F. R. PYNE & H. M. GREEN.

ELECTROLYTIC REFINING OR EXTRACTING PROCESS.

APPLICATION FILED APR. 20, 1915.

1,148,798. Patented Aug. 3, 1915.

Fig. 1.

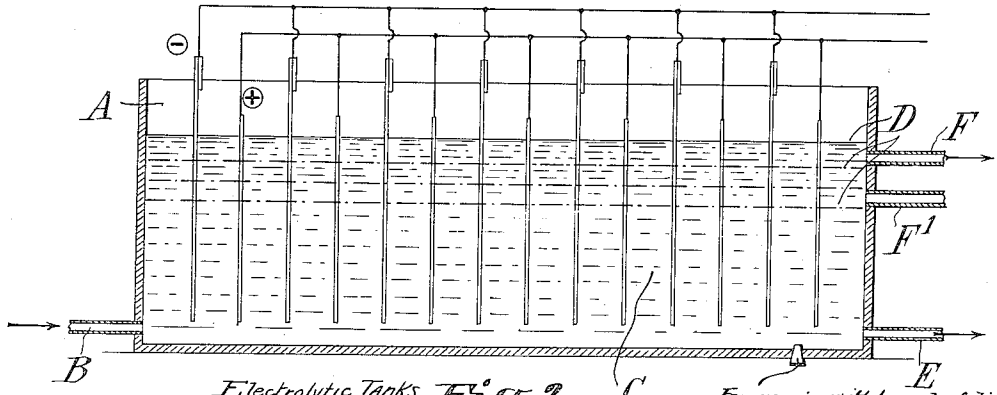
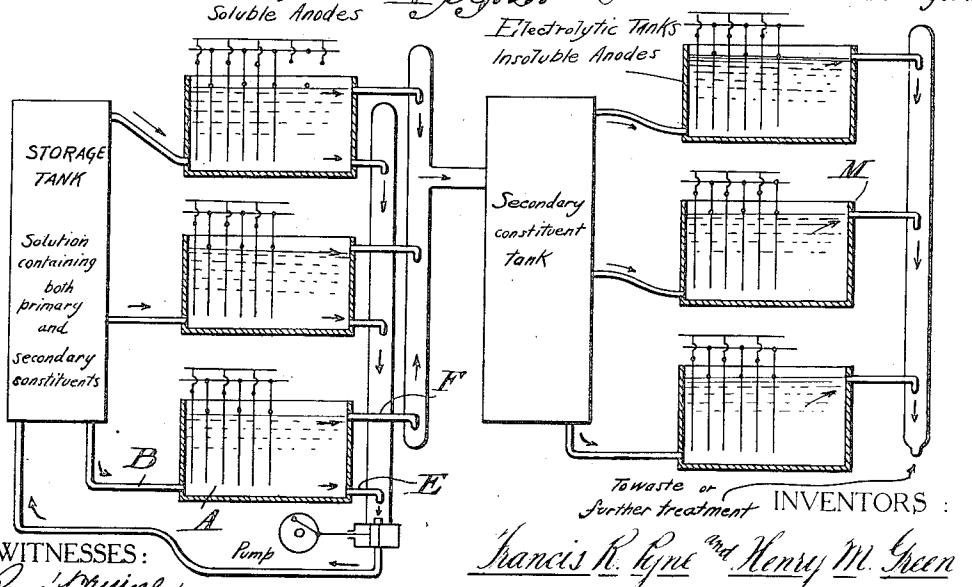


Fig. 2.



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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC REFINING OR EXTRACTING PROCESS.

1,148,798. Specification of Letters Patent. Patented Aug. 3, 1915.

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To all whom it may concern:

Be it known that we, FRANCIS R. PYNE, residing in Elizabeth, county of Union, State of New Jersey, and HENRY M. GREEN, residing in Chrome, county of Middlesex, State of New Jersey, both citizens of the United States of America, have invented certain new and useful Improvements in Electrolytic Refining or Extracting Processes, of which the following is a specification.

This invention relates to improvements in electrolytic refining or extraction processes, and aims to provide improvements therein.

Electrolytes are usually found to contain, or be composed of, several constituents, this being pricipally due to the fact that the substances, such as ores, bullion, ingots, etc., which are used in contact with the electrolyte, usually contain several compounds or elements. Some or all of these compounds or elements, are dissolved in the electrolyte, and some remain as insoluble particles, which, on settling, form slimes. Of the constituents of the electrolyte, there is usually but one primary constituent which contains the products which it is the direct or principal object to recover, the other constituents being subsidiary or secondary constituents, and being valuable, if at all, mainly as by-products.

It has been found that electrolytic solutions, while the current is passing, stratify, and that in electrolytes containing several constituents, the separate constituents will be found to be more concentrated in certain portions or strata of the electrolyte than in other portions or strata, the degree of stratification depending largely upon the rate of flow of the solution through the electrolytic tank, and the strength of the electric current. The primary constituent will accordingly be more concentrated in a stratum more or less distinct and separate from the stratum or strata in which there is the greatest concentration of the secondary constituent or constituents.

Heretofore, with the purpose of avoiding, as far as practicable, stratification, and in order to avoid the accumulation of the secondary constituents in the tank, it has been the practice to provide a good circulation through the tank, and to introduce and withdraw the incoming liquid in such manner as to attain an even distribution, as far as practicable, within the tank.

When operating under economical conditions, by the old method, the solution issuing from the tank, contains a percentage of the primary constituent which is of commercial importance, and a percentage of the secondary constituents which it may be desired to remove from the electrolyte. It has heretofore been customary to treat a portion of the electrolyte issuing from the first tank, or series of tanks, in a second tank, or series of tanks, for the purpose of recovering further products from the primary constituent before recovering or removing the secondary constituents. When the electrolyte reaches the second tank, or series of tanks, in order to effect the recovery of further products from the primary constituent and at the same time prepare for the recovery or removal of the secondary constituents, it is necessary to use insoluble anodes which require a higher electric pressure in the second tank or series of tanks than in the first, thereby requiring proportionately greater energy. The deposit in the second tank, or series of tanks, is usually inferior to that in the first, being of a second or intermediate grade. The electrolyte from the second tank, or series of tanks, usually contains enough of the primary constituent to interfere with the economical recovery or removal of the secondary constituents or products thereof. The electrolytic solution is accordingly run into a third electrolytic tank, or series of tanks, and subjected to the action of the current in a similar manner, until all or practically all of the primary constituent is removed. The secondary constituents are thereupon recovered or removed in any suitable way.

According to the present invention, the electrolyte in the first tank, or tanks, is allowed to stratify, to a determined or desired degree, and the solution issuing from the electrolytic tank is taken off in several portions or strata. The portion of the electrolyte which is richest in the primary constituent (and relatively poor in the other constituent or constituents) is run off separately, and is either run back into the first tank or tanks, or into other tanks, wherein it may be treated under the same conditions as, or more advantageous conditions than,

in the first tank. The portions of the electrolyte containing the greater concentration of the secondary constituents are run off separately or together, and are so poor in the principal constituent that they may be immediately treated for the elimination of the primary constituent, and may then undergo further treatment for the recovery or removal of the secondary constituent or products thereof.

The present invention provides a process whereby a greater output of merchantable product is obtained than heretofore, by enabling the second tank or series of tanks to operate under conditions of electrical pressure and grade of product, similar to the first tank or series of tanks. Furthermore, by reason of the lower electric pressure which may be employed in the second tank or series of tanks, there is a great saving of electrical energy.

The present invention will be described in greater detail with reference to the accompanying drawings.

Special reference will be made to the electrolytic refining of copper, though it is to be understood that the invention is applicable to electrolytic extracting and refining processes generally.

Figure 1 of the drawing illustrates an electrolytic tank in longitudinal vertical section, and Fig. 2 illustrates an example of a system of tanks, in which the process may be carried out.

A designates an electrolytic tank, and B an inlet. The anodes are preferably composed of, or comprise, the substance which is to be refined. A solvent, or a solution containing the necessary constituents of the electrolyte, is introduced into the tank. In the electrolytic refining of copper the anodes are usually made of unrefined copper, and contain, beside copper, other elements, depending on the ores from which the copper was obtained, etc. For instance, the anodes may contain, beside copper, iron, nickel, arsenic, zinc, antimony, silver, gold, etc., separately, or more generally, some two or more together.

Under the action of the electric current the anode is dissolved, the greater part of the copper therefrom being deposited on the cathode, such constituents as are insoluble in the electrolyte settling to the bottom of the tank as slime, and such constituents as are soluble in the electrolyte passing into solution and becoming a part thereof. However, during the passing of the electric current, a stratification of the electrolyte takes place, and, in the case of copper refining, for example, it is found that the copper solution (primary constituent) is most concentrated in the lower part of the tank, forming a lower strata as indicated at C. The solutions of the other substances (secondary constituents) which enter the electrolyte are found most concentrated in a stratum or strata D above that of the concentrated primary constituent, *i. e.* the concentrated copper solution. In order to prevent an excessive stratification of the electrolyte, which is detrimental to a proper working of the process, a circulation is produced through the tank or tanks, and, in order to prevent an undesirable accumulation of the secondary constituents, a portion of the circulated electrolyte is withdrawn for the removal or recovery of the secondary constituents. The circulation may take place by reason of a difference in level between the solution in the tank or tanks and the solution in the reservoir from which the tank or series of tanks is supplied.

According to the present invention, the circulation through the tank or tanks containing the primary and secondary constituents in any particular case, is not usually as rapid as in the old process, a determined or desired degree of stratification is allowed to take place, and instead of leading off the solution at a single level, or through a single pipe, the electrolyte is led off at several levels, or through the pipes E and F. The pipe E communicates with the stratum wherein the primary constituents are most concentrated, and the pipe F communicates with the stratum wherein the secondary constituents are most concentrated. Other pipes F^1 may be provided for leading off any particular fraction or stratum of the concentrated secondary constituents. The concentrated primary constituents may also be led off in fractions of different concentration, if desired. The portion of the electrolyte containing the high concentration of the primary constituent may be led back into the first electrolytic tank or series of tanks, or into other similar tanks. The portion of the electrolyte containing the high concentration of the secondary constituents is preferably led to an electrolytic tank M or series of tanks, and subjected to the action of the current for the purpose of eliminating the primary constituent, for example the copper, or may be led to other tanks for any desired treatment. The stratification, and the concentrations of the constituents of the electrolyte in the several strata, may be regulated by the degree of flow through the outlets, and more especially by the relative degrees of flow through the separate outlets.

In the refining of copper, the tanks with the insoluble anodes used for the intermediate and final treatment of the primary constituent of the electrolyte, are usually operated at an electric pressure of about 2. volts, and the copper deposited is usually of inferior grade. According to the present invention, there is usually no necessity to treat the liquid issuing from the first tanks in

intermediate tanks, using insoluble anodes for the purpose of eliminating the greater portion of the primary constituent. The part of the electrolyte issuing from the first tank or tanks containing the low concentration of the primary constituent may be immediately treated for the elimination of the primary constituent, and the part of the electrolyte containing the high concentration of the primary constituent may be returned to the first tank or tanks. A less number of tanks operating at high electrical pressure is therefore required than under the old methods, under similar conditions. There is a more efficient utilization of the electrolytic tanks and there is a saving in energy. For example, in copper refining, the tanks with the soluble anodes are operated at a pressure of about .3 volts and less.

What is claimed is:—

1. In an electrolytic refining or extracting process, wherein the electrolyte contains more than one constituent, allowing stratification to take place to a determined or desired degree, and leading off portions of the electrolyte separately from different strata.

2. In an electrolytic refining or extracting process, wherein the electrolyte contains more than one constituent, allowing stratification to take place to a determined or desired degree, and leading off the electrolyte separately at different levels.

3. In an electrolytic refining or extracting process, wherein the anode is soluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, and leading off separately a portion of the solution from the stratum of the concentrated primary constituent.

4. In an electrolytic refining or extracting process, wherein the anode is soluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, leading off separately a portion of the solution from the stratum of the concentrated primary constituent, and leading off a portion of the solution from a stratum of the concentrated secondary constituent.

5. In an electrolytic refining or extracting process, wherein the anode is soluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, leading off separately a portion of the solution from the stratum of the concentrated primary constituent, and leading off a portion of the solution from a stratum of the concentrated secondary constituent, and directly treating said portion containing the concentrated secondary constituent to eliminate the primary constituent.

6. In an electrolytic refining or extracting process, wherein the electrolyte contains more than one constituent, allowing stratification to take place to a determined or desired degree, leading off portions of the electrolyte separately from different strata, and controlling the relative concentrations of the constituents in the several strata by regulating the flow of the separate outflowing portions of the electrolyte.

7. In an electrolytic refining or extracting process, wherein the anode is soluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, leading off separately portions of the solution from several levels, a portion being led off from the stratum of the concentrated primary constituent, and returning the led-off portion of the electrolyte containing the concentrated primary constituent to the electrolytic tank.

8. In an electrolytic refining or extracting process, wherein the anode is insoluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, and leading off separately a portion of the solution from the stratum of the concentrated primary constituent.

9. In an electrolytic refining or extracting process, wherein the anode is insoluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, leading off separately a portion of the solution from the stratum of the concentrated primary constituent, and leading off a portion of the solution from a stratum of the concentrated secondary constituent.

10. In an electrolytic refining or extracting process, wherein the anode is insoluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, leading off separately a portion of the solution from the stratum of the concentrated primary constituent, and leading off a portion of the solution from a stratum of the concentrated secondary constituent, and directly treating said portion containing the concentrated secondary constituent to eliminate the primary constituent.

11. In an electrolytic refining or extracting process, wherein the anode is insoluble and wherein the electrolyte contains a primary constituent and a secondary constituent, allowing stratification to take place to a determined or desired degree, leading off

separately portions of the solution from several levels, a portion being let off from the stratum of the concentrated primary constituent, and returning the led-off portion of the electrolyte containing the concentrated primary constituent to the electrolytic tank.

In witness whereof, we have hereunto signed our names in the presence of two subscribing witnesses.

FRANCIS R. PYNE.
HENRY M. GREEN.

Witnesses:
WILLIAM C. WEBER,
JACOB ROTH.