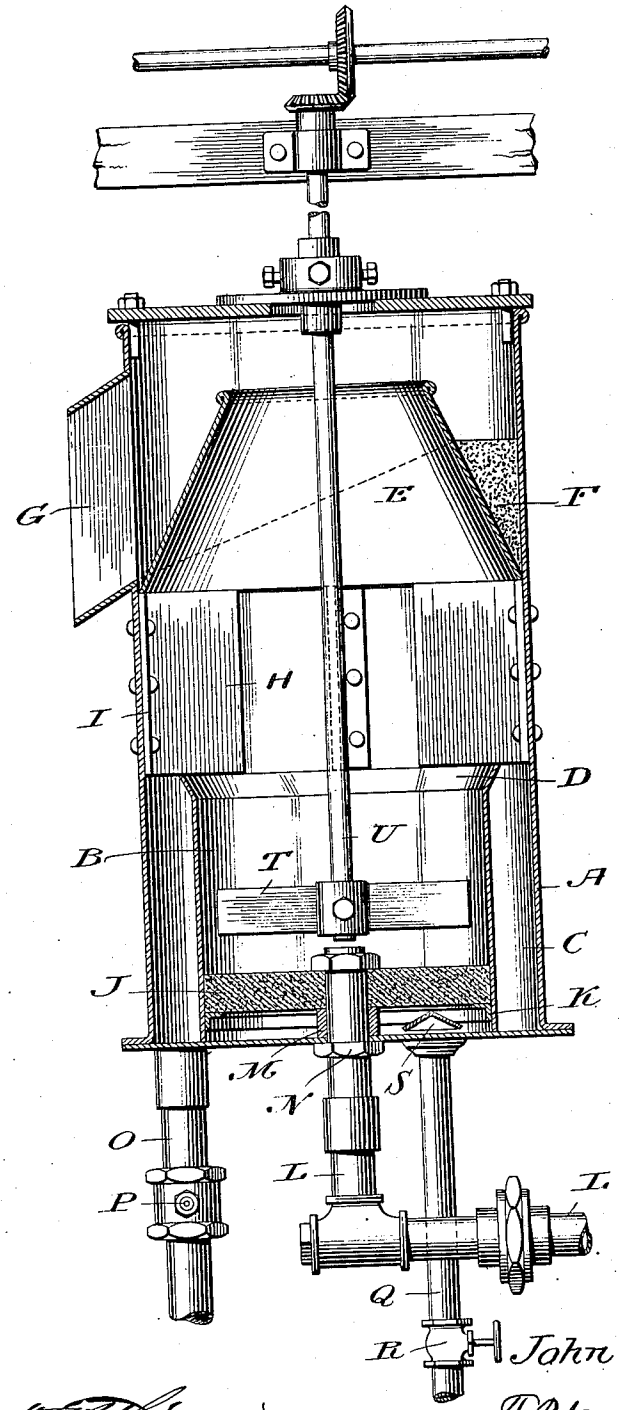
J. M. CALLOW.

ORE CONCENTRATING APPARATUS.

APPLICATION FILED MAR. 7, 1914.

1,124,853.

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ORE-CONCENTRATING APPARATUS.

1,124,853. Specification of Letters Patent. Patented Jan. 12, 1915.

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To all whom it may concern:

Be it known that I, JOHN M. CALLOW, a subject of the King of Great Britain, residing at Salt Lake City, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Ore-Concentrating Apparatus, of which the following is a specification.

My invention relates to certain new and useful improvements in apparatus for the concentration of metallic ores by separating the valuable metallic particles from the barren or rocky constituents thereof, and the invention consists of the parts and the constructions, arrangements and combinations of parts which I will hereinafter fully describe and claim.

In the accompanying drawing forming part of this specification, the figure represents a vertical sectional view of an ore concentrating tank embodying my invention and showing parts in elevation.

In my former application filed December 13, 1913, Serial Number 806,361, I have disclosed and claimed an ore concentrating apparatus similar to the one shown in the present instance, and which apparatus relates to an art which is distinguished from the usual amalgamation processes in which the ore forms an amalgam, and being identified more particularly with what is now known as "flotation processes" wherein a certain percentage of oil, or of two dissimilar oils, or an oil or an acid, or an oil and an alkali are mixed with finely ground ore pulp and the mixture then subjected to a violent agitation by means of mechanical propellers. The result is that large volumes of air are beaten into and entrained by the pulp, which action produces a froth composed of bubbles of air and oil, to which the mineral particles are attached. This froth has the appearance of an aggregation or a mass of fine small soap bubbles which, when collected and the froth discharged or broken down, by natural settlement, or by the addition of cold water, or other means, displaces the mineral particles that have been caught.

In my aforesaid former application, I disclose a means for impregnating the pulp with a large volume of air which seems to be necessary, or desirable, for aerating the pulp, and I provide a means for adding to the pulp containing the proper percentage of oil or other reagent, compressed air which is introduced into the pulp from beneath through some porous body and in innumerable fine streams or jets, this being for the purpose of aerating and agitating the pulp, the compressed air thus becoming the medium (1) of aerating or charging the pulp with the desired volume of air and (2) inducing and maintaining that agitation of the pulp which heretofore was obtained by mechanical propellers and stirrers.

In the present drawing I have shown for illustrative purposes one of such tanks or vessels in which the concentration of the ore is effected, it being understood that this vessel is but one of a series of similar vessels suitably connected and provided with a discharge spout which delivers into a suitable launder.

The tank consists of an outer casing, A, of suitable form, dimensions and construction, and an interior casing, B, of smaller size and separated from the walls of the outer casing to form a circumscribing space, C, the purpose of which will hereinafter appear, said inner casing having preferably, a flaring or funnel-shaped upper end, D.

In the upper part of the tank or receptacle, A, is suitably secured an inverted cone, E, the top or smaller end of which is disposed below the top of the tank, said cone having its lower part connecting with the inner side wall of the tank, and the tank being of uniform diameter and having its side walls extending above the cone whereby an annular gutter, F, is formed in the upper portion of the tank between the cone and the inner wall of the tank, said gutter terminating in a spout, G, at one side which is adapted to deliver into a side launder, not shown.

Between the base of the cone and the top of the interior casing, B, are arranged suitable baffles, which baffles are shown as vertically-disposed, and as consisting of blades, H, of substantial width having flanges, I, by which they are secured to the inside of the tank, said blades projecting substantially radially into the tank and overhanging the inner vessel, B, and being for the purpose of preventing the entire mass of pulp circulating.

In the lower portion of the inner casing, B, of the tank or receptacle and elevated a suitable distance above the bottom thereof,

is a porous medium, J, which may be supported upon suitable brackets, K, or other rests, located a short distance above the bottom of the tank, whereby a chamber is formed between the bottom of this medium and the bottom of the tank, which chamber is cut off from communication with the upper portion of the tank, and with the pulp contents thereof, except through the pores of the medium, J, and which medium is centrally pierced to admit the upturned end of the pipe, L, which conducts the pulp and its admixture of oil and acid or other reagents into the lower portion of the pulp chamber of the tank above the porous medium. Thus the feed coming through the pipe, L, is prevented from entering the space below the porous medium, J, but is allowed to discharge itself through the upturned end of the pipe, and directly into the main chamber of the tank above the porous medium referred to. In practice, the pulp is allowed to run into the tank until the latter is partly filled, the level of the water being variable according to the conditions of the ore and the work to be accomplished.

In the illustration shown, the pipe, L, is fixed directly to and serves to partially support the porous medium and this is effected by providing a spacing sleeve, M, between the bottom of the porous medium and the bottom of the tank, and supplying the upturned end of the feed pipe with locking nuts, N, N′, one engaging the bottom of the tank and the other clamping the upper surface of the porous medium. As before stated, a space, C, is formed between the inner and outer casings of the tank and this space constitutes a gutter or channel which connects with the discharge pipe, O, having a valve, P, which controls the height of the water in the tank by restricting the discharge. In other words, by the regulation of the valve, P, in relation to the amount of feed, any level of pulp in the tank can be maintained. It will be understood that the pipe, O, from the tank leads into a second tank, and through the porous medium therein.

The compressed air is designed to be introduced into the chamber formed below the porous medium and to this end I admit the compressed air through a pipe, Q, having a controlling valve, R. To prevent the air from impinging directly upon the porous medium immediately above the inlet end of the pipe, I place over the discharge end of said pipe, a shield or deflector, S. The air pipe may be otherwise disposed, but in any event its function is to admit into the chamber between the bottom of the porous medium and the bottom of the tank proper a volume of compressed air.

The porous medium may be of any suitable construction and material, through which air can be forced in more or less irregular jets of infinite number and fineness. The character of the porous material is, therefore, unimportant, except that it shall have the property of permitting the air introduced into the pulp chamber to be discharged through the pores of the material throughout the entire surface thereof and throughout the entire surface of the pulp in the chamber above, with the result that immediately upon the introduction of the air into the pulp, a violent agitation or ebullition takes place and froth is observed to rise and form on the surface of the pulp contents, which greatly increases in volume and density as the action proceeds. As the froth accumulates above the surface of the pulp within the tank, it overflows the top rim of the inside cone, E, and continues to do so as long as the tank is supplied with the necessary ingredients of pulp, oil, acid, and compressed air, and the overflowing froth is received into the gutter or annular launder, F, and is finally conducted to a second tank, or a feed box.

During the agitation of the pulp and the formation of the froth the tailings settle into the annular space, C, formed between the tank and the inner and outer casings of the tank thereof and the discharge of these tailings takes place through the discharge pipe, O, and through which pipe particles which are too heavy to float in the first tank and which have settled into the annular space, C, thereof are delivered into a succeeding tank.

Experiments with apparatus of this character indicated trouble because of coarse sands accumulating in the bottom of the tank and which tended to blanket the porous medium, and to some extent, at least, render this medium ineffective for the best results. So long as the pulp was infinitely fine and slimy, the air pressure was ample, and the velocities maintained in the tank were sufficient to discharge everything over the interior casing, B, and into the discharge gutter, C, surrounding the same, but when treating comparatively coarse and sandy material, the air pressure and velocities were found to be too low to raise these coarse sands over into the gutter so that they might be discharged; accordingly, they would gradually accumulate to such an extent as to form a layer or blanket of sand above the porous medium and so prevent the free passage therethrough of the air. The air instead of being distributed over the entire surface of the pulp, would all come up through some small area which might represent a path of least resistance and so, of course, destroy to some extent the action of the air. To meet this objection I found it desirable to maintain the sands in suspension, or in a condition of agitation and ac-

cordingly, in my aforesaid application, Serial Number 806,361, I disclosed and claimed suitable sweep-arms or agitators operating slightly above the porous medium, and which were designed to operate at a slow speed and particularly for the purpose of keeping the coarse sands above referred to in suspension, and thereby preventing their settling on and blanketing the porous medium thus clogging the pores of the latter so as to prevent the free passage of the air into the solution.

The propellers of the former application referred to being designed purely for the purpose of preventing the blanketing of the porous medium, it was only necessary that these propellers should have a peripheral velocity at the tip of the propeller arms of from two to three hundred feet per minute and at this speed there is absolutely no beating of air into the pulp. Consequently the diffusion of the air into the pulp was accomplished purely through the use of compressed air and the action of the porous medium.

In the present application I have shown sweep-arms, T, in the lower portion of the pulp chamber and within the inner vessel, a short distance above the surface of the porous medium, but instead of these being the slow moving sweep-arms of the former application, designed for the purpose of maintaining the upper surface of the porous medium clear of sedimentary deposits I desire that the arms shall be operated at a high speed through a shaft, U, and appropriate gearing, V, say at a velocity at the tip of the arms which shall be as high as 1800 or 2000 feet per minute and at this speed, the function of the sweep-arms is to beat large volumes of air into and out of the pulp. In other words, the porous medium is designed to diffuse the air into the pulp in numerous fine streams distributed substantially throughout the surface of the pulp, and that the sweep-arms in the present instance shall have a two-fold function of maintaining the coarse sands in suspension and thereby keeping them from depositing on the porous medium and blanketing the outlets of the pores thereof, and of diffusing this air throughout the entire body of the pulp, by violently beating the air into the pulp, this being the result of the high speed, to which the sweep-arms in the present instance, are subjected. Because of this violent agitation to which the pulp is subjected, it is desirable to use the baffle-blades, H, which are interposed between the sweep-arms and the upper cone, E, and which baffles are for the purpose of preventing the entire mass of pulp circulating, which it would have the tendency to do because of the high velocity of the sweep-arms, if the blades were not present.

From the foregoing, it will be understood that I employ high speed mechanical propellers operating in proximity to the surface of a porous medium, which latter has the function of splitting up the air into innumerable fine streams and distributing these fine streams over and into substantially the entire surface of the pulp, and that this air substantially immediately upon its delivery into the pulp is caught by the sweep-arms and beaten in large volumes into the body of the pulp, so as to produce a violent agitation or ebullition and the generation of a froth which finally rises and forms on the surface of the pulp and passes over the discharge-cone, E, at the top and into the side launder, in the manner before described.

The present invention, therefore, differs from the invention shown in my former application, Serial Number 806,361, in that the sweep-arms in the present case have the two-fold function of maintaining the surface of the porous medium clean and of engaging the air delivered through the porous medium and beating the same violently and in large volumes into the pulp for the purpose of producing the frothy action before referred to.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In ore concentrating apparatus having a solution-containing tank and a porous medium therein through which fine streams of air under pressure are admitted into the solution from below, a means operating in proximity to the upper surface of said medium for maintaining the heavier constituents of the solution in suspension to thereby prevent the blanketing of the air outlets of said porous medium, said means including a rotary member adapted to beat into the solution the air diffused by the porous medium, and means for rotating said member at a high speed.

2. In ore concentrating apparatus having a solution-containing tank, and a porous body therein, through which streams of air under pressure are delivered into the lower part of the solution, a sweep operating adjacent the upper face of said body for the purpose of maintaining the heavier constituents of the solution in suspension and thereby preventing the blanketing of the air outlets of said porous body, and means for rotating the sweep at a high speed whereby said sweep beats into the solution the air diffused by said porous body.

3. In apparatus of the character described, the combination with a solution-containing tank, a porous body therein and spaced therefrom to form a chamber between itself and the bottom of the tank, and means for admitting an expansible fluid into said

chamber, said porous body adapted to subdivide the fluid and deliver the same in numerous fine streams into the solution contained in the tank, of means operating in proximity to the upper face of the porous body adapted to maintain the heavier constituents of the solution in a state of suspension to prevent the blanketing of the outlets of said body, said means including a rotary member adapted to beat into the solution the air fluid diffused by the porous body, and means for rotating said member at a high speed.

4. In apparatus of the character described, having a solution-containing tank and a porous body therein, through which streams of fluid under pressure are admitted into the solution from below, of means operating in proximity to the upper surface of said body having the combined function of maintaining the heavier constituents of the solution in suspension to prevent the blanketing of the fluid outlets of the body and of beating into the solution the air diffused by said porous body and means for operating said means at high speed.

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

JOHN M. CALLOW.

Witnesses:

T. WALTER FOWLER,

C. W. FOWLER.