2 Sheets—Sheet 1.

C. E. BALL.

Processes and Apparatus for Amalgamating Ores.

No. 212,644. **Patented Feb. 25, 1879.**

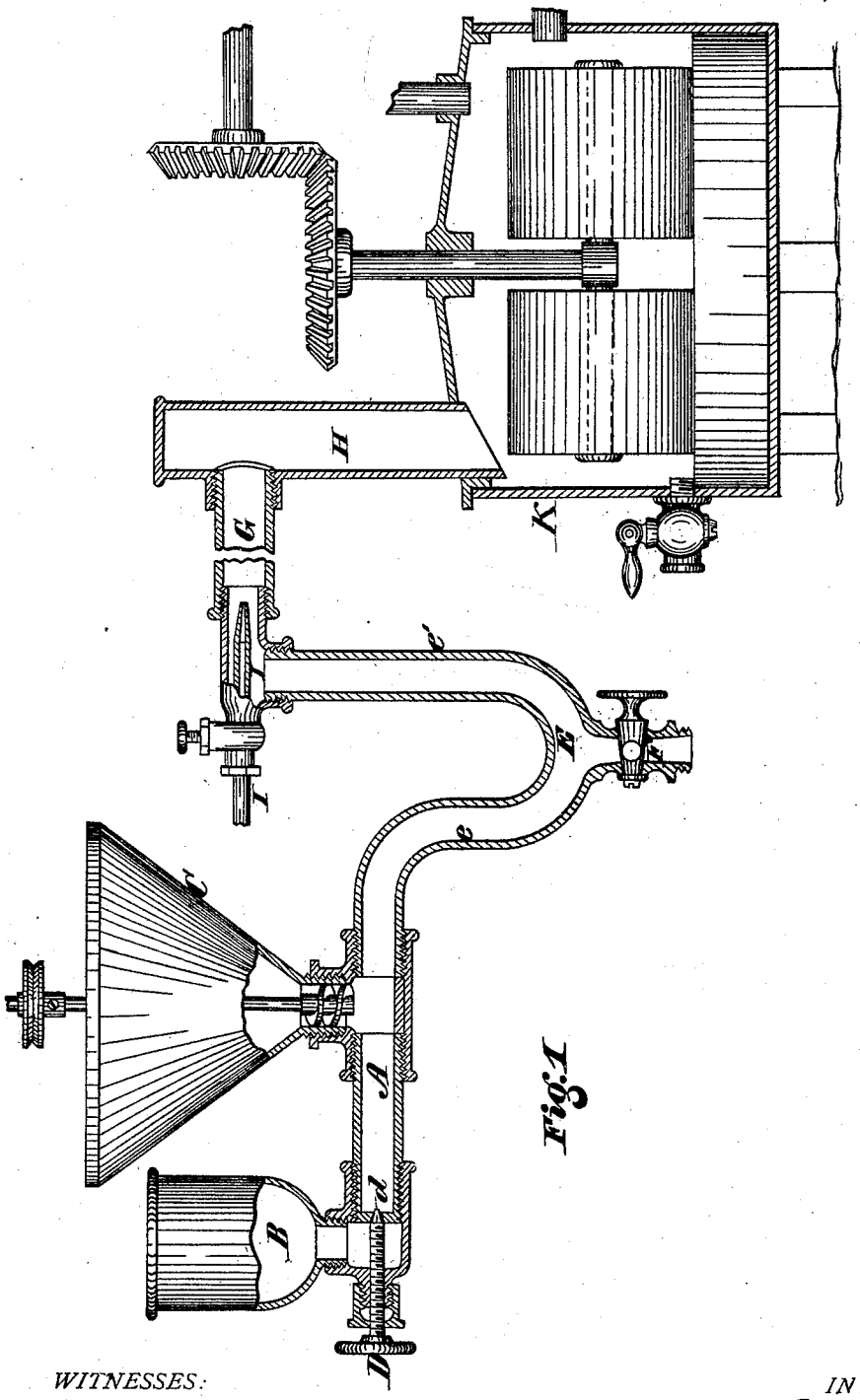

Fig. 1.

WITNESSES:

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J. B. Connolly

INVENTOR,

Charles E. Ball,

By Connolly Bros, ATTORNEY

2 Sheets—Sheet 2.

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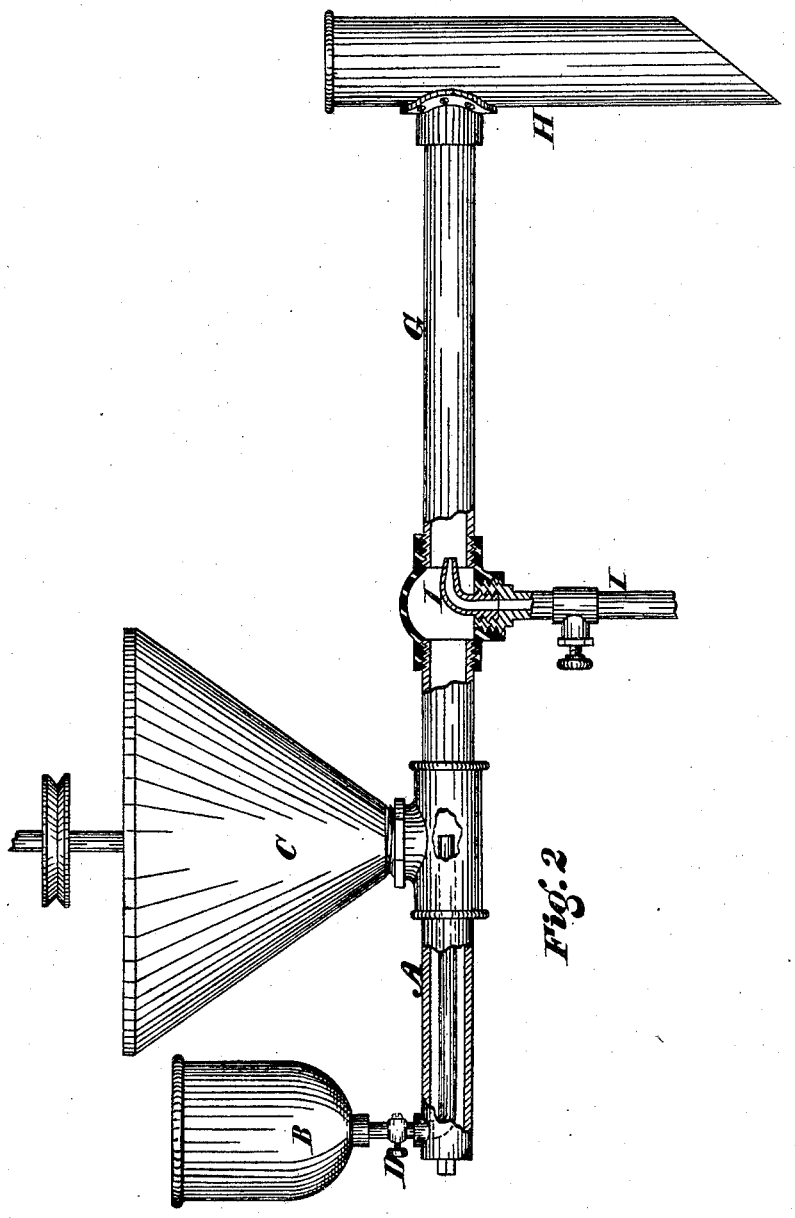

Fig. 2

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UNITED STATES PATENT OFFICE.

CHARLES E. BALL, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN PROCESSES AND APPARATUS FOR AMALGAMATING ORES.

Specification forming part of Letters Patent No. **212,644**, dated February 25, 1879; application filed April 19, 1878.

To all whom it may concern:

Be it known that I, CHARLES E. BALL, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Methods or Processes and Apparatus for Amalgamating Ores; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification, in which—

Figure 1 is a longitudinal side elevation of my improved apparatus, partly in section. Fig. 2 is a similar view of a modification.

My invention has relation to that class of amalgamators in which a stream of ore and mercury are caused to travel together through a tube or cylinder, in which the union or combination of the metallic elements is produced.

My improvements have reference to the process of effecting the amalgamation; and consist, in the first place, in effecting said process under exhaust instead of under direct artificial pressure, as heretofore.

My improvements further relate to a method of perfecting or completing the partial amalgamation effected in the metals while traveling together; and, in this connection, consist in causing the partially-amalgamated ore to pass through a body of mercury, entering said body from below, and passing out above before emerging from the amalgamating-chamber to the washer.

My invention still further consists in the combination, construction, and arrangement of parts for carrying my said process or method of amalgamation into effect.

I shall first proceed to describe the mechanical construction of the apparatus which I employ for my invention, and which constitutes a part thereof, and then set forth wherein my improved method or process of amalgamation consists.

Referring to the accompanying drawings, A constitutes the amalgamating-chamber, consisting of a tube or cylinder. B and C are, respectively, a mercury-holder and ore-hopper, fitted on and having open communication with said chamber. D is a valve, having a seat at *d*, whereby communication with the mercury-cup may be closed under conditions hereinafter set forth.

The tube A may be bent to form or connected with the U-shaped curved pipe E, which is but a continuation of said tube A and an integral part of the amalgamating-chamber.

F is a bib-cock or outlet at the lower part of the bend E. G represents another pipe, connected to the pipe E, and forming an extension thereof. Said pipes or tubes A E G constitute, in effect, a single pipe or continuous chamber and compose the amalgamating-chamber.

An unbroken pipe, having the bends described and illustrated, would accomplish the same purpose; but for facility of construction, &c., I prefer to make the amalgamating-chamber in three sections—two straight ones, A G, and one curved one, E.

In this connection I would remark that the leg *e* of the section E, adjacent to the section A, is shorter than the leg *e'*, next to the section G.

H is a vertical pipe leading from the end of the amalgamating-chamber to the washer. I is a steam-nozzle, introduced into the section G at or about the junction of the latter with the section E. Said nozzle points toward the discharge-tube H, so as to create, by the admission of steam, an exhaust in the sections A E and suction in the mercury-holder and ore-hopper.

The operation is substantially as follows: The valve D being closed, mercury is poured into the holder B, and the hopper C filled with ore, which may be either wet or dry, preferably the former—that is to say, in a semi-fluid condition. The valve D being now opened and steam introduced through the nozzle I, a rarefaction or exhaust is produced in the chamber A E, and a suction on the ore and mercury. Said ore and mercury are thus drawn through the tube A and down the leg *e* of the section E, the amalgamation (such as may be effected under the circumstances) taking place as the particles travel together. After pass-

ing the lower bend of the section E the mercury or amalgam and the earthy matter and water part company. The mercury, upon a well-known principle, owing to its great gravity, will rise, at the farthest, but thirty inches in a tube under the influence of atmospheric pressure, or under the exhaust produced by suction, and hence will not complete the ascent of the leg *e'*, which is of greater length or depth than thirty inches. The earthy matter or ore, deprived of its mineral, and the water (if any) in such earthy matter, being many times lighter than the mercury, and being free to detach itself from the latter, will ascend the leg *e'*, pass into the section G, and be blown off into the tube H and collected in a washer, K, where any of the amalgam which, owing to its finely-divided condition, may have been carried off with such ore, will be collected and recovered. After the operation has proceeded for a sufficient time the mercury or amalgam retained in the leg *e'* will form a fluid plug or bath, through which all the ore or earthy matter will have to pass, thereby insuring the most thorough and complete amalgamation of the metals contained therein, and which may have escaped amalgamation in the transit through the tube A.

If desired, the travel of the mercury and ore together through the tube A may be dispensed with, the mercury being first permitted to flow through the pipes A E until it has risen to a depth of, say, ten inches in the latter, the valve D being subsequently closed, ore fed into the hopper C, and steam admitted through the nozzle I. This causes the ore to travel alone through the pipe A, passing through the body of mercury held in the section E, where the amalgamation is effected, the metal of such ore remaining, as already suggested, in such body of mercury, while the earthy matter is drawn through the latter and blown into the washer.

In a modification illustrated in Fig. 2, the curved section E is dispensed with, the steam-nozzle I being located at the junction of the tubes A G. In this case the ore and mercury are caused to travel together until they fall into the washer, the amalgam as well as the earthy matter descending through the pipe H.

When the bent section E is used, the mercury or amalgam, as it collects in excess of the quantity required to form the plug or suspended bath in the leg *e'*, may be drawn off from time to time through the cock or outlet F.

I would here remark that while I have suggested a steam-nozzle for producing a draft or suction, I do not confine myself to that device, but may use any other known equivalent appliance—as, for example, a pump—for producing the same result. Furthermore, where the term "exhaust" is employed, I do not wish to be understood as asserting that a complete exhaust will be produced, but only such partial exhaust as can be obtained by the means and in the treatment of the materials suggested.

The advantages of these improvements are briefly as follows: I have discovered that the process of amalgamation will be better effected under exhaust than when conducted in the open air or under artificial pressure—a result which is probably owing to the temperature incident to the production of rarefaction, which temperature is that, or about that, at which amalgamation, whatever process is employed, is best effected.

By effecting the amalgamation under an exhaust, I also avoid all danger of vaporizing the mercury—a danger which might be incurred by the employment of steam at a high pressure and temperature—such vaporization preventing amalgamation until condensation of the mercury could be effected. Again, as the amalgamation which takes place in the tube or chamber while the ore and mercury are traveling together at a high rate of speed or with great velocity is only partial, I effect a great improvement by collecting the mercury in the curved section of the amalgamating-chamber, where it is retained and used as a bath, through which all the ore or earthy matter is compelled to pass, and where any metal which may previously have escaped amalgamation is completely amalgamated.

A still further advantage is, that in this curved section I am enabled to separate the amalgam from the earthy matter, and hence such amalgam does not pass to the washer. In other words, in the one chamber and continuously I not only produce a perfect amalgamation, but also separate the amalgam produced in said chamber from the earthy matter, leaving the latter alone or with a mere trace of the amalgam to be carried off to the washer.

What I claim as my invention is—

1. The method or process of amalgamation herein described, consisting in mingling mercury and ore traveling together in a chamber or tube under exhaust, substantially as set forth.

2. The method or process of amalgamation herein described, consisting in mingling the mercury and ore in a chamber or tube under exhaust while the amalgam is detained in said chamber, and causing the ore to be drawn by suction through such detained amalgam, substantially as set forth.

3. The method herein described for effecting amalgamation, by drawing ores through a body of mercury held in suspension by means of suction exerted above said body of mercury, the ore being admitted on the under side of said body on the side opposite to that on which the suction is produced, substantially as set forth.

4. The combination, with a chamber or tube, A, mercury-holder B, and ore-hopper C, of a steam-nozzle, I, or equivalent exhaust appa-

ratus, located between said hopper and the discharge end of said tube or chamber A, substantially as set forth.

5. The amalgamating apparatus herein described, consisting of chambers composed of tubes A E G, mercury-holder B, ore-hopper C, and steam-nozzle or suction appliance I, arranged and operating substantially as shown and described.

In testimony that I claim the foregoing I have hereunto set my hand this 15th day of April, 1878.

CHAS. E. BALL.

Witnesses:
M. D. CONNOLLY,
CHAS. F. VAN HORN.

2,000 words.