United States Patent Office 3,142,478 Patented July 28, 1964

3,142,478

MIXING APPARATUS AND METHOD

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Filed Jan. 30, 1959, Ser. No. 790,221
22 Claims. (Cl. 259—114)

The present invention relates to metallurgical processes, and particularly to a new and improved method of, and apparatus for resuspending within a liquid, finely divided, small particles that have settled from a slurry of said particles and liquid.

In certain metallurgical recovery processes, slurries made up of water and suspended particles of ore must be handled. As an example, a serious problem arises in the handling of nickel sulfide slurries which are produced at the point of mining and which must be transported great distances, often overseas, to processing plants where the initial step in the metallurgical recovery process requires the nickel sulfide particles to be suspended within water in the form of the slurry produced at the site of the original mining.

Many attempts have been made in an effort to overcome this problem, but with substantially no success. The power required to maintain the sulfide particles in suspension is exorbitant, amounting to something like 3 H.P. per 1,000 gallons of slurry. When it is considered that quantities of upwards of 300,000 gallons comprise a normal quantity for shipment, it becomes apparent that the power to maintain the slurry agitated would be prohibitive. Moreover, the large sizes of tanks required for economically handling the quantities of slurry involved create serious mechanical problems in the design of agitating equipment of the required dimensions and power output.

Permitting the slurry to remain unagitated during storage and en route with an idle agitator within the containers causes embedding of the particles around the agitator blade in such fashion as to make it practically impossible to restart the agitator blade when it is desired to cause resuspension of the particles within the liquid of the slurry.

Filtering the slurry, drying and packaging the precipitate involve an excessive amount of equipment, labor and loss of valuable materials within the slurry. Furthermore, upon arrival at the processing plant, the dry precipitate must be resuspended in water prior to the recovery processing thereof.

The principal object of this invention is to provide a method of, and an apparatus for delivering to a distant point a slurry of finely divided particles suspended within a liquid.

Another object of this invention is to provide such a method and apparatus that will entail a minimum of power requirements.

Another object of this invention is to provide an apparatus for accomplishing the desired results that will permit the solids settling out of the slurry and still require less power to resuspend them than would be required to maintain the slurry agitated to prevent such settling out of the particles.

Another object of this invention is to provide such an apparatus including a portable agitating assembly capable of being locked over a tank or container of slurry from which finely divided particles have settled, and a control system therefor that will cause the agitator of the assembly to progressively resuspend controlled quantities of the precipitated particles into the liquid thereabove.

Another object of this invention is to provide a design of agitating apparatus which is suitable for heavy-duty service in tanks of large diameter and depth requiring

large diameter impellers, heavy rotating torque to supply large horsepowers at slow speeds, and long axial movement of impeller.

Another object of this invention is to provide such an agitating apparatus which is latched in its upper position when not being used, and is incapable of being released until supported by hydraulic means.

It has been found that the top layer of settled particles of a cake of precipitated nickel sulfide or the like can be resuspended in the liquid from which the particles have settled, by agitating the portion of said liquid in contact with the top layer of settled particles. Then by progressively and in a controlled manner lowering the agitator blade or paddle, successive layers of such particles can be resuspended in the liquid until the entire mass is returned to its initial slurry condition.

In one aspect of the invention, a portable, structural steel supporting bridge may be formed in a manner to be mounted in position over a tank or container containing the slurry from which the solids have settled out into a cake of solids. The bridge structure may support driving motor means, which may be a plurality of symmetrically spaced motors, adapted to drive, through gear reduction units, a common ring gear that may be fixed to a main driving quill. In one form, motors may be diametrically spaced. The quill may be journaled in anti-friction bearings within a centrally disposed, hollow, cylindrical housing forming part of the bridge structure. The quill may include an elongated, split, cylindrical driving member having internal spline-like recesses for receiving shoe-like members on the periphery of an elongated, hollow cylinder that is adapted to be rotated by the quill and capable of axial movement. The lower end of the cylinder may be axially aligned with, and fixed to a shaft, on the lower end of which may be mounted a radial paddle or agitating blade. The upper end of the cylinder may be closed by a stuffing box through which may extend a rotatable but axially fixed, hollow, tubular piston rod which may be fixed at its upper end to a mounting flange that is in turn fixed to the split cylindrical driving member.

The lower end of the hollow, tubular piston rod may support a piston within the cylinder, and a hollow tube may extend from the bottom of the piston upwardly and concentrically with the hollow piston rod, providing an annular space therebetween. This tube may extend to the top of the piston rod and both its top end and that of the piston rod may be connected to a manifold mounted on, and rotatable with the mounting flange connected to the split cylindrical member of the driving quill. The manifold may be supplied with liquid under pressure from a hydraulic system through a revolving joint similar to the type known commercially as a "Barco Revolving Joint."

In another aspect of the invention, a latching device may be mounted on, and rotatable with the split cylindrical driving member and cooperable with a ratchet element fixed to the top of the hollow, rotatable, axially movable cylinder. The latching means may be operated hydraulically, and so connected into the hydraulic system for reciprocating the cylinder and paddle that it will not be released until the pressure in the hydraulic system is sufficient to support thhe weight of the paddle and its driving structure.

In still another aspect of the invention, the hydraulic system may include means for supplying pressure liquid to the annular space between the hollow, cylindrical piston rod and the concentrically disposed tube extending therethrough, from which annular space it may exit to the space above the piston within the rotatable, axially movable cylinder, or through the concentric tube to the space below the piston within said cylinder. A flow control valve may be provided in the hydraulic system for varying