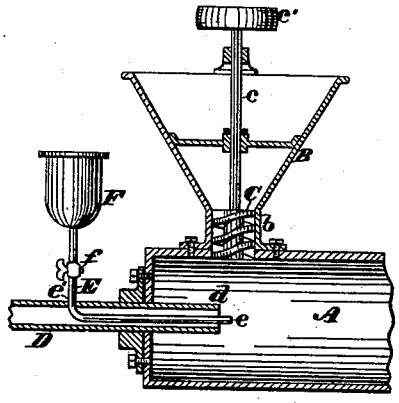
T. A. D. FORSTER & G. J. FIRMIN.

Process and Apparatus for Amalgamating Ores.

No. 196,212. Patented Oct. 16, 1877.



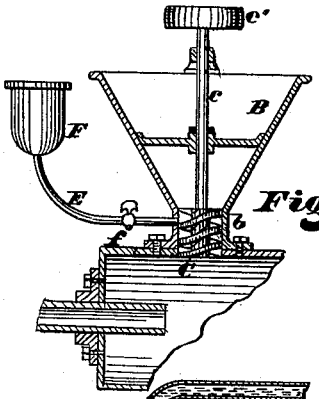


Fig. 2.

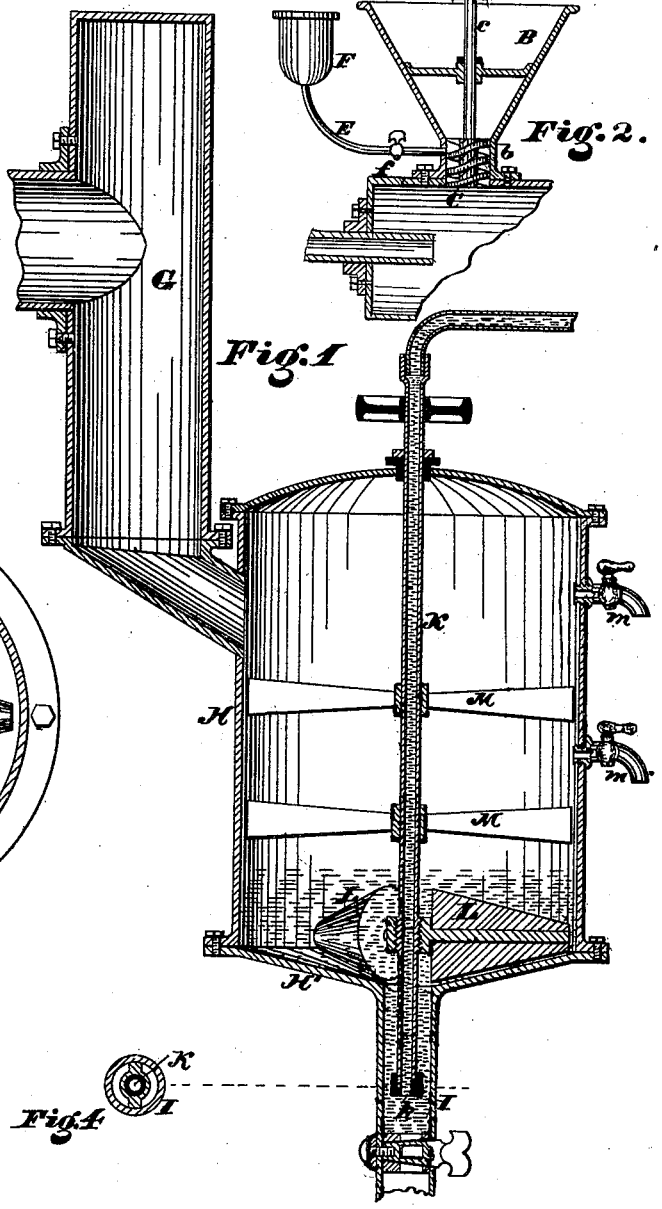


Fig. 1

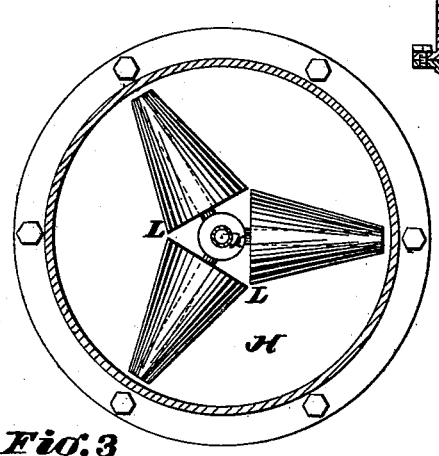


Fig. 3

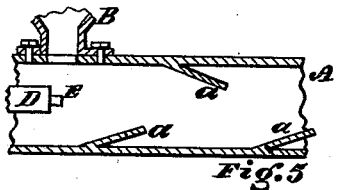


Fig. 5

Fig. 4

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UNITED STATES PATENT OFFICE.

THOMAS A. D. FORSTER AND GEORGE J. FIRMIN, OF NORRISTOWN, PA.

IMPROVEMENT IN PROCESSES AND APPARATUS FOR AMALGAMATING ORES.

Specification forming part of Letters Patent No. **196,212**, dated October 16, 1877; application filed June 1, 1876.

To all whom it may concern:

Be it known that we, THOMAS A. D. FORSTER and GEORGE J. FIRMIN, of Norristown, in the county of Montgomery and State of Pennsylvania, have invented certain new and useful Improvements in Processes and Apparatus for Amalgamating Metals, and machines for washing ores; and we 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 vertical longitudinal section. Fig. 2 is a vertical section of a modification. Fig. 3 is a horizontal transverse section of washing-machine. Fig. 4 is a cross-section of well. Fig. 5 is a vertical longitudinal section, showing deflecting-plates in cylinder.

The object of our invention is to provide an improved process of amalgamating metals, and novel machinery for conducting said process.

A further object of our invention is to provide an apparatus of peculiar construction and operation for washing the ore after amalgamation has been effected.

Our invention accordingly consists of a new process for amalgamating metals, and of peculiarly-constructed and combined apparatus for effecting said process, and for washing the ore after amalgamation has been produced.

In carrying our invention into effect we take ore which has been finely pulverized and feed it through a hopper, preferably provided with a screw, into a horizontally-arranged cylindrical vessel, into which a jet of steam or air enters from the end, said jet forming with the falling ore a current resembling a sand-blast. A vessel of mercury, located above the steam or air pipe, is connected with the latter by a branch pipe, in such manner that the mercurial contents of said vessel will be drawn in by the steam or air current, and forcibly projected into and through the descending ore in the cylinder. This projection of the mercury has the effect of thoroughly atomizing it, mingling it with the fine ore, and causing amalgamation to be effected before the combined mass or blast reaches the other end of the cylinder. The ore and amalgamated metals pass from said cylinder into a washer consisting of a tank with a hollow vertical shaft, on the lower extremity of which are secured conical rollers arranged to move over the inclined bottom of said tank. The hollow shaft conducts water to a point below the bottom of the tank, consisting of an enlarged pipe provided with a stop cock or valve, whence it surges up beneath and between the rollers, filling the tank to any desired extent, two or more bib-cocks being provided at various altitudes, by which the depth of water is graduated.

The vertical shaft is provided with wings or beaters, by which the contents of the tank are kept agitated, the quartz or earthy matter being carried off through the bib-cock then opened, while the amalgamated metals are drawn off separately from time to time through the opening or valve in the well at the bottom of the tank.

Referring to the accompanying drawings, A designates a cylindrical vessel—say, six feet long and two inches in diameter. B is a hopper, connected with the cylinder A by means of a neck, *b*, within which is located a feed-screw, C, rotated by means of a belt and pulley, *c'*, on its shaft *c*. D is a pipe for conveying steam or air to the cylinder A, advanced into the latter until it comes to, or about to, a point directly beneath the center of the hopper-neck *b*, and connected at its other extremity with a steam-generator, fan-blower, or other device for producing a current of steam or air. E is another pipe, located partially within the pipe D, its nozzle or delivery end *e* projecting into the cylinder A slightly beyond the nozzle or delivery end *d* of the pipe D. Said pipe E passes through the pipe D, as shown at *e'*, and communicates with a mercury-cup, F, as shown. The relative sizes or diameters of the pipes D and E for a cylinder six feet long and two inches diameter should be, say, one-half and one-eighth of an inch. The diameter of the throat *b* with said cylinder should be about two inches.

The operation is as follows: Ore being placed in the hopper B, and the feed-screw set in motion, the cock *f* is opened, permitting mercury to flow through the pipe E. At the same time, steam, air, or any other equivalent medium sufficient to produce a strong current, is admit-

ted, under pressure, through the pipe D, carrying forward the mercury, which it atomizes, to the stream of finely-pulverized ore falling from the hopper. The falling ore is also taken up by the steam or air current and projected, in the form of a sand-blast, to the other end of the cylinder A. During the passage of the ore and mercury through the cylinder A, an intimate connection of the particles or atoms takes place, so that by the time said journey has been performed a perfect amalgamation of the metals is effected.

The amalgamated metals and ore then fall through the passage way or duct G into the washer, the construction of which we shall now proceed to describe, remarking, however, that, by the modification shown in Fig. 2, the pipe leading from the mercury-cup may pass into the neck *b*, so that the mercury and ore may be fed into the cylinder A together, instead of having the former enter through the pipe D, as shown in Fig. 1.

H represents a tank formed with a conical bottom, H′, the apex of which terminates in a well, formed of a short pipe, I, having a valve or opening by which, when necessary, said well may be relieved of its contents.

K is a hollow vertical shaft stepped in or above said well, in such manner that water admitted by it will freely pass into the latter. L L are conical rollers arranged to be moved over the bottom H′ by said shaft K, and M M are wings or beaters fitted on said shaft for agitating the contents of the tank H. *m m* are bib-cocks at various altitudes on the tank H.

The mass dropping through the duct G falls into the water in the tank H, which is kept as high as one of the bib-cocks *m m*, said water entering through the shaft K at the point *k*, and surging up beneath and between the rollers L L over the conical bottom H′.

The quartz, deprived of its metals, and the earthy matter therewith, are carried off through the bib-cocks *m m*, (either or both,) one of which is always kept open, while the amalgamated metals sink into the well I, whence they are drawn off from time to time, and the mercury then recovered.

When the mercury-pipe enters, as shown in Fig. 1, it must project beyond the pipe D, as in said figure shown, otherwise its contents would not flow out; and it is necessary that the said pipe D should come about as far as the center of the hopper B, or at least within the circumference of the neck *b*, in order to avoid a steam or air pressure in said neck, which would prevent the ore from entering the cylinder A. The too speedy progress of the blast through the cylinder may be prevented by reflecting-plates *a a*.

What we claim as our invention is—

1. The process of amalgamating metals by projecting mercury into or against a stream of pulverized ore by means of a current of steam or air under pressure, substantially as described.

2. The method of amalgamating metals by a continuous process or operation, consisting in feeding the ore, in a pulverized condition, into a vessel or receiver, where, in the act of falling, it is impinged upon by a current of steam or air, which carries said ore, in the form of a blast, through said cylinder, mercury being at the same time carried along, and producing amalgamation without cessation of the feed, substantially as set forth.

3. The combination of cylinder A, hopper or feeding device B, steam or air pipe D, and mercury-pipe E, the said parts being relatively so arranged that, when the ore, mercury, and steam or air are admitted to the several parts, a blast will be created, and the material carried to or toward the delivery-duct G, as set forth.

4. In combination with the steam or air pipe D, pipe A, and hopper B, the mercury-pipe E, said last-mentioned pipe projecting beyond the delivery end of the other, as and for the purpose set forth.

5. In combination with the cylinder A, hopper B, vessel H, and steam and mercury pipes D E, the duct G, affording an unimpeded passage for the blast after amalgamation, and serving to render the process continuous, as set forth.

6. The washer herein described, consisting of a vessel, H, having conical bottom H′, hollow shaft K, rollers L L, wings M M, well I, and bib-cocks *m m*, the several parts being constructed and combined for operation substantially as shown and described.

7. The continuous process of amalgamation, consisting in admitting the pulverized ore and mercury into a vessel, wherein they are impinged upon by a current of steam or air, which promotes rapid and thorough amalgamation, and forces the ore and mercury together into a receiver, substantially as described.

In testimony that we claim the foregoing we have hereunto set our hands this 31st day of May, 1876.

THOMAS A. D. FORSTER.
GEO. J. FIRMIN.

Witnesses:
M. DANL. CONNOLLY,
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