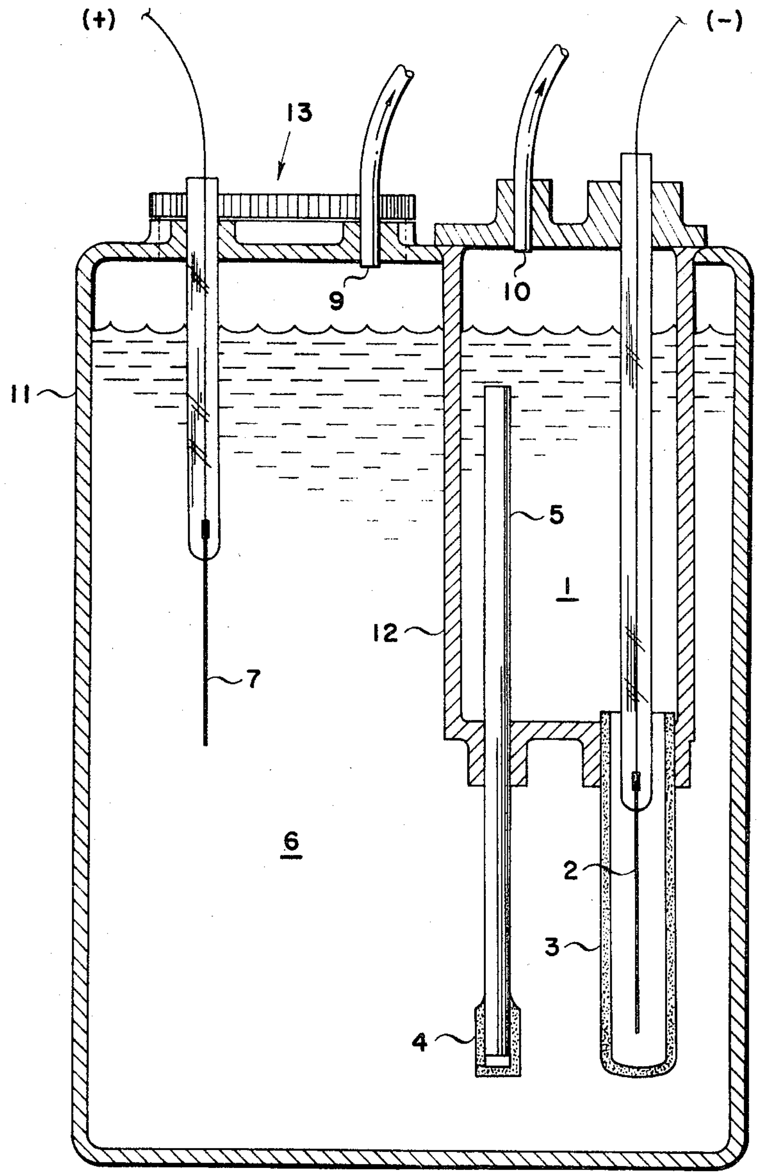
May 29, 1973 H. HELBER ET AL 3,736,322

CHLORINATOR CELL WITH INTERNAL PRESSURE REGULATION

Filed July 19, 1971



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United States Patent Office

3,736,322
Patented May 29, 1973

3,736,322
CHLORINATOR CELL WITH INTERNAL PRESSURE REGULATION

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Filed July 19, 1971, Ser. No. 163,732
Int. Cl. B01k 3/10
U.S. Cl. 204—266 4 Claims

ABSTRACT OF THE DISCLOSURE

An electrolytic cell for the generation of chlorine wherein a pressure relief device is used to equalize pressures in the anode and cathode compartments. The pressure relief device comprises a tube, interconnecting the anode and cathode compartments, covered with a diaphragm of a greater porosity than the diaphragm separating the anode from the cathode compartment. The unequal pressures are caused by an initial absorption of chlorine when the cell is started.

This invention relates to an electrolytic cell and more particularly to such a cell for the generation of chlorine.

In general, electrolytic cells for the generation of gases utilize porous diaphragms or the like for separation of the gases generated at the anode and the cathode. In some cases, the separation is necessary since the gases form an explosive mixture. While the porous separator may take various configurations, it is preferable that the cathode compartment consist of a porous cup, or the like, or an impervious cup with a thimble type porous separator attached to the bottom of the cup. The latter type will be described in connection with this invention.

In an electrolytic cell for the generation of chlorine from electrolysis of hydrochloric acid (HCl), the passage of current in a freshly prepared HCl solution results in the evolution of chlorine at the anode and hydrogen at the cathode. Initially, chlorine is absorbed in the solution, whereas hydrogen has virtually no solubility in the HCl solution. Working against zero heads; i.e., vented to the air or equivalent, the hydrogen and some chlorine would escape, the pressures in the anode and cathode compartments will be equal and the liquid or solution levels will be the same. In practice, however, the gases are generally ejected into water against approximately a one-foot head.

In such cases, the initial absorption of chlorine in the solution results in a lower pressure in the anode compartment than the cathode compartment, where, the hydrogen is opposing the approximately one-foot head. The differential pressure forces the liquid from the cathode compartment through the porous separator into the anode compartment at a rate dependent upon the porosity of the separator. By the time the liquid is saturated and the pressures in both compartments equalize, the cathode compartment may be empty, thus stopping the electrolytic action.

In order to overcome the problems of differential pressures, the prior art has typically incorporated external, mechanically actuated, pressure relief valves which allow one or both compartments or a cell to vent during the period when electrolysis is not proceeding. Such valves are unreliable and costly, and have a tendency to leak. They have to be actuated by a suitable signal relay arrangement incorporated into the electrical system, or alternatively they may be manually actuated. Another way to overcome the problem is to apply pressure to the cell from an external source, but this has the effect of pumping some of the electrolyte out of the cell. Any electrolyte pumped out in this manner must, of course, be replaced with fresh solution. The present invention overcomes these previous difficulties.

Another important aspect of the invention is the fail-safe characteristic. Tests were performed in which the anode and cathode tubes were individually blocked or vented to air (representing a broken gas tube). Current was 10 amps.

(1) Cathode tube blocked with anode tube under one foot head of water. The cathode compartment emptied in 25 minutes and electrolysis ceased.

(2) Anode tube blocked. The anode compartment liquid passed through the separator **4** and out through part **10** until the liquid level was below the anode **7**. Electrolysis then ceased. This required three hours.

(3) Anode vented to air. Current ceased after three hours, due to the emptying of the cathode compartment.

(4) Cathode vented to air. Anode emptied after 60 hours of continuous operation or, after first turnoff of the system, suck-back caused the cathode chamber to empty and remain so until failure was rectified.

It is believed apparent that the invention can be used for the production of other gases from electrolytes where similar circumstances exist.

It has been discovered that the foregoing can be prevented by the present invention wherein a pressure regulating device is used.

It is therefore an object of the present invention to provide pressure regulation in an electrolytic cell.

A further object of the invention is to provide an electrolytic cell for chlorine generation which is economical and easy to fabricate.

These and other objects will become apparent from the following description when taken with the drawings in which:

The single figure is a cross section in elevation of a cell embodying the invention.

Referring now to the drawings, the outer cell casing **11** forms the anode compartment **6** and an inner casing **12** forms the cathode compartment **1**. The casings may be of any desired shape or configuration but for purposes of this invention are shown to be cylindrical. The inner casing may extend into the outer casing through an aperture in the top thereof and is cemented in place. A cap covers the top of the inner casing. An inert anode **7** extends through the top of the anode compartment and into the compartment as indicated. An inert cathode **2** is located in the cathode compartment and preferably exends into the thimble separator **3**. The anode and cathode are connected to a source of voltage as indicated. A port **9** in the top of the compartment **6** permits passage of chlorine generated at the anode, whereas port **10** permits passage of hydrogen when the electrolyte is hydrochloric acid. The casings are filled with hydrochloric acid to within about one inch (1") of the top of the casings. Thus far has been described the elements of a typical cell for production of chlorine. Tubes may be connected to the ports **9** and **10**. A cap **13** is provided for refilling the cell.

Where the evolved chlorine is used to treat water, as for example in swimming pools, there is a frequent on-off operation. In addition to the aforementioned differential pressure due to chlorine absorption at start up, there is a similar problem when the cell is turned off. The cell temperature rises during operation, and as the cell cools after turn-off, the solubility for the chlorine increases and the pressure in the anode compartment decreases. Chlorine will also be absorbed in the water at the outlet tube exit. In many cases, the liquid in cathode compartment **1** will be removed and replaced by hydrogen, and the system remains inoperative until the hydrogen is vented and the compartment refilled.

To overcome these difficulties, it has been discovered that a tube **5** with a porous separator **4** should be installed. The separator **4** is in effect a pressure relief device and should have a porosity somewhat greater than that of separator **3**. The top of tube **5** should be below the level of the fluid in the cell; a cell wherein the top of tube **5** is about two inches (2″) below the top of the cell has been found to be satisfactory. The separator **3** should have a porosity of from 1 to 10 microns (μ), preferably 2–3μ, and be constructed of any material (polyethylene, Teflon, porcelain, etc.) which is stable in chlorine saturated hydrochloric acid. Separator **4** should have a porosity of 13–60μ, preferably 13–20μ, and be constructed of similar materials.

Electrolysis of the hydrochloric acid solution results in the initial establishment of pressure differences, due to absorption of chlorine, as noted previously. However, with the new configuration, the liquid in compartment **1** can pass freely through separator **4** until the liquid level reaches the top of tube **5**. Subsequently, because the initial pressure difference has been relieved, very little liquid passes through separator **3**, because of its lower porosity, and thus the level in compartment **1** does not drop significantly further. During the period of this initial pressure relief operation, the liquid in the anode compartment becomes saturated with chlorine and the gas pressures in the two campartments become equalized. Fluid flows through separator **4** until the levels are the same, and the cell continues operation in the normal manner.

What is claimed is:

1. A chlorinator cell for electrolizing hydrochloric acid comprising an anode compartment, a cathode compartment, separate electrodes in the compartments, a first porous separator defining a first area between the compartments and having a porosity of from 1–10 microns (μ), and a second porous separator defining a second area between the compartments and having a porosity of from 13–60μ, and an outlet in each compartment.

2. A chlorinator cell as defined by claim **1**, wherein said anode compartment is an outer casing and said cathode compartment is a smaller casing and positioned within the outer casing.

3. A chlorinator cell as defined by claim **2**, wherein said first porous separator is a thimble shaped member attached to the bottom of the smaller casing, and the second porous separator is attached to the bottom of a tube, which is mounted in the bottom of the smaller casing.

4. An electrolytic cell comprising a casing, means dividing the casing into an anode compartment and a cathode compartment, an electrode in each compartment, a tube extending from about 2″ below the top of the cathode compartment into the anode compartment, a first porous member between the compartments and having a porosity of 1–10μ, a second porous member covering the bottom of the tube and having a porosity of 13–60μ, and an outlet in each compartment.

References Cited

UNITED STATES PATENTS

3,117,066	1/1964	Juda	204—266
2,846,384	8/1958	DeNora	204—266
3,223,242	12/1965	Murray	204—266

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U.S. Cl. X.R.

204—128, 151, 252