

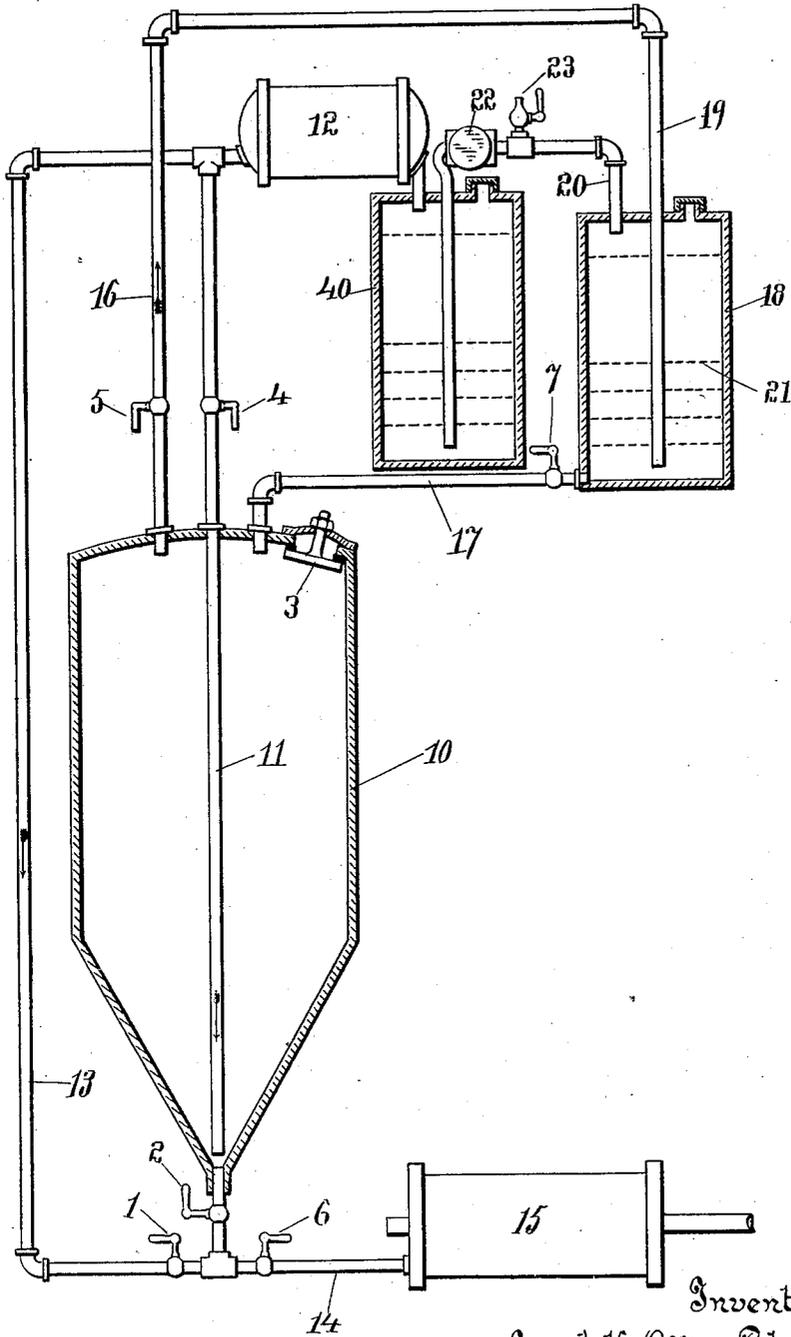
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APPARATUS FOR USE IN METALLURGICAL PROCESSES.

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NO. MODEL.



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APPARATUS FOR USE IN METALLURGICAL PROCESSES.

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To all whom it may concern:

Be it known that we, FRANK H. OFFICER, ROBERT H. OFFICER, JOACHIM H. BURFEIND, and JAMES W. NEILL, citizens of the United States, and residents of Salt Lake City, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Apparatus for Use in Metallurgical Processes, of which the following is a specification.

This invention relates to apparatus for use in metallurgical processes wherein the ore-pulp is agitated in a suitable tank or vat and is then withdrawn from the same for precipitating the metal from the solution or for other purposes.

The invention relates more particularly to the construction of a tank adapted to permit the charge of pulp contained therein to be readily agitated and circulated by the action of a stream or streams of air or gas under pressure; and the invention consists in so constructing the air-conveying pipe or passage as to deliver the air or gas at or near the apex of the cone-shaped bottom of the tank, leaving space around the pipe or gas-delivery passages free, so that the pulp may be circulated in a continuous stream upward through the center and down around the sides of the conical bottom to be again met by the stream of air or gas.

Another feature of our invention relates to the provision of means whereby clogging may be prevented at the outlet provided at the apex of the conical bottom and whereby also the discharge of the contents of the tank to a filter-press or any other receptacle may be facilitated by a siphon or sucking action.

Our invention relates, further, to combinations of apparatus especially suitable for use in metallurgical operations wherein it is desirable to reduce the loss of the solvent used in the treating-tank, to avoid danger to workmen, and to secure other advantages which will be obvious to those skilled in the art from the subjoined description and which are particularly useful in carrying on the operation of treating metals by the cyanid process when the agitation of the pulp is conducted by air or gas under pressure. The apparatus, however, is useful in other metallurgical opera-

tions and in connection with solvents other than the cyanid salts.

In the accompanying drawing is shown in general side elevation and partly vertical section the preferred form or arrangement of apparatus embodying our invention.

10 indicates in outline the treating or dissolving tank or vat, adapted to receive the charge of pulp which is to undergo treatment and which consists of the subdivided ore, tailings, concentrates, slimes, or other metal-bearing substance, together with a suitable liquid embodying in whole or in part the chemical agent or reagent used in the process. The bottom of the tank is conical in form, as shown, and at its apex is provided with a suitable delivery-outlet connected with a pipe through which the pulp may flow to a filter-press 15 or to any other receptacle or tank, as desired.

11 indicates a suitable pipe whose outlet is located at or near the apex and is adapted to deliver a stream or streams of air or gas under pressure directed downwardly or outwardly at the apex, so as to produce a circulation of the pulp upward around the pipe and downward around the sides to the conical bottom in a free and continuous stream, the falling material flowing down the conical sides freely in the space between the pipe and the sides and being met by fresh streams of air or gas, which cause it to rise upward in the center. By this means a continuous circulation and agitation of the pulp is produced and the tendency to channeling which occurs when the air or gas is delivered in a number of fine streams over the whole bottom of a tank is avoided.

12 indicates any suitable receiver or source of air or gas under pressure connected with pipe 11, while 4 is a suitable valve controlling the flow of air or gas from the receiver.

13 is a pipe connected with any source of air or gas under pressure, preferably the receiver 12, and serving to supply air or gas under pressure into the pipe through which the pulp is discharged from the tank. Suitable valves 1, 2, and 6 may be located, as shown, in the passages to control the flow of gas and of pulp. By opening the valves 2 and 6 the pulp is permitted to flow from the tank

to the filter-press or to any other receptacle. By opening the valve 1 at the same time the flow of pulp may be greatly assisted to any desired extent, the air or gas acting as an injector to help to force the pulp through the outlet-pipe by a siphon or sucking action upon the contents of the tank. By closing valve 6 and allowing the air to pass upward through the exit-pipe into the apex of the conical bottom any sediment or clogging at that point may be removed effectually.

The tank 10 is preferably closed at its top and provided with a suitable charge-hole 3, that may be sealed in any proper manner, and also preferably with an air or gas outlet 16, controlled by a valve 5.

18 indicates a suitable absorption-tank to be charged with a solution adapted to take up and recover any valuable gaseous products eliminated during the treating action taking place in the tank 10. Said gas is passed through pipe 16 to the bottom of the tank 18, and escaping there passes up through the contents of the tank and finally passes away through pipe 20 into the atmosphere or into pipes or passages which permit it to be used over again after giving up its valuable ingredients for the purpose of agitating any charge in the tank 10, as will be presently described. When the apparatus is employed in the cyanid process for treating ores, the tank 18 would be charged through a suitable charge-hole with some caustic solution—such as a solution of caustic soda, caustic potash, caustic lime, or any other caustic alkali or alkaline earth adapted to unite with or absorb hydrocyanic acid—and thus produces a soluble or simple cyanid adapted to act as a solvent for gold, silver, or other metal-bearing ore or pulp undergoing treatment in the tank or vat 10. A number of screens 21, provided with small openings, may be placed in the tank 18 to break up the flow of gas and bring about more intimate contact of the same with the solution.

The tank 18 is preferably located at a higher level than the tank 10, so that the solution of cyanid salt generated therein may flow by gravity through pipe 17 to the tank or vat where it is to be employed as a solvent. A suitable valve 7 may be located in the passage or pipe 17 to close the connection while the material is undergoing treatment in the tank 10 and to open said connection and permit the liquid in tank 18 to flow into tank 10 after it has absorbed a sufficient amount of gas.

22 typifies a compressor of any suitable construction which receives the air or gas delivered from the regenerator after it has parted with its valuable constituents and compresses the same into the tank or receiver 12, from which it may be delivered to the treating tank or vat, as already described.

23 is a suitable intake controlled by a valve, as indicated, by which air may be taken directly into the compressor for the purpose of

providing the initial charge of air or gas used in the operation or for the purpose of introducing air, together with the gas received through pipe 20, into the compressor should it be so desired at any time during the operation. Ordinarily the intake 23 is closed, and the operation of the compressor 22 is obviously to produce circulation of the air or other gas or gaseous mixture through the dissolving-tank 10 and absorption-tank 18 in a continuous circulation over and over.

Inasmuch as carbonic acid contained in the air or gas used to agitate the charge in cyaniding a gold or silver ore will always decompose more or less of the solvent for the gold and also in the preliminary treatment of the ore by caustic alkali or alkaline earth will convert part of the caustic to carbonate, and thus render it useless for the purposes for which it was introduced into the charge, it is desirable to have the air used in stirring the charge free from carbonic-acid gas. This can easily and cheaply be effected by placing between the compressor and the treating-tank a vessel similar to the absorption-tank and charging it with a material which will absorb carbonic acid, such as milk of lime, or a solution of a caustic alkali or alkaline earth. The air or gas passing through this will give up its carbonic acid and enter the charge of ore free from this deleterious substance. Such a vessel is indicated in outline at 40.

The arrangement of air or gas pipes 11 and 13 whereby the air or gas under pressure may be introduced into the tank, as hereinafter described, gives us this advantage that by opening the valve 4 the liquid can be stirred or agitated, while by opening the valves 1 and 2 the heavier portions of the charge, which tend to settle into the outlet of the tank leading to the filter-press, may be kept from lodging in said outlet, thus keeping the pipe free, so that when the valve 6 is open the charge will fall readily into the filter-press, and a comparatively-small pressure will be required to effect its movement. This is a very great improvement upon the devices heretofore employed, since if no means be used to keep the outlet free or to dislodge any accumulation in the outlet an air-pressure even as high as two hundred pounds will not serve to dislodge the accumulation of heavier material which may exist at the outlet after the treatment or agitation of it by air through the pipe 11 alone. By this improvement we effectually prevent clogging, thus saving time and annoyance in that part of the operation which involves the removal of the pulp from the treating-tank to the filter-press.

In using this apparatus for recovering metals by the cyanid process, for instance, a solution of the required strength, depending upon the nature of the material to be treated as ascertained by a preliminary test, is introduced into the tank 10 and the ore to be treated is charged into the solution, while the solution is kept agitated by opening valve 4

and, if desired, valves 1 and 2 also, valve 6 being at such time closed. By this means the material as soon as it is introduced into the opening 3 is at once mixed thoroughly with the cyanid solution. The charge-opening 3 is then tightly closed, and the valve 5, which at the preliminary stage should be closed, is then opened, and the air or gas after circulating through the charge is permitted to pass, together with any hydrocyanic acid set free in the solution to the absorption-tank 18 where it comes into contact with the caustic solution and in order to escape has to pass upward through the same and thence is carried by the pipe 20 back to the receiver 12 by the action of the compressor. By this means the hydrocyanic acid freed from the tank 10, and which may exist in a considerable amount when a large amount of air is used for agitation, will be absorbed in the caustic solution, and thus produce the cyanid salt, which is useful as a solvent in the tank 10. By using the air or gas after it has passed through the absorption-tank again for agitating the solution we avoid the action of the carbonic acid and oxygen, whose presence in the air brings about the liberation or freeing of the hydrocyanic gas in the solution, and at the same time recovery of such of the hydrocyanic-acid gas as may be freed in the form in which it may be used again as a solvent. As will be obvious, the expense of this is practically only the cost of the caustic lime, soda, or other material that may be required in the absorption-tank.

While the operation is carried on in this manner, there will be in the dissolving tank or vat a pressure which may be regulated practically by the height of the solution in the absorption-tank, and this pressure will much accelerate the action in the dissolving-tank. The operation having been carried on until the precious metals have been dissolved in the charge, the flow of the air or gas through the solution is stopped by closing valve 5, and valve 6 is opened, so that the pulp may be allowed to flow to the filter-press, carrying the solution containing the precious metal with it, where the solution is freed from the gangue and is then in the usual manner conducted to the precipitating apparatus, after which it may be used again on a fresh charge of material or until it becomes foul or inert. While the pulp is passing to the press its movement may be accelerated, if desired, by allowing the valve 1 to remain partially open. If desired, the valve 1 may be kept closed during the operation of treating the material and only opened in case the tank should become clogged at the outlet or apex or in case there should be an obstruction in the pipe leading to the filter-press through accumulation of the heavy parts of the pulp. In the latter instance the air-pressure let in by the opening of valve 1 may be used to create a suction from the pipe leading to the press, thereby drawing out the obstruction and freeing the pipe. There being then no resistance in the

pipe leading to the filter-press, the air will change the current into the filter-press, drawing with it the pulp and solution from the treating or pressure tank, aided by gravity and the air-pressure in said tank. Thus the pulp and solution are homogeneous and cannot clog. They will enter the filter-press evenly and quickly, making the most desirable homogeneous press-cake for washing. After the charge is in the filter-press the air-pressure may be raised, so as to press out all the solution possible, and then in order to displace the small amount of valuable solution left in the press-cakes water may be forced through them while yet in the press to replace the remainder of the valuable solution, and the cleansing-water may also be carried to the precipitating apparatus, as well understood in the art. The press is then opened and the valueless gangue removed in any desired manner. The solution produced in the tank 18 by the hydrocyanic acid recovered therein may, as occasion requires, be introduced into the tank 10 through pipe 17 or otherwise.

By the use of this apparatus in a cyanid process it is obvious that a valuable solvent may be secured from the hydrocyanic acid released from the tank 10, and also all danger to workmen may be avoided from the hydrocyanic acid set free and which otherwise might be allowed to escape into the atmosphere.

Our apparatus also is useful in other operations in connection with cyanid processes—as, for instance, in the recovery of metals from a spent cyanid solution. In this case the solution would be introduced into the tank 10 and then acidified either by introducing sulfurous-acid gas or by sulfuric acid, after which it would be agitated by the compressed air or gas, said air or gas, with the freed hydrocyanic-acid gas, being passed, as already described, through the absorption-tank. The metal precipitated would be recovered by passing the precipitate and liquid to the filter-press or to any other receptacle in any well-known way.

It will be obvious that the apparatus could be employed in other metallurgical operations, the regenerator-tank operating to recover any valuable constituent freed in the treating-tank and the pipes and connections therefrom serving to return the gas freed from a decomposing element to the compressor for use in agitating fresh volumes or charges in the treating-tank. It is also obvious that in place of the material mentioned as being used in the tank 40 other material might be employed, dependent upon the particular chemical actions or reactions to be carried out, the purpose of this device being merely to free the agitating air or gas of those constituents which would serve to decompose the solution in the treating-tank to no useful purpose.

We claim as our invention—

1. A treating tank or vat for metallurgical

operations having a conical bottom provided at its apex with a suitable discharge-opening connected with a delivery-pipe leading to a filter, in combination with a gas-delivery pipe extending downward centrally through the tank and having its outlet located near the apex of the conical bottom and of such form as to deliver a stream or streams of air or gas under pressure directed downwardly and outwardly at or near the apex, the space between said pipe and conical sides of the tank being free to permit free circulation of the contained pulp from the apex upwardly through the center and down along the conical sides in a continuous stream.

2. A treating tank or vat for metallurgical operations having an outlet-pipe at its bottom, a filter connected to said pipe and adapted to receive the contents of the tank and means for delivering air or gas under pressure into said outlet-pipe between the tank or vat and the filter, as and for the purpose described.

3. A treating tank or vat for metallurgical operations provided at its bottom with a delivery pipe or outlet through which the contents of the tank may be delivered by gravity, a source of air or gas under pressure and a pipe conveying the same to the said delivery-pipe and adapted to deliver a stream of air or gas under pressure into the pipe through which the pulp flows from the tank, as and for the purpose described.

4. In an apparatus for extracting gold, silver and other metals from ore or other materials, the combination substantially as described of a treating-tank, an absorption-tank having a gas or air pipe connection from the air or gas space at the top of the treating-tank and adapted to pass the air or gas into the absorption-tank near the bottom thereof, and a second pipe connected to said tanks and adapted to pass the liquid contents of the absorption-tank back to the treating-tank.

5. In a treating tank or vat for metallurgical operation, the combination with means for delivering a stream of air or gas under pressure downwardly into the material at or near the outlet of the tank, of means for delivering air or gas under pressure upwardly into said outlet, as and for the purpose described.

6. In an apparatus for treating ores or other metal-bearing materials, the combination substantially as described of a treating-tank, a filter-press and an outlet-pipe connecting the treating-tank and filter-press, and means for

delivering air or gas under pressure into said outlet-pipe to assist the flow of the pulp to the filter-press.

7. In an apparatus for treating ores or other materials containing gold or silver or other metals by the cyanid process, the combination substantially as described of a treating-tank, an absorption-tank containing a caustic solution, a compressor and connections as described between the compressor, treating-tank and absorption-tank whereby air or gas under pressure may be forced from the compressor through the material in the treating-tank and the gases released or freed from said material may be passed through the absorbing solution in the regenerator-tank and thence to the compressor so as to permit the air to be used over and over and the valuable products released in the treating-tank to be recovered, as and for the purpose described.

8. The combination substantially as described of the treating-tank adapted to contain the pulp and permit the same to be agitated by air or gas under pressure, an absorption-tank containing material adapted to absorb the gas liberated and carried off by the air or gas used in the treating-tank, a gas-pipe leading from the gas-space at the top of the treating-tank and down through the solution in the absorption-tank so as to deliver the air or gas below the level of the contents of said absorption-tank, a pipe or connection between said tanks whereby the solution may be conveyed from the absorption-tank to the treating-tank, and a valve in the latter pipe adapted to close the connection during the operation of treating the material in the treating-tank.

Signed at Salt Lake City, in the county of Salt Lake and State of Utah, this 9th day of December, A. D. 1901.

FRANK H. OFFICER.

ROBERT H. OFFICER.

JOACHIM H. BURFEIND.

Witnesses as to the signatures of Frank H. Officer, Robert H. Officer, and Joachim H. Burfeind:

FRANK CROCKER,

W. A. BLACK.

Signed at New York city, in the county of New York and State of New York, this 13th day of December, A. D. 1901.

JAMES W. NEILL.

Witnesses as to the signature of James W. Neill:

A. R. DONLON,

HENRY STEIN.