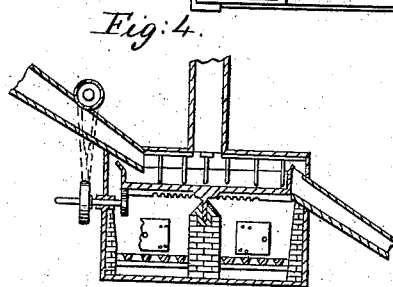
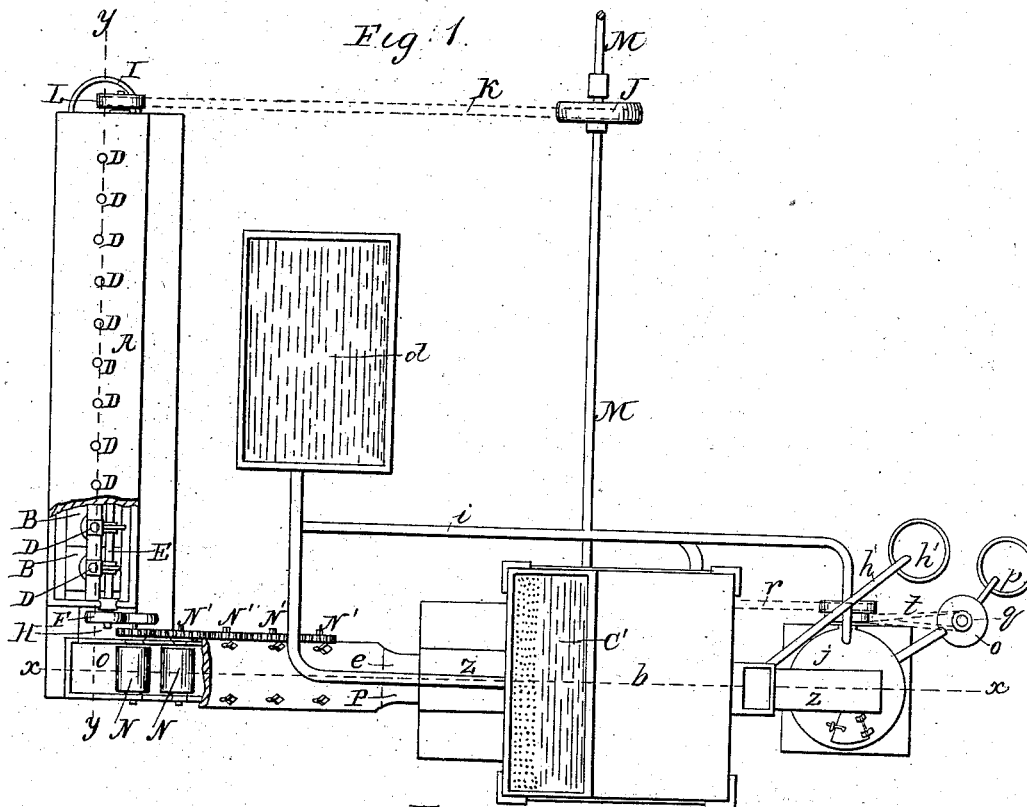


J. A. HITCHINGS.

Machinery for Separating Metals from Ores.

No. 54,726.

Patented May 15, 1866.



Witnesses.

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Inventor.

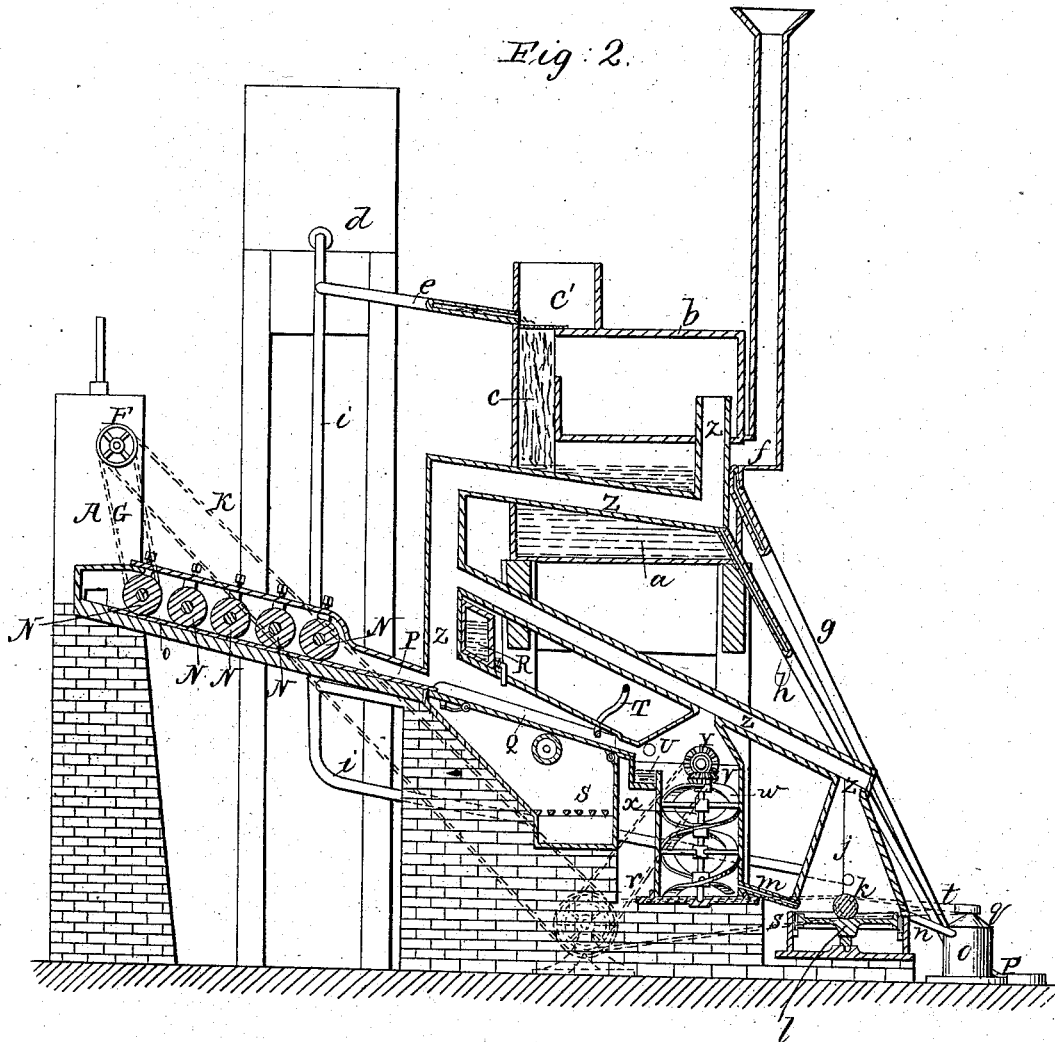
John A. Hitchings  
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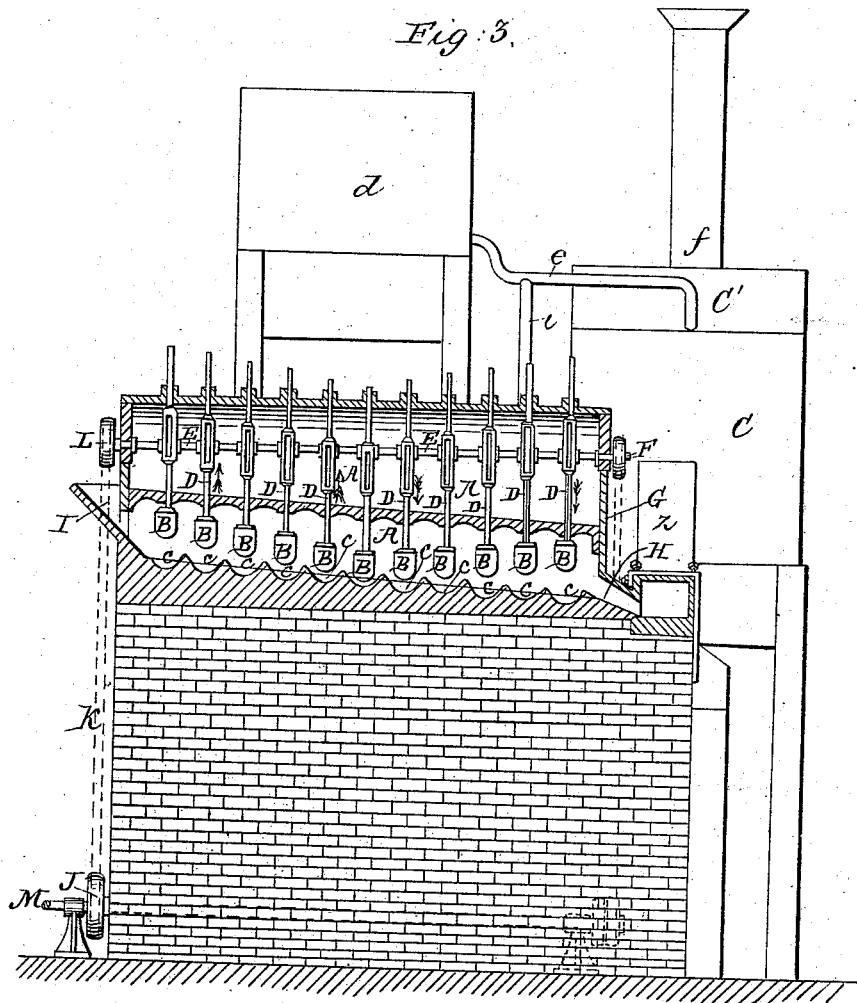
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Fig. 3.



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# UNITED STATES PATENT OFFICE.

JOHN A. HITCHINGS, OF DENVER CITY, COLORADO.

## IMPROVEMENT IN MACHINERY FOR SEPARATING METALS FROM ORES.

Specification forming part of Letters Patent No. 54,726, dated May 15, 1866.

*To all whom it may concern:*

Be it known that I, JOHN A. HITCHINGS, of Denver City, in the county of Arapahoe and Territory of Colorado, have made new and useful Improvements in Machinery for Separating Metals from Ores; and I do hereby declare the following to be a full, clear, and exact description of the nature, construction, and operation of the same, sufficient to enable one skilled in the art to which appertains to construct and use the same, reference being had to the accompanying drawings, which are made part of this specification, and in which—

Figure 1 is a plan or top view. Fig. 2 is a vertical section on the line *xx*, Fig. 1. Fig. 3 is a vertical section on the line *yy*, Fig. 1. Fig. 4 is a detached view of the furnace-pan.

My invention consists of a number of portions through which the ores are consecutively passed, and which are, first, a stamping-mill; second, a series of crushing-rollers; third, a furnace; fourth, a cold-water tank; fifth, an amalgamator; sixth, an arrastra; seventh, a second amalgamator.

The ore descends in all these successive operations, so as not to require to be mechanically raised or lifted as it is passed from one to the other. The fumes are carried from the various portions where heat is applied, so as not to interfere with health, and the valuable vapors are condensed and returned to the apparatus at a point beyond the influence of the furnace.

The ore is fed into the machine at the hopper I, whence it passes to the chamber A, where it is exposed to the stampers B B, which are moved vertically by the shaft E and allowed to drop into the mortars C, which are in an inclined series, and which connect by slots which extend half of their depth, and by which the comminuted ore passes from one to another through the series until it is discharged at the spout H.

The motion of the stamps is produced by means of cams or cogs on the shaft E, which latter is rotated by the band K, which connects the pulley L on the shaft E with the pulley J on the main shaft M.

The pounded ore from the spout H passes along the inclined floor O under the crushing-rollers N N, which are rotated in the same direction by the cog-wheels N' N', which are rotated by a band, G, from the pulley F on the shaft E.

The ore, being further reduced by the action of the rollers N N, passes by the way of the spout P into a pan, Q, in the furnace S, where the ore is heated and a stream of mercurial vapor brought into contact with it by means of the pipe T. Water from the tank R, as may be required, (hot preferred,) is poured occasionally upon the heated pan Q to prevent the aggregation of the ore to the pan. The motion of the pan and its inclined position cause the comminuted and heated ore to be discharged into the chamber U, where the mineral oil which may not have been removed by the destructive distillation floats to the top and is carried off by a discharge-pipe.

From the chamber U the ore falls into the amalgamating-chamber V, which is charged with mercury, and in which is a revolving vertical shaft, X, on which are spiral wings W, which agitate the contents as the shaft is revolved by the bevel-wheels Y and the band *r* from a pulley on the shaft M.

The union of the quicksilver with the precious metals having been mainly completed in the chamber V, the amalgam is discharged by the pipe *m* into the arrastra *j*, where the roller K on the muller *k* on the revolving bed *l* has the effect of bringing the particles of mercury and precious metal into still closer contact. A stream of water from the pipe *i* is introduced into the arrastra and the amalgam-pulp is carried by the pipe *n* into the final amalgamator *o*, whose vertical shaft, with beater charged with mercury, revolves under the influence of the pulley *q*, which is rotated by the belt *t* from the pulley on the shaft of the arrastra-roller *k*.

The volatile fumes from the amalgamator V and the arrastra *k l* are carried by the flue Z Z, together with those from the furnace, to the chamber *b*, having previously, in the chamber *a*, been exposed to the refrigerating action of cool water by the passage of the flue Z in a downwardly-inclined direction through the water-chamber *a*. Whatever fume or vapor becomes condensed in this angle of the pipe is returned by the pipe *h* to a chamber or pan, *h'*, where it is utilized or collected.

The vapor escaping at the end of the flue Z into the chamber *b* is exposed to a shower-bath, *c*, to cleanse it of mercurial and sulphurous vapor, and is then allowed to escape by the chimney *f*.

The water for the supply of the various portions is derived from the tank *d*, which supplies the shower-bath chamber *c'* by means of the pipe *e*, and the arrastra by means of the pipe *i*. The condensed vapor of the chamber *b* is discharged, along with that from the lower descending angle of *Z*, into the pan *h'*.

The character of the furnace-pan which receives the comminuted ore from the rollers is designed to be as in Fig. 4, which consists of a cast-iron disk, *u*, four to six feet in diameter, placed over the furnace and supported by a pivot-pin on which it slowly revolves by means of the application of power to the pinion-shaft *w* coming through the wall of the furnace and gearing with a rack on the under side of the plate. A few inches above this plate is a rod, *T*, to which scrapers *X* are attached, which, by the revolution of the disk beneath, gradually remove the ore toward the periphery of the plate, where it falls into a spout which conducts it in its heated condition to the amalgamator. The flame of the furnace is admitted to pass around the edge of the disk and reverberates above it. The upper surface of the plate is covered with fire-clay, soapstone, or some fire-proof material thicker toward the center, and air is admitted by the discharge-slucice, furnace-doors, or through holes in the covering.

A small hollow cylinder is placed over the feed-slucice *P*, and is charged with soda, lime, or any other reagent, which is discharged into the passing ore and is fed with it to the roaster.

Set-screws above the rollers *N N* serve to gage their pressure upon the partially powdered ore which passes beneath them.

The arrastra has a circular concave cast-iron bed of four to six feet diameter, mounted on a stout table, *Z*, and revolving on a central pivot-ball and casters set in the frame under the periphery or rim of the bed. The bed is strengthened by flanges beneath, has a rim of several inches elevation, and has fixed across it an iron cylinder, *K*, of about sixteen inches diameter in the center and eight or ten at the ends, which is driven by a belt and connected to the bed by cog-and-pinion gear, thus producing a rubbing and sliding as well as grinding motion. Set-screws over the beams of the cylinder admit of an intimate and perfect pulverization and amalgamation. An opening in the rim through a fine screen with a circular catch-lift, carries the floating refuse to a copper amalgamator, *o*, shaped like a circular tea-caddy, which is provided with a revolving stirrer, and an opening near the bottom with slide-door to clean out its contents at. The pulp passes in at the side and out at the top. The inside is coated with quicksilver, and also charged with a few pounds of it. The copper amalgamator *o*, being coated with mercury, serves to arrest any floating particles of unamalgamized gold, and may be profitably used at the tail end of the quartz-mill to catch flour-gold in muddy water.

The cooler and first amalgamator and the arrastra are covered with dome-casings, and have pipes leading to the smoke-stack of the furnace to carry off the poisonous vapors liberated. The smoke-stack is bent down horizontally a few feet above the furnace and carried with a depressing angle of its own diameter below a horizontal line some eight feet into a sheet-iron vessel, and then turned up perpendicularly three feet and cut off in a dry chamber of several feet square. The vapors not settling in this chamber pass over a partition-wall at the end opposite their entrance, where a shower-bath of cold water from a reservoir above washes them down to the cistern below, the condensed vapors sinking therein to be drawn off by a pipe beneath, while the floating refuse passes out at a small opening to a waste-slucice with the surplus water. The smoke and other uncondensed vapors go out at a large opening near the turn-up elbow to an outside chimney, and thence to the open air.

These improvements are especially designed for pyritous ores, in which the presence of a mineral oil prevents the perfect amalgamation. The object, after reducing it to powder, is to heat it in contact with alkali and quicksilver fumes and then plunge it into cold water, when the mineral oil not previously dissipated will float and may be conveyed away, while the sediment being ground with mercury will be very perfectly amalgamated and the precious metals afterward separated.

Having described my invention, what I claim therein as new, and desire to secure by Letters Patent, is—

1. The arrangement of the mortars, rounded stamps, and slotted connecting-openings, substantially as and for the purpose set forth.
2. The arrangement, as a sequence to the subject-matter of the first claim, of the rollers *N* in the trough, for the further comminution of the ore received from the stamps.
3. A basin-shaped revolving roasting-plate, Fig. 4, provided with scrapers, as described, and with a vessel containing salts of soda, alum, or potash, which are intermingled with the ground ore.
4. The arrangement, with the revolving roaster, of the cold-water tank which receives the heated ore therefrom, as described.
5. The arrangement of the roasting-plate, cold-water bath, amalgamator, and arrastra, as described.
6. The quicksilver-coated copper amalgamator, acting as a final means of arresting non-mercurialized metals, arranged and operated as described.
7. The condenser, arranged as described, consisting of the flue *Z*, passing through the water-chamber, the discharge-pipes *h*, and the chamber *b*, the shower-bath *c*, and exit-flue *f*.

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Witnesses:

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