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ELECTRO-OSMOTIC PROCESS OF TREATING LIQUID MIXTURES.

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1,235,063. Patented July 31, 1917.

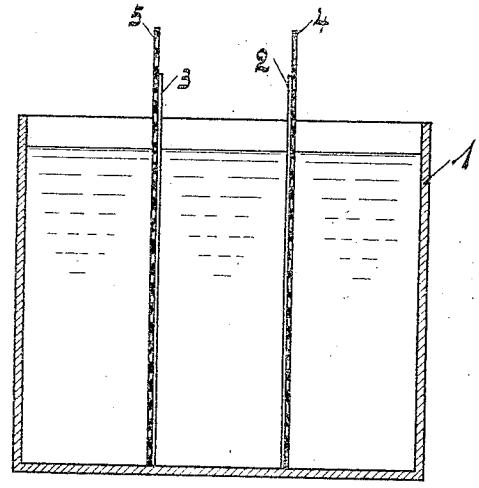

Fig. I.

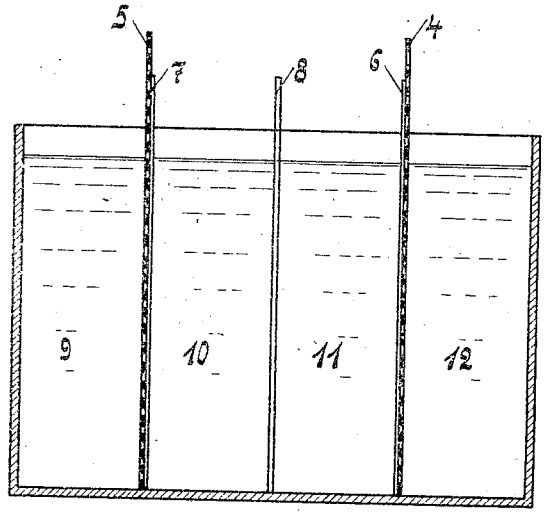

Fig. II.

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ELECTRO-OSMOTIC PROCESS OF TREATING LIQUID MIXTURES.

1,235,063. Specification of Letters Patent. Patented July 31, 1917.

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To all whom it may concern:

Be it known that I, BOTHO SCHWERIN, a subject of the German Emperor, residing at Frankfort-on-the-Main, Germany, Wilhelmstr. 34, have invented certain new and useful Improvements in Electro-Osmotic Processes of Treating Liquid Mixtures, of which the following is a specification.

A known method of separating a constituent of a mixture of suspension colloids consists in subjecting the mixture to electro-osmosis, whereby the component in question is separated at the pole or at a partition inserted in front thereof.

This method is limited in application. For example, it fails in the presence of an injurious electrolyte which may hinder completely, under some circumstances, the electro-osmotic migration.

The present invention relates to a process which permits quite generally a separation from each other of suspension colloids or emulsion colloids, the so-called true colloids, actually dissolved bodies and electrolytically dissociated ions. The process, therefore, serves for separating constituents from mixtures of bodies falling within the foregoing category and, indeed, for separating fractionally several constituents. For instance, the colloids and the dissolved bodies may be separated individually from a solution containing several colloids.

The invention consists in subjecting the mixture to the action of an electric current in a circuit wherein are interposed one or more diaphragms the potential of which is so selected, that the constituent or constituents which cannot pass the diaphragm or diaphragms are separated, while the other constituent or constituents migrate through the diaphragm or diaphragms.

By arranging several diaphragms of different charge capacity one behind the other, any desired separation of the constituents may be accomplished.

In the accompanying drawing,

Figure 1 is a vertical sectional view through an apparatus adapted to carry out the improved process;

Fig. 2 is a similar view of a slightly different form of apparatus.

Referring to the drawing 1 designates a suitable tank or receptacle which in the form illustrated in Fig. 1 is divided into three compartments by two diaphragms 2, 3, the electrodes 4, 5, being arranged in the end compartments thus formed and separated by the diaphragms from the intermediate compartment.

In the form of apparatus illustrated in Fig. 2, the space between the electrodes is divided into two chambers or compartments 10, 11, by means of three diaphragms 6, 7, 8.

The diaphragms act in several ways. By means of indifferent diaphragms inserted in front of the poles, the electrolytes may be first eliminated. For example with an apparatus like that of Fig. 1 having the diaphragms 2, 3, made of parchment and a colloidal solution in the compartment between the diaphragms while the end compartments contain water the effect of passing an electric current through the solution is to separate the inorganic ions from the mixture, those of acid character migrating to the anode and those of basic nature to the cathode. The mixture may be impoverished, however, in acid or basic residues by separating the one or the other residue in increased proportion. For instance, by means of a positive diaphragm the acid, or by means of a negative diaphragm the basic residues may be removed comparatively more quickly, so that in the mixture the electrolytes which are suitable for the desired separation may be retained in the correct degree of concentration.

It has been shown that the migrating of the colloids is often prevented by the presence of unsuitable electrolytes. It will be seen, however, that if by the above mentioned method the electrolyte is completely removed, or at least so far as it affects the migrations, the colloids will begin to migrate at once. Cases may arise in which the mixture is first of all freed from acid, whereupon the negative colloids begin to migrate at once, while as the process proceeds the bases are removed from the mixture whereby the positive components are also caused to migrate.

The following is an example of the possibility of giving to the mixture any required concentration as regards the electrolyte.

If, as stated above, a parchment diaphragm is placed before the cathode and a

diaphragm of a more positive charging capacity, for example one made of animal bladder, before the anode, the migration of the acid ions from the solution will be accelerated and the contents of the compartment between the diaphragms remain alkaline. For example, if under these conditions a dilute common salt solution is electrolytically treated, the contents of the central compartment (Fig. 1) at once becomes alkaline.

A further action of the diaphragms is due to the fact that they permit fractionation of the ions. It has been shown, for example, that ions of the same kind pass through a diaphragm with greater or less migration velocity according to the nature of the diaphragm. For example, with a viscose diaphragm at the anode and parchment paper at the cathode, a mixture of sulfuric acid and lactic acid will be fractionated, the sulfuric acid passing through the viscose diaphragm, while the lactic acid will not be permitted to pass the viscose diaphragm, so that after a time the central compartment contains only lactic acid.

Furthermore, the diaphragms act by rendering it possible to fractionate dissolved bodies, such as sugar, existing in a mixture, which are neither electrolytes nor colloids and cannot be separated or removed merely by electrical means; for such bodies migrate together with the water and may be separated from the other constituents and thus recovered, by interposition of suitable diaphragms. For example, by using an animal diaphragm at the anode and a viscose diaphragm at the cathode, the dissolved non-saccharine material can be separated from a solution of crude sugar.

Finally, true colloids may be separated by the invention, since after separation of the unsuitable electrolyte they migrate and, according to their character and their relationship to the diaphragms, in part pass through the latter and are in part retained by them. For example a glue solution can be fractionated by using an apparatus such as is illustrated in Fig. 2. In such apparatus the diaphragm 7 adjacent the anode 5 is of leather, pig bladder or hardened albumen, for example, while a viscose diaphragm 6 is positioned adjacent the cathode 4 and the space between said diaphragms is separated into two compartments by a third diaphragm 8 of woven fabric. With such an apparatus containing a glue solution in the chamber 11, while the other chambers contain water, the action of the electric current results in fractionating the solution. As a result the particles of albumen will collect in the chamber 10 and the color components of the glue in the anode chamber 9, while the gelatose and glutinous particles pass to the cathode chamber 12 and the pure gelatin remains in the chamber 11.

What I claim is:

1. The process of separating the constituents of a liquid mixture which comprises disposing said mixture between two electrodes so that it is separated therefrom by two osmotic diaphragms having different potential characters dependent upon the constituents to be separated, and passing an electric current from one electrode to the other through said diaphragms and said mixture whereby certain constituents are separated from others.

2. The process of separating the constituents of a liquid mixture which comprises disposing said mixture between two electrodes so that it is separated from at least one of said electrodes by a plurality of osmotic diaphragms having different potential characters dependent upon the constituents to be separated, and passing an electric current from one electrode to the other through said diaphragms and said mixture whereby a fractional separation of the different constituents of the mixture is effected.

3. The process of separating the constituents of a liquid mixture which comprises disposing said mixture between two electrodes so that it is separated from one of said electrodes by an osmotic diaphragm and from the other of said electrodes by a plurality of osmotic diaphragms, all of said diaphragms having different potential characters dependent upon the constituents to be separated, and passing an electric current from one electrode to the other through said diaphragms and said mixture.

4. The process of fractionally separating a liquid mixture, comprising passing an electric current through the mixture while there is interposed between said mixture and an electrode a diaphragm having a potential corresponding to that of the electrode toward which the particles to be separated are caused to migrate, which diaphragm permits certain particles having one kind of charge to pass therethrough more freely than other similarly charged particles.

5. The process of separating the colloidal constituents of a colloidal solution containing electrolytes in undesirable proportions which comprises reducing the concentration of the electrolytes by electro-osmosis to a point where they will no longer hinder the migration of a colloidal constituent, and then subjecting the so treated solution to electro-osmosis with a diaphragm whose potential character is such as to permit the passage therethrough of one or more of the colloidal constituents whereby a separation of the constituents is effected.

6. The process of separating the colloidal

constituents of a colloidal solution containing electrolytes in undesirable proportions which comprises reducing the concentration of the electrolytes by electro-osmosis to a point where they will no longer hinder the migration of a colloidal constituent, and then passing a current through the so treated solution and its retaining diaphragms whose potential characters are dependent upon the constituents to be separated.

In testimony whereof I affix my signature in presence of two witnesses.

BOTHO SCHWERIN.

Witnesses:
JEAN GRUND,
CARL GRUND.