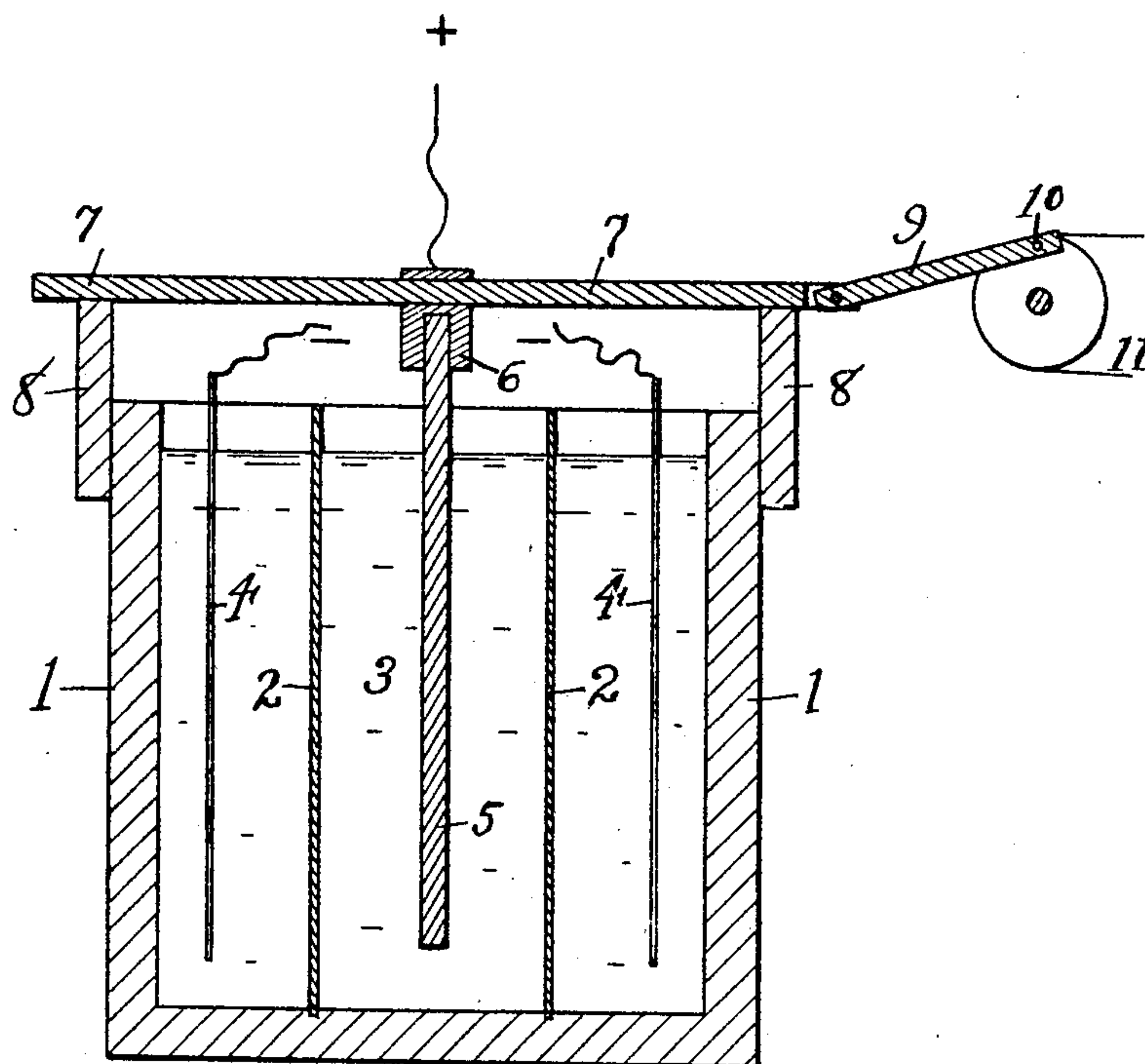


No. 803,543.

PATENTED NOV. 7, 1905.

A. G. BETTS.
ELECTROLYTIC PROCESS USING INSOLUBLE ANODES.
APPLICATION FILED FEB. 16, 1905.



Witnesses

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ELECTROLYTIC PROCESS USING INSOLUBLE ANODES.

No. 803,543.

Specification of Letters Patent.

Patented Nov. 7, 1905.

Application filed February 16, 1905. Serial No. 245,884.

To all whom it may concern:

Be it known that I, ANSON GARDNER BETTS, a citizen of the United States, residing at Troy, in the county of Rensselaer and State of New York, have invented certain new and useful Improvements in Electrolytic Processes Using Insoluble Anodes, of which the following is a specification accompanied by a drawing.

Reference may be had to the accompanying drawing, and the reference characters marked thereon, which forms a part of this specification.

Similar characters refer to similar parts in the drawing.

The single figure of the drawing is a view in vertical cross-section of an electrolytic cell for carrying out my invention.

This invention relates to improvements in electrolytic processes in carrying out which insoluble anodes are used.

The principal objects of my invention are to increase the yield from oxidations carried out by the anode reaction, to prolong the life of the anodes, and to decrease the voltage required. Such objects are achieved by very greatly increasing the speed with which the layer of solution in contact with the anode-surface is changed. A sufficiently rapid change can be brought about by circulation much more rapid than has been used in practical operations; but the size and disposition of electrodes used in practical work are such that quick enough circulation could only be obtained with difficulty.

My present preferred method consists in using anodes, most suitably in the form of rods, and giving them a motion, most easily and satisfactorily a reciprocating motion in a direction perpendicular to their length, whereby the layer of electrolyte is so rapidly changed that surprising results follow. For example, in electrolyzing a solution of ferrous and cupric sulfates, with a diaphragm, depositing copper on a cathode, and converting ferrous to ferric sulfate at the anode, and with a circulation of electrolyte that was previously considered amply sufficient, the electromotive force required to work the cell was considerably reduced; the evolution of gas at the anode was entirely stopped, and the current efficiency raised from about fifty per cent. to one hundred per cent. on giving the anodes a

reciprocating motion of about one hundred complete cycles per minute, with an amplitude of about one inch.

I am aware that motion has been given to soluble anodes, but not that it has been done in practical work, as no material advantages are secured in this way; but I have discovered by experiment that by moving insoluble anodes through the electrolyte greatly improved results are obtained. When using soluble anodes, the anions are electrolytically brought to the anode-surface and there combine with the elements of the anodes to form salts which diffuse into the solutions. There is a more concentrated layer of electrolyte around the anodes; but this does not cause serious polarization; but when using insoluble anodes in processes in which it is not intended that oxygen or halogens should be liberated in the free state the anions, with their oxidizing properties, are liberated in a very narrow zone, in which zone the supply of reagent it is intended to oxidize is quickly used up and oxidation of the water or of the anode, or of both, must take place. Further, the element it is intended to oxidize is in general present as cation, so that it is always moving away from and out of the layer in which its oxidation can take place.

My process is applicable to a great number of electrolytic oxidations, of which I might mention as examples the oxidation of organic substances and the manufacture of chromic acid from chromium sulfate. It is of the greatest advantage in electrolyzing with anodes of amorphous or graphitic carbon, for the lowering of the electromotive force hinders or entirely prevents the oxidation of the carbon.

In my application, Serial No. 202,367, filed May 11, 1904, I have shown and claimed apparatus for carrying out my present invention.

Reference is had to the accompanying drawing, in which—

1 is a tank fitted with diaphragms 2 and containing the electrolyte 3, which contains a substance it is desired to oxidize.

4 represents cathodes, and 5 the anode, supported in a conducting-block 6, in turn carried by a non-conducting rod 7, sliding on supports 8. Reciprocating motion is given the anode by means of the connecting-rod 9 and the crank 10, driven by the belt 11.

I consider a fluorin acid to be the equivalent of an oxygen acid for the present purpose, for the result is the same at the anode.

If no oxidation is taking place at the anode, oxygen is liberated in both cases.

What I claim as new, and desire to secure by Letters Patent, is—

1. The process of oxidizing an ingredient of a solution, substantially free from halogen ions, which consists in electrolyzing the solution with an insoluble anode, while producing relative motion between said anode and solution sufficient to materially facilitate the continuous oxidation of the said ingredient by the liberated anions, and to substantially continuously prevent the evolution of oxygen-containing gas at the anode.

2. The process of oxidizing, in a solution practically free from halogen ions, a metallic salt of polybasic acid, which consists in electrolyzing the solution with an insoluble anode, while producing relative motion between said anode and solution sufficient to materially facilitate the continuous oxidation of the said salt, and to substantially continuously prevent the evolution of oxygen-containing gas at the anode.

3. The process of oxidizing in solution a ferrous salt of a polybasic acid to ferric salt, which consists in electrolyzing the solution with an insoluble anode, while producing relative movement between said anode and solution sufficient to materially facilitate the continuous conversion of said ferrous salt to ferric salt, and to substantially continuously prevent the evolution of oxygen-containing gas at the anode.

4. The process of oxidizing in solution ferrous salt to ferric salt which consists in elec-

trolyzing the solution with an insoluble anode, and giving the anode sufficient motion through the solution to materially facilitate the continuous conversion of the ferrous salt to ferric salt.

5. The process of oxidizing in solution a ferrous salt of a polybasic acid to ferric salt, which consists in electrolyzing the solution with a carbon anode, and giving the anode sufficient motion through the solution to materially facilitate the continuous conversion of ferrous salt to ferric salt.

6. The process of converting in solution ferrous salt to ferric salt and depositing a metal from said solution simultaneously, which consists in electrolyzing the solution with an insoluble anode and a suitable cathode, and moving the anode through the solution.

7. The process of converting ferrous salt in solution to ferric salt and simultaneously depositing copper from the solution, which consists in electrolyzing the solution with an insoluble anode moving through the solution, and with a suitable cathode.

8. The process of converting in solution ferrous to ferric sulfate, and removing copper from the solution which consists in electrolyzing the solution with an insoluble anode moving through the solution, and with a suitable cathode.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 14th day of February, 1905.

ANSON GARDNER BETTS.

Witnesses:

FREDERICK CLARK,
EDWARD F. KERN.