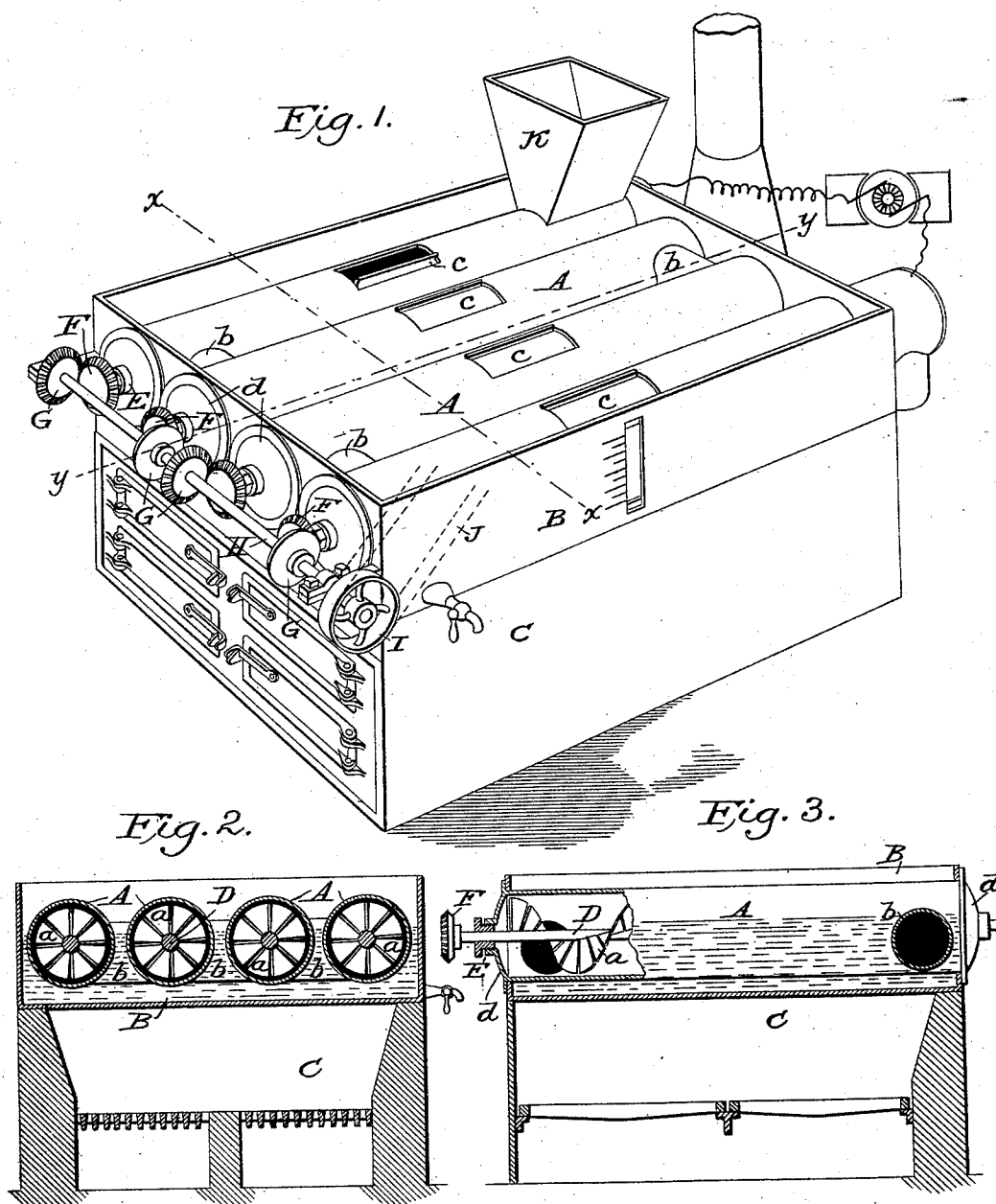


(No Model.)

H. CALHOUN & A. M. BEAM.
AMALGAMATOR.

No. 489,216.

Patented Jan. 3, 1893.



Witnesses:

James F. Duhamel.
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UNITED STATES PATENT OFFICE.

HUGH CALHOUN, OF HOT SPRINGS, AND ARON. M. BEAM, OF BEAR, ASSIGNORS
OF ONE-THIRD TO PROSPER H. ELLSWORTH, OF HOT SPRINGS, ARKANSAS.

AMALGAMATOR.

SPECIFICATION forming part of Letters Patent No. 489,216, dated January 3, 1893.

Application filed June 30, 1891. Serial No. 397,995. (No model.)

To all whom it may concern:

Be it known that we, HUGH CALHOUN, residing at Hot Springs, in the county of Garland, and ARON. M. BEAM, residing at Bear, in the county of Montgomery, State of Arkansas, citizens of the United States, have invented certain new and useful Improvements in Amalgamators, of which the following is a specification.

This invention relates to amalgamating machinery for use in the treatment of gold and silver ores, and is more especially designed for use in carrying out the process of treating ores set forth in an application filed in the joint names of Hugh Calhoun and Aron Beam, on the 1st day of April 1891, designated by Serial No. 387,275. Although especially designed for such use, the apparatus is susceptible of general application to amalgamating processes, and will be found particularly efficient in the treatment of "dry ores," or those containing no base metals in quantity sufficient to form a flux.

In the annexed drawings, Figure 1 is a perspective view of the improved apparatus; and Figs. 2 and 3 respectively, transverse and longitudinal vertical sections through the same.

The apparatus consists essentially of a series of cylinders A, of wrought iron, cast iron, or other suitable material, connected alternately at opposite ends,—a tank or vessel B in which said cylinders are mounted; and a furnace, C, beneath the tank or vessel to heat the water with which it is supplied when the apparatus is in use.

Within each cylinder A there is arranged an axial shaft D, the ends of which are carried through stuffing boxes or glands E, and each of which is furnished with a gear wheel F, or equivalent means of rotation. In practice bevel gears are preferred, and these receive motion from similar gears, G, carried by a shaft H, bearing a band pulley I, and receiving motion from any convenient source, through a belt J. It is, however, apparent that any other means of rotating the shafts D may be adopted. Each shaft is armed with a series of blades or paddles *a*, projecting radi-

ally therefrom or substantially so,—the blades being arranged in spiral order about the shafts so as to constitute in each case a spiral conveyor.

The dimensions of the blades or paddles may vary, and their faces may be set more or less oblique to their respective planes of rotation,—these matters depending somewhat upon the size of the ore particles,—the condition in which the ore is delivered to the amalgamator, and like considerations. They should travel quite close to the inner faces or walls of the cylinder, which latter are stationary and serve only as receptacles or containers for the ore, the agitation and working thereof being wholly performed by the blades or paddles. It is, however, practicable to rotate both the cylinders and the shafts, or even the cylinders alone, but this is not deemed advantageous. The spirals of the shafts may be alternated in direction, or the shafts may be made to rotate to the right and left, alternately, to cause the material to traverse the cylinders in series, and to pass from each to the next through the large connecting pipes or trunks *b*, which as stated are placed alternately at opposite ends, as shown in Fig. 1. At the receiving end of the first cylinder of the series there is arranged a feed hopper, K, through which the ore and the quicksilver are both introduced. At or near the midlength of each cylinder, and at other points if deemed advisable, are sight doors *c*, to permit inspection of the batch from time to time.

The furnace or heater C may be of any convenient construction, the ordinary fire-box, grate-bars, ash-pit, and doors being represented in the drawings.

L indicates an electric generator or source of electrical energy, by which term it is meant to include any and all known forms of generator, whether galvanic, voltaic, dynamic or other, the ordinary dynamo being, however, preferred by reason of its convenience, economy, and efficiency. The brushes of the dynamo, or the binding posts of the generator are respectively connected with the receiving and delivery ends of the first and last cylinders

A, and the commutator is of such construction as to deliver a current continuous as to direction, but broken or intermittent as to duration. In other words, what is commonly termed a "continuous current," is converted into a series of rapidly recurring pulsations or shocks,—so rapid or closely succeeding as to be imperceptible to the senses though existing in fact. To render the current efficacious and prevent its being short circuited it is of course necessary that the cylinders be thoroughly insulated from the tank, or that the latter be made of non-conducting material,—and similar protection is to be made against short-circuiting through shaft H.

The apparatus is not dependent for its successful operation, upon the employment of electricity, but its action is materially improved thereby. The interruption of the current is found to be quite important.

When using the apparatus, the tank or vessel B is supplied with water to a depth sufficient to about two-thirds cover the cylinders A, and fire is started in the furnace and kept up to maintain the water at or near the boiling point,—the heat thereby imparted to the contents of the cylinders being thus kept quite uniform; and serving to quicken and enhance the action of the quicksilver. The ores, particularly if of the character mentioned, are preferably reduced to comparatively fine condition and roasted at a heat not exceeding 1200° or thereabout, (Fahrenheit) in the presence of muriate of ammonia and carbon; but if not subjected to this chlorination, and if of a refractory character, should have mingled with them, per ton of ore, oxalic acid four pounds; caustic soda four pounds; sal ammoniac four pounds,—and common salt five pounds. The batch being thus prepared is delivered to the hopper K and thence to the cylinders, in as stiff a condition as it is practicable to handle it in,—and the mercury is run in with the ore. The blades or paddles turn the ore over and over,—press it, and move it along through the cylinders, until it is finally discharged at the rear end of the last one of the series, or through an intermediate outlet at any suitable point: The action of the blades or paddles though easy and gentle, and closely resembling hand treatment, is peculiarly efficacious, especially with slimy ores,—pressing the gold or silver out of the enveloping slime, and exposing it to the quicksilver, which promptly takes it up.

The action of the electric current materially expedites and improves the work, particularly with certain classes of ores, but its use is not essential.

The number, size, and arrangement of cylinders may be varied, though it is deemed advantageous to use two or more, and to make them of or about eight inches diameter, and

ten feet in length,—with removable heads to facilitate repair, or access to the interior.

It is found advisable to employ a current of from sixteen to eighteen volts, and of about thirty five ampères, and to break the same about two thousand five hundred times per minute, which may readily be accomplished by leaving proper spaces between the conducting strips of the commutator cylinder,—or by means of an intermediate current breaker between the generator and the amalgamator. It is also found advantageous to employ a conductor of large capacity from the generator to the amalgamator, and one of comparatively small capacity for the return from the amalgamator to the commutator, as by this plan the electricity passes freely to the ore or charge and there acts efficaciously,—the ore apparently serving or acting as a condenser,—while the comparatively small conducting capacity of the return line tends to more effectually hold the electric current back and cause it to permeate the entire mass of ore. Whether this be or be not the correct theory of action, practice demonstrates that it is highly advantageous both to interrupt the current and to employ a return conductor relatively smaller than the supply conductor. The electric current thus applied, both aids or effects chlorination, and aggregates the gold in the pure metallic state, removing the coating which otherwise would prevent the mercury from acting upon and taking up the particles. The current seems also to increase the affinity of the mercury for the gold and silver; and for these several reasons we deem it very important to employ it. The mercury should be thoroughly commingled with and distributed through the mass of ore, and the pulp should be brought to proper consistency before it is introduced into the amalgamator. After the ore leaves the amalgamator it should be passed into a settler, of any convenient type, to give the mercury time to settle, using hot water in the settler and drawing off the pulp in the ordinary way.

Ore which has been previously chlorinated may be treated in the amalgamator without fear of contaminating the mercury with lead, for the reason that in the chlorinating operation the lead becomes blackened or oxidized, the coating thus formed preventing the mercury from acting upon the lead. The electric current seems also to retard or prevent the action of the mercury upon the lead.

The invention being thus described, what is claimed is:

1. In combination with an amalgamating vessel, an electric generator connected therewith and adapted to deliver an interrupted current of constant direction.

2. The herein-described amalgamating ap-

paratus, consisting of connected cylinders A provided with spirally-bladed axial shafts; tank B, furnace C, electric generator L, all combined and operating substantially as set forth.

3. The method of amalgamation herein set forth, which consists in mingling with the pulp a proper quantity of mercury and stirring the mass in a suitable receptacle subject to the heat of a water bath, and to the

action of an interrupted current of electricity of constant direction.

In witness whereof we hereunto set our hands in the presence of two witnesses.

HUGH CALHOUN.
ARON. M. BEAM.

Witnesses:

E. C. BEAM,
J. A. BENNETT.