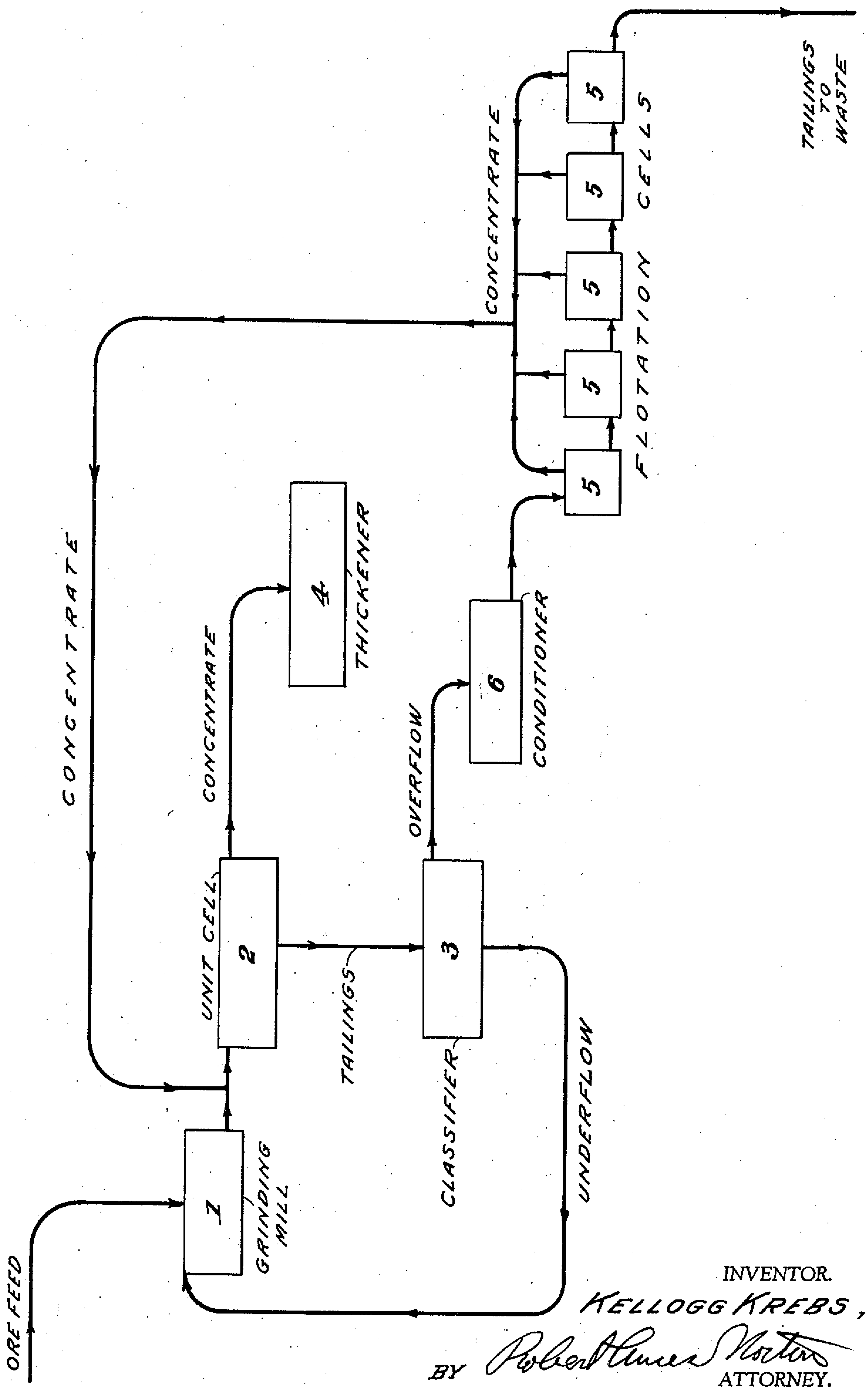
Feb. 28, 1939.

K. KREBS

2,149,220

FLOTATION OF PRECIOUS METAL ORES

Filed Feb. 27, 1937



INVENTOR.
KELLOGG KREBS,

BY Robert Ames Norton
ATTORNEY.

Patented Feb. 28, 1939

2,149,220

UNITED STATES PATENT OFFICE

2,149,220

FLOTATION OF PRECIOUS METAL ORES

Kellogg Krebs, Monrovia, Calif., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine

Application February 27, 1937, Serial No. 128,095

2 Claims. (Cl. 83—94)

This invention relates to a method of flotation and particularly to a method of flotation of ores containing precious metals.

In the past, it has been common practice to interpose a unit flotation cell in the grinding circuit of ore flotation plants, particularly those dealing with precious metal ores. In such plants there is normally a closed grinding circuit including a mill from which the ground material, after suitable conditioning, is introduced into a unit flotation cell from which a concentrate is scalped off and the tailings passed into a classifier from which the underflow is returned to the grinding mill and the overflow, if necessary, with further conditioning, is passed to a flotation plant. The concentrates from the unit cell and the flotation plant may be mixed and taken to ore in some cases cleaned. This procedure possesses a number of disadvantages. The recovery of values which are scalped off in the unit cell is often more than offset by the disruption of classification conditions, lack of balance of reagents in the circuit and in many cases excessive reagent consumption.

It will be apparent that the unit cell as used in the past has been a rougher used only for scalping off a certain proportion of values. I have found that greatly improved recovery, without any of the disadvantages incident to unit cell operation in the grinding circuit, may be obtained if the unit cell is used primarily as a cleaner instead of as a rougher. This is effected by returning all of the concentrate from the flotation plant to the unit cell feed, the only final concentrate from the whole system being taken off from the unit cell. Under such conditions, the flotation time in the flotation plant proper which now becomes a pure middling circuit, is increased without adversely affecting total capacity; increased pulp density may be obtained without affecting the solids in the classifier underflow, reduced reagent consumption and improved metallurgy. The reasons for this surprising improvement which is obtained when the unit cell is operated purely as a cleaner are not definitely known. I believe that at least one factor of importance is the regrinding of a certain proportion of the middlings concentrate which, after passing through the unit cell, may drop in the classifier, and the fact that the large unit cell and advantageous pulp density produces an ideal froth condition.

In referring to a unit cell in the above general description of the invention, it should be understood that this term is not necessarily limited to a single flotation cell. On the contrary, a string of flotation cells may be present in the grinding circuit. The advantages of the present invention are, of course, obtained regardless of whether the flotation capacity in the closed grinding circuit is in the form of a single cell or a string of cells.

The present invention is not concerned with any particular type of reagent and it is an advantage of the invention that it is applicable to the standard reagent combinations. Similarly, the invention may be used with various types of flotation equipment. I have found that Fagergren mechanical flotation machines are highly effective, particularly in the middlings circuit and I prefer to use this type of machine, although the invention operates with improved results with any type of flotation machine. It is not so essential to use a Fagergren flotation cell or cells in the grinding circuit as satisfactory results can be obtained with other types of machines in this part of the plant.

The invention is also not broadly concerned with a particular arrangement of equipment in the grinder circuit or in the middling circuit. The type of equipment and arrangement will be dictated by the nature of the ore being treated and by the factors of space, available plant equipment and the like. It is one of the outstanding advantages of the present invention that it is applicable to existing plants with a minimum of rearrangement and can utilize, for the most part, available equipment.

The invention will be described in greater detail in conjunction with a typical flow sheet which is used with great success in the Spring Hill mine of Grass Valley, Calif. The drawing is a diagrammatic flow sheet of the grinding and flotation portions of this mill.

In the drawing, the ore feed of the Spring Hill mine, which is a quartz and mineralized diabase and averages about $10 of gold per ton, enters a suitable grinding mill which may be a ball mill of standard construction. The ground ore, if necessary after adjustment to suitable pulp density, e. g. about 27% solids, passes into a unit cell 2, where a concentrate is floated off and thickened in the tower 4. The thickened concentrate may then be cyanided in a standard cyanide plant (not shown). The tailings from the unit cell 2 pass into a classifier 3 from which the underflow is returned to the grinding mill. The classifier overflow runs to a reagent conditioner 6 where it is mixed with approximately .02 lb. of mixture of sodium diethyl and disecondary butyldithiophosphates, 0.15 lb. per ton of secondary butyl xanthate, 0.015 ton of cresylic acid, and ½ gallon per ton of 4% stable solution. From the conditioner the conditioned pulp passes into a string of Fagergren flotation cells 5. The tailings are discharged to waste and the concentrate from all five cells returned to the unit cell feed.

Prior to the use of the present invention, the Spring Hill plant was operated in the normal manner, that is to say, the unit cell operated as a rougher and the concentrate from the unit cell and the first of the Fagergren machines was taken as final concentrate and mixed with the concentrate from a culm cell which took concentrates from the last three Fagergren machines. The reagent combination used was the same and the great improvement can be seen from the following table:

	Heads oz. Au	Tails oz. Au	Conc. oz. Au
October	0.18	0.025	10.97
November	0.17	0.018	10.95
December	0.12	0.019	9.08
January	0.20	0.016	14.09
February	0.17	0.013	12.72
March	0.14	0.014	18.34

During the months of October, November and December (over the line) the plant operated in the ordinary manner. Beginning with January, the flow sheet of the present invention went into operation.

While marked improvement is shown by the present invention in all of the months showing both lower tails and richer concentrates, the improvements are more striking in the months when the plant operated on richer feed, namely, October, as contrasted with January. In the Spring Hill plant it was desired to obtain low tails and high grade concentrates, rather than to effect a maximum economy in reagents. Therefore, the amount of reagents was not decreased. With lower grade ores where the reagent cost is proportionately a larger item, a better compromise is frequently obtainable by lowering the reagent consumption and keeping recovery constant, or by lowering the reagent consumption somewhat and obtaining improved metallurgy. Every plant presents an individual problem and the best compromise between reagent saving and metallurgy will have to be chosen for each plant. It is an advantage of the present invention that it is very flexible and permits obtaining the most economical compromise in each particular case.

I claim:

1. A method of recovering values from the ore by flotation which comprises grinding ore, floating the ground ore, classifying flotation tailings, returning oversize to the grinding plant, floating undersize to form a concentrate and tailing, discarding this second tailing and returning the concentrate to the feed of the flotation unit in the grinding circuit.

2. A method according to claim 1 in which the undersize of the classifier is conditioned with flotation reagents between the classifier and the second flotation plant.

KELLOGG KREBS.