e.g., the cathode, is coated in known ways with platinum or a metal of the platinum group, such as palladium or iridium. The metal employed for this purpose should be of technical purity and can contain the usual impurities found in these metals. This coating is applied to assure a good current outlet.

In order to obtain improved efficiency of the rods and

a uniform distribution of current, the surface of the anode must be as level as possible. Therefore the rods or tubes for the electrodes according to the invention are employed in flattened form. The rods or tubes are thus pressed flat by shaping them, by, for example, rolling, forging or hammering. This is done before or after the platinizing. In this form they are arranged next to each other with narrow intermediate spaces. These intermediate spaces are between about 0.1 and 10 mm., preferably about 5 mm. In this way the desired small clearance between the anode and the cathode can be attained, for example, in an alkali chloride electrolysis, over substantially the entire surface of the electrode so that with horizontal arrangement of the anode only the electrolysis gases can still just flow between the individual elements of the anode.

An anode according to the invention can be produced for an alkali chloride electrolysis, for example, by solidly joining a long tube of titanium to an uncoated rod of copper forming a titanium clad copper rod by drawing a copper rod surrounded by a titanium tube. This clad rod is formed into the shape of a snake, that is, the rod is sinusoidally shaped. The rods of the electrode unit shaped to the desired size are then rolled flat so that a flat anode is obtained having narrow intervals between the individual adjacent rod cross-sections. The two ends of the rod are placed so that they project out of the electrolysis cell and can be employed to conduct current to the electrode. The bottom or underside of the anode, which is situated over the cathode is provided with a coating of platinum or suitably a platinum alloy which contains up to 20% palladium. This coating is applied in known ways to a thickness of a few microns. The platinum coating naturally can be applied to the titanium at an earlier stage of the process of production when this is found to be technically advantageous in a particular case.

The copper electrodes, coated with titanium, can also be shaped into an anode according to the invention by first bending the rod or tube into the shape of a slightly expanded spiral and then pressing it flat as a whole by rolling or similar shaping.

According to another embodiment of the invention a plurality of relatively short copper rods, having a cladding of titanium, are associated adjacent each other. Each rod is provided with one or two power leads. In this case also the part of the rods situated in the electrolyte is flattened in order to utilize the rods better and to assure a uniform clearance of the cathode.

A particular advantage of the invention also is that the arrangement and shape of the copper rods or tubes which have been coated with titanium and pressed flat, assures that the electrolysis gases can escape or leave the electrolyte when the rods or tubes are employed as a horizontal electrode in an electrolytic cell wherein the rods or tubes are in electrical communication with one another for an alkali chloride electrolysis. It also assures that the side turned toward the cathode is exceptionally even and therefore large parts thereof can be placed as close as possible to the cathode and, moreover, the electrode is made under economically feasible conditions making use of the corrosion resistance of titanium, of the good conductivity of copper and the good ability of platinum to deliver current to the electrolyte.

The structure of the electrodes according to the invention is described hereinafter with reference to the accompanying drawings in which:

FIGURE 1 is a side cross-sectional view of an electrolytic cell containing an anode according to the invention;

FIGURE 2 is a top plan view of the anode of FIGURE 1;

FIGURE 3 is a perspective view of an electrode according to the invention comprising a unit of individual rods or tubes; and

FIGURE 4 is a broken view of an electrode according to the invention having platinum wire wrapped around it to improve conductivity.

In FIGURE 1, **1** is the cell wall, **2** is the mercury cathode on the bottom of the electrolytic cell. The sodium chloride solution **3** is situated over the mercury cathode. The anode **4** according to the invention is placed a short distance from the mercury cathode and as shown in the side cross-sectional view the individual rods of the anode unit are flattened. Each rod consists of a core **5**, a cladding **6** and a platinum coating on the surface facing the cathode in the form of platinum weld spots *7a* which are a few microns thick. Additionally, only a narrow distance **7** is present between the individual rods through which the electrolysis gases can pass directly. The anode has a power lead wire **8** at both ends which goes to the positive pole of the source of current not shown.

FIGURE 2 is a top plan view of the anode shown in FIGURE 1 wherein it can be seen that the anode **4** consists of a rod which is formed in so-called snake shaped turns so that only a narrow distance **7** is present between the rod sections.

FIGURE 3 illustrates an electrode constructed of short elements. Three of these elements are shown. The power supply leads are mounted on the ends **9** which project out of the electrolyte. The individual elements consist of rods rolled flat and then bent at right angles having a copper core **5** and a titanium cladding **6**.

The electrode of the invention, as shown, for example, in FIGURE 4, may also be provided with a coating of platinum in the form of thin platinum wire **10** wrapped around the electrode.

The present invention is further illustrated by the following example of the electrolysis of a sodium chloride solution employing an anode of the type described above.

Example

A purified brine solution containing 315 g./l. NaCl was electrolyzed at 80° C. between a titanium anode having a copper core and a flowing mercury cathode. A current of 4000 amperes per square meter of cathode surface was employed. The NaCl concentration thereby dropped to 260 g./l. 0.15% sodium as amalgam was dissolved in the flowing mercury and converted in a decomposer of conventional construction with water to 50% caustic soda and hydrogen gas. The chlorine formed at the anode was withdrawn from the cell and cooled, dried and liquified in a known way.

The primary cell employed consisted of a smooth iron bottom, over which the mercury flowed, rubberized sides,

and a rubberized top through which the conductor passed to the anode.

The anode employed for this electrolysis consisted of a tube of titanium having an outer diameter of 10 mm. and a wall thickness of 1 mm. and a copper core. The copper and titanium were bound firmly together by drawing as described above. The clad rod was bent back and fourth so that the rebent sections were closely adjacent to each other and the unit formed an even surface, that is, the clad rod in its final form was sinusoidally shaped as illustrated in FIGURE 2. Thereafter the bent rod was shaped or flattened with a press in such a way that its height was only 5 mm. and its width changed accordingly. A space of 1 mm. was present between the adjacent sections of a rod. The free ends of the rod projected through the cover of the cell according to the above construction and acted as current leads. Finally, two rows of small weld spots were arranged every 5 mm. on the underside of the electrodes with an electrical welding apparatus having a platiunm electrode.

I claim:

1. In an electrolytic cell including an anode and a cathode the improvement wherein said anode comprises a unit of parallel elongated rods of copper clad with a thin tube of a metal selected from the group consisting of titanium, tantalum and their alloys, said rods being in electrical communication with one another and defining parallel sections adjacent each other between about 0.1 and 10 millimeters apart, the parallel sections being flattened to a thickness of about 5 millimeters and having rows of weld spots of a metal selected from the group consisting of the platinum metals and their alloys on their underside.

2. An electrode for a generally horizontal electrolytic cell comprising an elongated rod of copper clad with a thin tube of a metal selected from the group consisting of titanium, tantalum and their alloys sinusoidally shaped to form parallel sections adjacent each other about 0.1 to 10 millimeters apart, the shaped rod being flattened to a thickness of about 5 millimeters and having rows of weld spots of a metal selected from the group consisting of the platinum metals and their alloys on the underside of each of the parallel sections.

References Cited by the Examiner

UNITED STATES PATENTS

2,795,541	6/1957	Muller	204—290

FOREIGN PATENTS

233,388	2/1961	Australia.
896,963	5/1962	Great Britain.

JOHN H. MACK, *Primary Examiner.*

R. K. MIHALEK, *Assistant Examiner.*