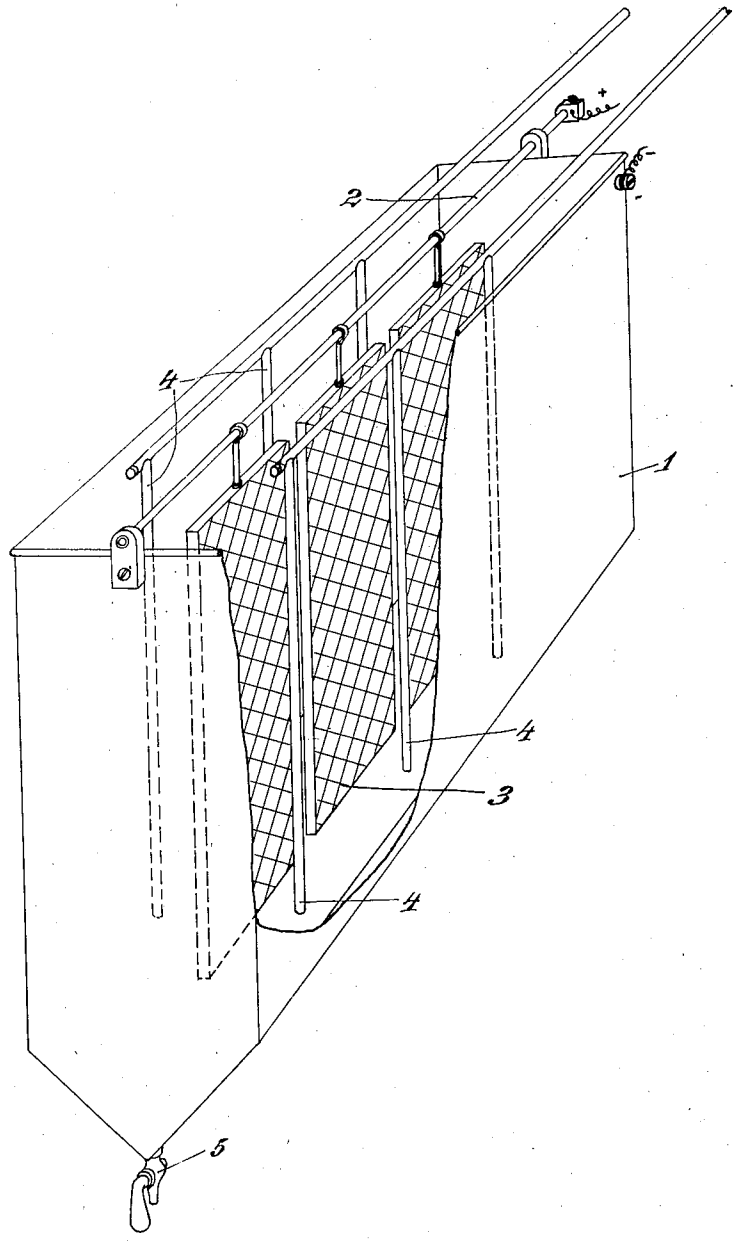
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PROCESS OF ELECTROLYTICALLY SEPARATING THE ALLOYS OF SILVER WITH OTHER PRECIOUS OR BASE METALS

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PROCESS OF ELECTROLYTICALLY SEPARATING THE ALLOYS OF SILVER WITH OTHER PRECIOUS OR BASE METALS.

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The commonly used processes of electrolytically separating alloys of previous metals, particularly the alloys of silver, which cannot be subjected directly to an electrolytic refining for instance according to the process of Moebius are based on the fact, that the silver as well as also the base metals, particularly copper, are anodically dissolved in an acidified electrolyte, the obtained solution being separated from the cathode and the silver removed in a silver precipitating plant outside the electrolytic cell. Thereafter the solution, which is freed from the silver, is again passed into the cathode chambers in a continuous circular path, this being effected by a pump. The anodic current density, employed by this process, is only 2½ to 3 amperes per square decimetre, so that the separation of the precious metals will take place at a comparatively slow rate.

According to the present invention, firstly it is rendered possible without any increased demand of energy to employ anodic current densities of 6 amperes and even of 10 amperes per square decimetre, so that the separation of the precious metals will take place at a rate which is two to four times as fast as in the known processes;

Secondly, as compared with the known processes above referred to, the troublesome and expensive precipitating plant is dispensed with;

Thirdly the pump and the power for operating it, in order to effect the circulation of the electrolyte, is dispensed with;

Fourthly the precious metals are obtained without any loss, while in the other processes the precious metals, even if only in small quantities, will pass into the cathodically precipitated metal (copper);

Fifthly the electrolyte will remain quite unchanged, and therefore it does not require to be regenerated as in the known processes.

The invention is based on the following facts:

When anodically dissolving the alloys of silver in a possibly neutral electrolyte, whose anions are adapted to form easily soluble salts with the silver and the base metals, hydroxyl ions are formed which lead to the formation of silver oxide and hydroxides of the base metals. If the electrolyte is well stirred or agitated all the silver oxide particles which have been formed pass to the cathode, act here as a depolarizer and prevent the discharge of hydrogen, whereby the silver is reduced to finely distributed metallic silver which does not adhere to the cathode. Thus the discharge of hydrogen is reduced in accordance with the proportion of silver contained in the parting or separating agent.

However the hydroxides of the base metals are cathodically only partly reduced if at all. During this procedure the depolarizing action of the silver oxide will cause a very considerable reduction in the pressure or voltage of the bath which, as compared with the electrolysis without depolarization, will amount to about 30 per cent when using an alloy with any tolerable proportion of silver. After the electrolysis is completed the electrolyte is allowed to clarify or settle, thereafter the same is filtered, and now the metallic silver and any other precious metals, small quantities of base metals, as well as the hydroxides of the base metals are deposited on the filter. The base metals and their hydroxides are then separated from this mixture by means of a diluted acid, if desired by blowing in air or steam, whereby the precious metals remain behind in a very pure condition. The precious metals are separated from one another by any convenient and known method of refining.

The filtered solution, containing the base metals, is worked up to get the corresponding metallic salts or the metal is separated electrolytically at the cathode with respect to an insoluble anode.

As will be seen the stirring or agitation of the electrolyte is of the greatest importance, as it renders it possible to obtain, at very small costs, the maximum of the depolarization and the decrease or reduction of voltage connected with it, and further permits the simple separation of the precious metals from the base metals.

In case the electrolyte is not well stirred or agitated, a large part of the silver-oxide formed at the anode would not be reduced at the cathode. In this case there would be obtained a mixture of silver-oxide with a little metallic silver and hydroxides of the base metals, the separation and further treatment of which is difficult.

The necessary agitation is preferably accomplished by blowing in compressed air.

As already mentioned the electrolyte has the characteristic of being substantially neutral and its anion has to form readily soluble salts with the silver and the base metals.

Such a member may be perchlorate of sodium ($NaClO_4$), further sodium fluoborate ($NaBF_4$), ethyl- and methyl sulphuric acid, alkalies and similar salts. Salts, which are reduced at the cathode, such as the chlorates and nitrates of the alkalies are unsuitable.

The electrolysis preferably takes place in cells, which also serve as cathodes and consist of copper, brass, iron and the like. Of course the cell may be in the shape of a receptacle, in which the cathode is inserted. One mode of carrying out the present invention is illustrated by way of example in the accompanying drawing.

In an electrolytic cell 1 of copper-sheathing and of parallelepipedal shape, which is connected to the negative pole of a source of current, are arranged electrodes 3, the latter being suspended from a conductive bar 2, which is insulated with respect to the cell 1 and connected to the positive pole of a source of current. Tubes 4, which extend to near the bottom of the cell and are disposed at both sides of the electrodes, serve for the introduction of compressed air, in order to well mix or agitate the electrolyte.

A discharge-cock 5 serves for the discharge of the electrolyte together with the separated metal-sludge. The electrode 3 preferably consists of 60 parts of silver, 35 parts of copper, 4 parts of zinc and 1 part of gold.

The electrolyte is composed of 25 parts of perchlorate of sodium in 100 parts of water. The current density is from 7 to 8 amperes per square centimetre of the anode.

During the electrolysis the silver and gold is separated in the form of metal, while the zinc in the form of hydroxid passes into the sludge. The copper is separated as metal in a spongy form and remains in the sludge. This sludge is then separated by filtering the electrolyte, the latter being again returned into the cell. The sludge is then boiled with diluted sulphuric acid, and air is blown in, thereby dissolving copper and zinc while the precious metals are not dissolved and remain free of any foreign admixtures. Gold and silver can then be separated in any known manner. The copper-solution is worked up to give copper-sulphate or the copper is separated electrolytically.

For instance if it is a case of separating alloys of silver, gold and lead, it is of advantage to separate from the mixture of metallic silver- (gold) and lead-hydroxid, produced during the electrolysis by the hydroxyl-ions generated at the anode, the lead-hydroxid with perchloric acid ($HClO_4$) or hydrofluoboric acid (HBF_4) or by means of solutions of caustic potash or hydrates of potassium, and the solutions obtained are worked up for lead-compounds or metallic lead.

It may be thought that the subject matter of this invention is set forth in the German patent specifications Nos. 91707, 99121 and 105.143. However the process according to the present invention differs from these known processes as far as the final result is concerned, as well as in principle. The said patents have for their aim the production of difficultly soluble metallic salts and metallic oxides of a high degree of purity, in order to directly employ the obtained final products, mixed electrolytes being used for attaining this object and the latter requiring continuous regeneration, in order to retain constant or invariable the proportion of combination between solvent salt and the precipitating salt.

As distinguished from the above the final object of the process of the present application is not the production of difficultly soluble metallic salts, but the production of metallic silver or auriferous silver.

The residual products produced thereby, the hydroxides of the base metals are mixed with the precious metal, and already for that reason they can not be looked upon as the desired final product. On the contrary they are dissolved from the obtained mixture. Besides this, the hydroxides are not of a high degree of purity. Further in the process according to the present invention an electrolyte is not employed, which consists of a solvent salt and a precipitating salt, this would be very inexpedient, and finally the decisive feature is the utilization of the depolarizing effect of the silver-oxide, which is not employed in any of the known proceses.

I claim:

1. In a process of electrolytically separating the alloys of silver with other precious and base metals, the step consisting in employing these alloys as anode in a neutral electrolyte whose anion is able to form with the silver and the base metals of the alloy easily soluble salts, whereby hydroxylions are released at the anode and form oxides of the precious metals and hydroxides of the base metals, the hydrogen released at the cathode reducing the silver oxide to a finely distributed silver which does not adhere to the cathode.

2. In a process of electrolytically separating the alloys of silver with other precious and base metals, the steps consisting in employing these alloys as anode in a neutral electrolyte whose anion is able to form with the silver and the base metals of the alloy easily soluble salts, whereby hydroxylions are released at the anode and form oxides of the precious metals and hydroxides of the base metals, the hydrogen released at the cathode reducing the silver oxide to a finely distributed silver which does not adhere to

the cathode, and continuously agitating the electrolyte during the electrolysis in order to mechanically move the silver-oxid to the cathode to be reduced to metal.

3. In a process of electrolytically separating the alloys of silver with other precious and base metals, the steps, consisting in employing these alloys as anode in a neutral electrolyte whose anion is able to form with the silver and the base metals of the alloy easily soluble salts, whereby hydroxylions are released at the anode and form oxides of the precious metals and hydroxides of the base metals, the hydrogen released at the cathode reducing the silver oxide to a finely distributed silver which does not adhere to the cathode, and continuously agitating the electrolyte during the electrolysis in order to mechanically move the silver-oxid to the cathode to be reduced to metal, and treating with a diluted acid the precipitate thus produced in order to free the same of the base metals.

In testimony whereof I hereunto affix my signature.

DR. RUDOLF CARL.