

UNITED STATES PATENT OFFICE

2,124,421

CYANIDE PROCESS

Leonard Klein, Clarkdale, Ariz., assignor to
Phelps Dodge Corporation, New York, N. Y., a
corporation of New York

No Drawing. Application May 7, 1935, Serial
No. 20,194

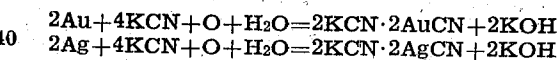
18 Claims. (Cl. 75—107)

This invention relates to the recovery of metals by means of cyanide solutions and has for an object the provision of certain improvements in cyanide processes. A particular object of the invention is to provide an improved process for recovering precious metals such as gold and silver. A further object of the invention is to provide an improved process for recovering precious metals from precious metal-bearing material containing base metals such as copper. The invention further contemplates the provision of an improved process for regenerating cyanide solutions.

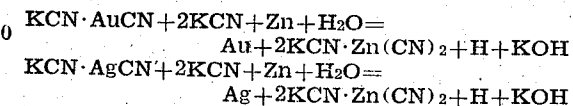
The invention contemplates the treatment of all metal-bearing materials such as ores, slimes, concentrates, tailings and other metallurgical products containing valuable metals in such forms as to be soluble in alkaline cyanide solutions, and throughout the remainder of the specification and in the claims the term "ores" is intended to include all such materials. The invention also contemplates the treatment of all cyanide solutions amenable to treatment, for the regeneration of alkaline cyanide solutions, regardless of their methods of production.

For purposes of illustration, the invention will be described in its application to the treatment of precious metal-bearing ores containing copper and cyanide solutions containing precious metals and copper.

According to cyanide processes as employed heretofore, ore containing precious metals such as gold and silver are subjected to the action of dilute aqueous solutions of sodium, potassium, calcium or other cyanides in leaching operations to dissolve the gold and silver, forming complex cyanides. The reactions involved may be represented by the following equations:



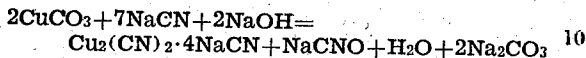
The resulting solution, containing free sodium or potassium cyanide and one or more precious metal cyanides is subjected to the action of metallic zinc to precipitate the precious metals in elemental form, the zinc displacing gold and silver probably in accordance with the following equations:



The precious metal precipitate is separated from the residual solution and melted and cast into

suitable forms, and the filtrate is returned to the leaching cycle.

When a base metal cyanide such as copper is present in the ore, considerable trouble results from fouling of the leaching solutions. Copper carbonate, for example, reacts with alkali metal cyanide in alkaline solution in accordance with the following equation:



The above equation indicates a consumption of 2.7 pounds of NaCN per pound of copper, 2.3 pounds being complexed with the copper.

Alkaline cyanides are relatively high-priced chemicals and their consumption in a cyanidation operation constitutes one of the major operating costs. One of the chief causes of high consumption of cyanide is the formation of soluble double cyanides or complex cyanogen compounds of the base metals such as copper, as indicated by the above equation. The efficiency of a cyanide process in the treatment of precious metal-bearing ore containing base metal cyanides such as copper is further reduced by virtue of the fact that leaching solutions highly charged with double cyanides or complex cyanogen compounds of such metals are inefficient solvents of gold and silver. Solutions containing copper may deposit metallic films on the zinc employed for precipitation which coat the zinc in such a way that the precipitation of gold and silver is retarded. When copper has accumulated to a certain extent in the solution, it also becomes practically impossible to use the solution for extraction of gold and silver from the ore, and the copper must be removed by some means or the solution must be wasted.

Many methods or processes have been proposed for overcoming the difficulties encountered in the treatment of precious metal-bearing ores containing base metal cyanides. These processes, for the most part, have been designed to effect the recovery of the cyanogen in fouled solutions. Probably the most effective of such processes proposed heretofore is one involving acidification of the solution with the resulting production of hydrogen cyanide and the precipitation of insoluble cyanides. Briefly this process consists in acidifying the cyanide solution, thus converting part of the contained cyanogen to hydrogen cyanide, a gas, and the remainder, together with the metals present, to soluble and insoluble cyanogen compounds. The hydrogen cyanide is removed from the acid solution by blowing with