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[54] **METHOD AND APPARATUS FOR THE DISINFECTION OF LIQUIDS BY ANODIC OXIDATION AND PRECEDING REDUCTION**

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[51] **Int. Cl.²** **C02B 1/82**

[58] **Field of Search** ..... 204/149, 151, 130, 180 P

[56] **References Cited**

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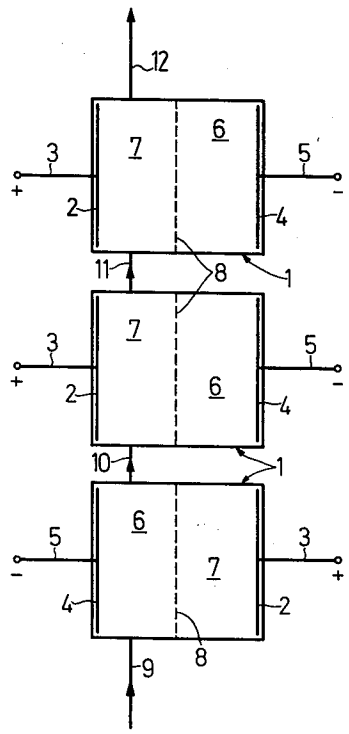
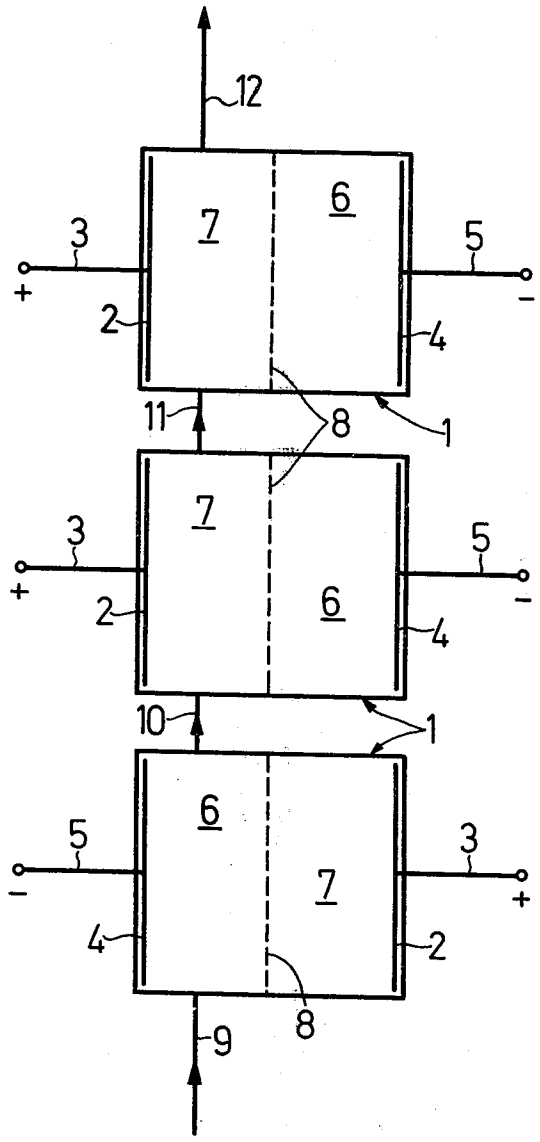
[57] **ABSTRACT**

This invention relates to the disinfection of liquids, preferably of water-containing liquids by anodic oxidation. The disinfecting effect of anodic oxidation in an electrolytic cell is known. This invention is directed to the improvement of the disinfecting effect while maintaining the investment for the apparatus at a minimum and avoiding the addition of disinfecting additives.

3 Claims, 1 Drawing Figure

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METHOD AND APPARATUS FOR THE DISINFECTION OF LIQUIDS BY ANODIC OXIDATION AND PRECEDING REDUCTION

This invention is directed to a method of disinfecting liquids, preferably water-containing liquids, by anodic oxidation, wherein the liquid to be disinfected is exposed in a first electrolytic cell having a cathode and an anode within the anode compartment to an electric current, cathode compartment and anode compartment being separated by a diaphragm.

This method consists in exposing the liquid to be disinfected to a reducing agent before the treatment in the electrolytic cell, i.e., enriching the liquid to be disinfected with electrons.

By this measure the disinfecting effect in the anodic oxidation is essentially improved, so that the size of the apparatus and therewith construction expenses are reduced; furthermore there is achieved the advantage that the liquid to be disinfected stays in the apparatus for a shorter time, which guarantees a reduction of separations of the electrode material and thus a disinfecting effect which is substantially free of negative results.

The method according to this invention is especially simply to realize if the cathode compartment of an electrolytic cell is used as the reduction agent. In this event it is not necessary to add any reagents to the liquid so as to obtain a reduction effect. In this connection it is of some advantage to make such an arrangement that a plurality of electrolytic cells are passed subsequently, whereby the liquid flows through the cathode compartment of the first cell and through the anode compartments of the following cells.

Furthermore, this invention relates to an apparatus for performing the afore-mentioned method. Such apparatus comprises a plurality of electrolytic cells arranged in series, each electrolytic cell being provided with a cathode compartment and an anode compartment, at least one of said cells being provided with an inlet and an outlet in its cathode compartment, the rest of the electrolytic cell being provided with respective inlets and outlets in their anode compartment, the cells being arranged in series such that the outlet from the cathode compartment of said one cell is connected to the inlet of the anode compartment of another cell, possible further cells being connected with the inlet of their anode compartment to the outlet of the anode compartment of the preceding cell and with their outlet to the inlet of the anode compartment of the subsequent cell. This allows a very simple construction having substantially identical parts and saving space.

Other features and many of the attendant advantages of this invention will readily be understood from the following detailed description of a preferred embodiment when considered in connection with the appended drawing:

In the embodiment as shown in the drawing there are arranged in series three electrolytic cells. The principle arrangement is such that the liquid to be disinfected passes through the cathode compartment **6** of the first cell and through the anode compartment **7** of the two following cells. All the three cells are marked by identic reference numerals, because they may be identic in their construction; only their arrangement with respect to each other is modified according to this invention. In each of the three cells illustrated, the space in a container **1** is divided into two compartments **6, 7** by a diaphragm **8.** The liquid to be purified is fed to the compartment **6** of the first cell through an inlet duct **9,** caused to flow from the compartment **6** of the first cell to the compartment **7** of the second cell through a connecting line **10.** It enters the compartment **7** of the third cell from the compartment **7** of the second cell through a connecting line **11,** and is discharged from the compartment **7** of the third cell through an outlet duct **12.**

Each compartment **6** contains an electrode **4** connected by a conductor **5** to the negative pole of a source of electric current. Each compartment **7** contains an electrode **2** connected to the positive pole of the current source by a conductor **3.** During operation of the apparatus, liquid flows sequentially through respective compartments of the first, second, and third cells whose electrodes are made the cathode in the first cell and the anode in the second and third cells.

The basic function of the apparatus is that before the very anodic oxidation there takes place a reduction process in the cathode compartment **6** of the first electrolytic cell for the purpose of disinfection within the anode compartments **7** of the second and the third electrolytic cell. The effect of the anodic oxidation turned out to have been improved in this way, in particular there is a more rapid cut-down of number of germs within a relatively short period.

A comparison of the apparatus according to this invention on the one hand with the system of a simple liquid flow through the anode compartment of an electrolytic cell on the other hand has shown essential advantages achieved by this invention. Starting from a number of 10^8 coli germs per milliliter and having a current intensity in the electrolytic cell of approximately 100 to 200 mA at a voltage between the anode plate **2** and the cathode plate **4** of approximately 10 to 20 V, the circulation test (this means the duct **12** is connected with duct **9** by a pump to form a closed circulation), in particular up to a duration of four minutes, results in a considerably greater cut-down of the number of germs when employing the method according to this invention. The diaphragma may be of any known material. The tests as made up to now have not brought more favourable results from the employment of only cationpermeable diaphragms or only anionpermeable diaphragms respectively. By the employment of the method of this invention, the circulation test resulted after approximately 4 to 6 minutes in total disinfection, whereas according to the prior art method there was no cut-down of the concentration of germs after a certain time.

The expression disinfection as used in the specification and in the claims is to comprise also decontammination and detoxication.

We claim:

1. A method of purifying an aqueous liquid contaminated with microorganisms which comprises:

a. causing said liquid to flow sequentially through respective first compartments of a first electrolytic cell and of a second electrolytic cell, each cell having a first compartment and a second compartment separated from said first compartment by a permeable diaphragm, each cell further having a first electrode in said first compartment thereof and a second electrode in said second compartment thereof;

b. passing direct electric current through said liquid in said first cell between the first electrode of said

first cell as the cathode and the second electrode of said first cell as the anode;

c. passing direct electric current through said liquid in said second cell between the first electrode of said second cell as the anode and the second electrode of said second cell as the cathode; and

d. withdrawing the liquid in purified condition from the first compartment of said second cell.

2. A method as set forth in claim **1,** wherein said liquid, after being withdrawn from said second cell, is passed through one of two compartments of a third cell, said third cell having an electrode in each of said two compartments, said two compartments being separated by a permeable diaphragm, electric current being passed through said liquid in said third cell between the electrode in said one compartment as the anode and the electrode in the other compartment as the cathode.

3. A method as set forth in claim **1,** wherein said liquid, after being withdrawn from said second cell, is returned to the first compartment of said first cell.

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