April 30, 1929. V. A. LAPENTA 1,711,416

ELECTRO ENDOSMOSIS METHOD AND APPARATUS

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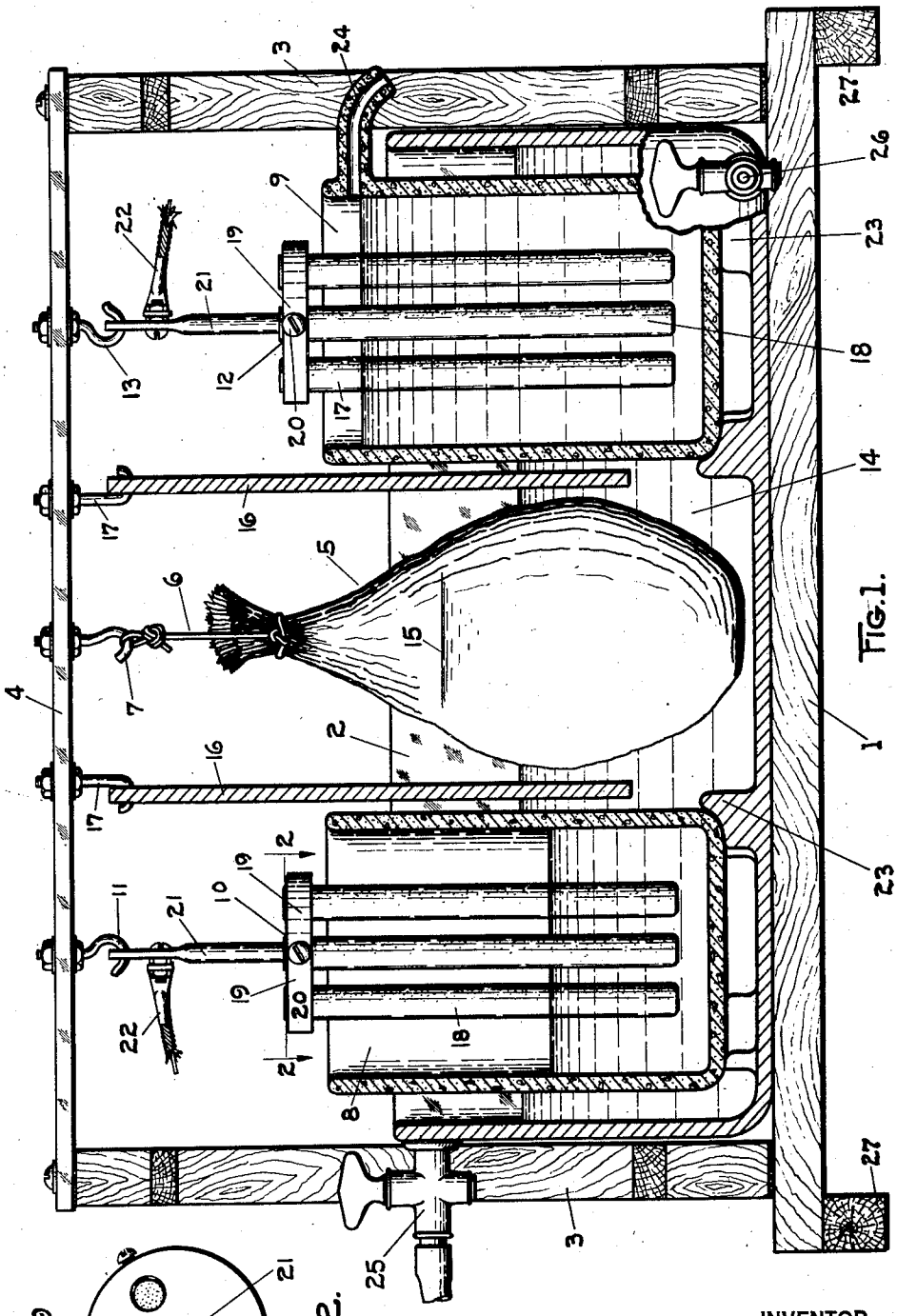


FIG. 1.

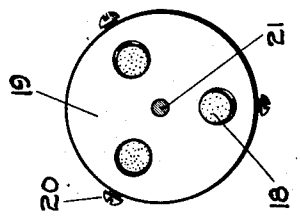


FIG. 2.

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UNITED STATES PATENT OFFICE.

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ELECTRO-ENDOSMOSIS METHOD AND APPARATUS.

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This invention relates to electro-osmotic apparatus used for the disassociation of binary substances and is an improvement over my former apparatus as disclosed in Patent No. 1,546,908, and one feature of the present invention is in so arranging the various compartments that certain of the ions may circulate around or pass by the compartment containing the chemical product to be treated.

A further feature of the invention is the provision of a bag preferably composed of a semi-permeable membranous substance, in which a chemical substance to be treated is placed, a porous preferably porcelain cell for the positive and negative electrodes, and suitable circumambient means between said cells and bag to promote osmosis.

A further feature of the invention is the provision of an overflow on the cathode cell at a suitable height to automatically drain the more purified electrolyte from the aforesaid cell and a valve controlled drain for the electrolyte containing vessel, for drawing off the less purified electrolyte together with the classes of ions which have adhered to the electrolyte particles and which have migrated from within the osmosis membrane bag, being thus claimed while in an intermediate electrolytic state.

It is also an object of the invention to provide a valve controlled electrolyte inlet for somewhat constantly conveying a new supply of electrolyte as the old or saturated supply is removed through the overflow and drain, the fee through the inlet into the electrolyte containing vessel being at the same rate as the electrolyte in the vessel is used.

It is also an object of the invention to maintain an electro-current pressure through the electrolyte in accordance with the rate at which the ions are disassociated from the chemical product within the osmosis bag, whereby a constant uniform stream of electrolyte will be passing through the electrolyte in accordance with the rate at which the ions are disassociated from the chemical product within the osmosis bag, whereby a constant uniform stream of electrolyte will be passing through the overflow, and thus remove the electrolized ions.

The aforesaid and other objects may be attained by the structure illustrated in the accompanying drawings, in which: Figure 1 is a partly sectional and fragmentary side view, and Fig. 2 is a detailed plan view of the clamping means for supporting the electrodes, taken in the proximity of line 2—2 of Fig. 1.

Similar characters of reference designate similar parts thruout the several views. Referring to Fig. 1, the numeral 1 designates the base of my invention, upon which directly rests the vessel 2 which is of "wash-boiler" type and is adapted to be thus supported. The vessel serves both as a surrounding and as an intermediate cell means, being adapted to contain the other compartments of the apparatus which are normally surrounded therein by an adsorbent electrolyte solution also contained in said vessel, which is thus disposed between the said other compartments.

The symmetrically arranged struts 3 extend upwardly from opposite ends of the base 1 and are together adapted to straddle the vessel 2. The insulating plate 4 is conveniently constructed of glass. Said plate is supported horizontally over the vessel 2, the ends thereof resting on the struts 3. From a medial point of said plate, the osmotic membrane bag 5 is suspended by means of the cord 6 which engages the downwardly disposed hook 7 of said plate and is adapted to ordinarily contain the original or untreated material which is conveniently disposed within said bag in combination with distilled water.

The anode cell 8 and the cathode cell 9 are disposed within the vessel 2 at opposite ends thereof and on opposite sides of the osmotic bag 5. The anode 10 is supported by the downwardly extending hook 11 of the plate 4, being thus suspended so as to hang into the anode cell 8. In like manner, the cathode 12 is supported by the hook 13 of said plate, being suspended to hang into the cathode cell 9. Said cells are constructed of porous material preferably porcelain, by which a filtering communication exists between the interior of same with the surrounding electrolyte 14 of said vessel.

The contents of the bag 5 are designated by the numeral 15.

I have provided baffle members 16 which are conveniently suspended from the plate 4 by means of the hooks 17 between the bag 5, and the cells 8 and 9, and serve to more effectively impede the movement of the ions from said bag to said cells, thus permitting more time for uniting same with the surrounding electrolyte 14.

The anode 10 and the cathode 12 are each

composed of a plurality of non-ionizable electrodes 18, preferably carbon, which engage corresponding holes of the supporting heads 19, being retained in suspended relation therefrom by the set screws 20, which are threaded in said heads into nosed relation with said electrodes. Said heads are in turn suspended from the plate 4 by means of the eye rods 21 which engage the aforesaid downwardly disposed hooks 11 and 13 thereof, the electrical current being supplied by means of the conductor means 22 which connect with said eye rods.

By the mere predetermining of the physico-chemical conditions of the material within the osmosis bag 5, such control being consistent with the action of hydrogen ion concentration desired and the content of neutral salt present, I am able to carry out the given operations for which the process may be applied. For instance, in the application of the apparatus to certain agents for pH of 6.5 may be desired; in others, pH higher or lower, as may be required. pH contents of the osmosis bag content being ascertained by electrometric determinations for proper maintenance of the proper physico-chemical constituents necessary for the given operations, the apparatus operates automatically and automatically maintains the induction of electro-endosmosis within the bag contents, and automatically prevents the equilibrium from being established, by which conditions I am able to maintain the osmotic phenomena.

In order to replenish the electrolyte 14 within the vessel 2 a valve controlled fluid inlet 25 is provided thru a wall of said vessel, preferably near the anode end thereof, thru which suitable electrolyte is supplied somewhat constantly, in accordance with the combined rate of discharge at the overflow 24, and drain 26, of the vessel 2. By this arrangement this apparatus provides a continuous and automatic process, and results in a continuous and automatic operation for the purpose of more constantly and rapidly producing highly purified iso-tonic curative antitoxins, such as curative antitoxins against diptheria, tetanus, scarlet fever, and antibacterial sera may be freed from all inert and toxic material, usuable against streptococcus, pneumococcus, meningcoccus and other bacterial infections, it being understood, however, that the contents of either of the compartments of the apparatus may be removed and used in the respective stage of electrolization, as desired.

It is understood that my apparatus differs in function from all such apparatus heretofore used, as it is not used for the purpose of manufacturing acids or alkalies, but is designed to produce osmotic separation of what has heretofore been considered electro-dissociatable salts from an organic base, such salts being contained in and harmful to man organic extracts and serums, and more correctly termed anti-serums. My invention also differs from apparatus heretofore generally used, in the fact that it is not for the purpose of synthetic production through electro-chemical reaction in the making, for example of sodium carbonate from sodium chloride by bubbling carbonic acid in the negative cell at the cathode, while electrolysis is proceeding, as is understood by those familiar with the art. The specific and novel uses of my invention are instead, confined to the induced electro-osmotic removal of such constituents as are considered impurities in many organic residues, gums, resins, gelatine solutions, normal animal sera, and immune sera produced against various diseases. Such work is carried out in my invention by causing electrolytic disassociation of the inorganic salts etc., and inert proteins, by which the electro-positive ions of such salts are directed toward the cathode and the electro-negative ions toward the anode.

One method of operating my invention is the provision of a suitable electrolyte agent having adsorbing properties friendly to the desired elements of a certain serum, medicinal plant, extract or the like of the bag 5, such properties being for example, kaolin, charcoal or mixtures containing other well known adsorbing properties. Such agent is placed in the vessel 2 and the electrolyzing process as above mentioned will cause such properties to collect the desired elements from the bag 5, the desired solids being thus removed by disassociation and adsorption. In certain other instances, by the use of a suitable parchment osmosis membrane bag, either animal, vegetable or other material, it is an object to include in the electrolyte, properties friendly to the undesired elements, said vessel leaving in the bag 5 the usable principles, thereby bringing about a purification of the original fluid.

As demonstrating a simple operation of the device, a prescribed quantity of serum in its raw state, for treating diphtheria, is entered in the bag 5, and the bag is then suspended in a particular mixture 14, within the vessel 2, said mixture including a pulverized adsorbent. An electric current is then set up through the positive and negative electrodes 18, which will direct an electric current through the said mixture, the bag being suspended in same. The current will act on the contents thereof and in this instance attract and remove certain serum products, such as toxic agents, inert protein, salts, and the like and deposit them on the floating adsorbent particles. A large portion of the thus migrated toxic agents etc. will normally adhere to and be collected by the particles of the mixture 14 and clinging to these particles will be further separated by the filtering action of the walls of the cells 8 and 9, it being un-

derstood that the deposit carrying particles of the electrolyte are too large to pass thru said walls, by which the discharge from the spout 24 is purified.

It will be understood that the electrolyte will be constantly resupplied through the inlet 25, as it is removed through the overflow 24, and the outlet 26, thus maintaining a substantially fresh supply of electrolyte into which the impurities are discharged from the bag 5. After the contents of the bag 5 has been subjected to electrical influence a prescribed interval, the bag is removed from the vessel 2 and the remaining contents removed therefrom which is also in substantially purified form.

In some instances, this operation is reversed, the desired serum products being removed and the gross impurities left within the bag 5, a desired part of the product escaping through the overflow 24, while another desired part will be drawn off through the outlet 26.

I claim as my invention:

1. An electro-osmosis apparatus comprising a membranous bag for retaining substance to be treated, a pair of porous cells, a positive electrode in one of said cells and a negative electrode in the other cell, a vessel into which said bag and cells are extended, and an electrolyte in said vessel contacting said bag and cells, whereby when an electric current is passed through said electrodes components of said substance within the bag will be osmosised into said vessel and be collected by said electrolyte.

2. An electro-osmosis apparatus comprising a membranous bag for retaining an electrolyte solute, a vessel for containing an electrolyte, a pair of porous cells entering said vessel, a positive electrode in one cell and a negative electrode in the other cell, said electrolyte in the vessel being adapted to collect by adsorption components osmosised from said solute incident to an electric current being passed through the electrolyte into the vessel, and overflow spout on one of said cells, and a drain for said vessel.

3. An electro-osmosis apparatus comprising an electrolyte containing vessel, a pair of cells within said vessel, in spaced relation, an electrode in each cell, and an electrolyte solute containing receptacle between said cells so positioned that a current passing between said electrodes may pass through the receptacle or shunt around the same.

4. An electro-osmosis apparatus comprising an electrolyte containing vessel, a pair of cells within said vessel and in spaced relation, an electrode in each cell adapted to pass an electric current through the electrolyte within said vessel, and an electrolyte solute containing bag suspended in said electrolyte within the vessel, and so arranged that the electric current may pass through the bag or around the same.

5. An electro-osmosis apparatus comprising a vessel for containing electrolyte, a pair of cells within said vessel and entering said electrolyte, and an electrode in each cell, whereby when energized an electric current will flow through said electrolyte, a membranous bag adapted to contain an electrolyte solute, and means for suspending said bag between said electrodes and in spaced relation with the walls of said vessel, whereby an electric current may pass through and around said bag.

6. An electro-osmosis apparatus comprising a vessel having electrolyte therein, and electrolyte solute containing bag suspended in said vessel and in spaced relation with the walls thereof, means for directing an electric current through the electrolyte within said vessel, and means for retarding the movement of the ions from the electrolyte solute on their passage through the electrolyte in the vessel.

In testimony whereof, I have hereunto set my hand on this the 7th day of July, 1925, A. D.

VINCENT A. LAPENTA, M. D.