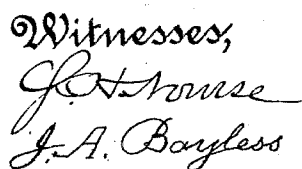


2 Sheets—Sheet 1.

No. 584,086.

Patented June 8, 1897.



Inventor,
William A. Woods
By Devey & Co Attys

(No Model.)

2 Sheets—Sheet 2.

W. A. WOODS.
ORE GRINDING MACHINE.

No. 584,086.

Patented June 8, 1897.

Fig. 3.

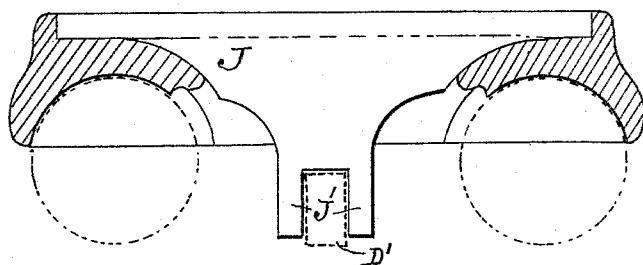
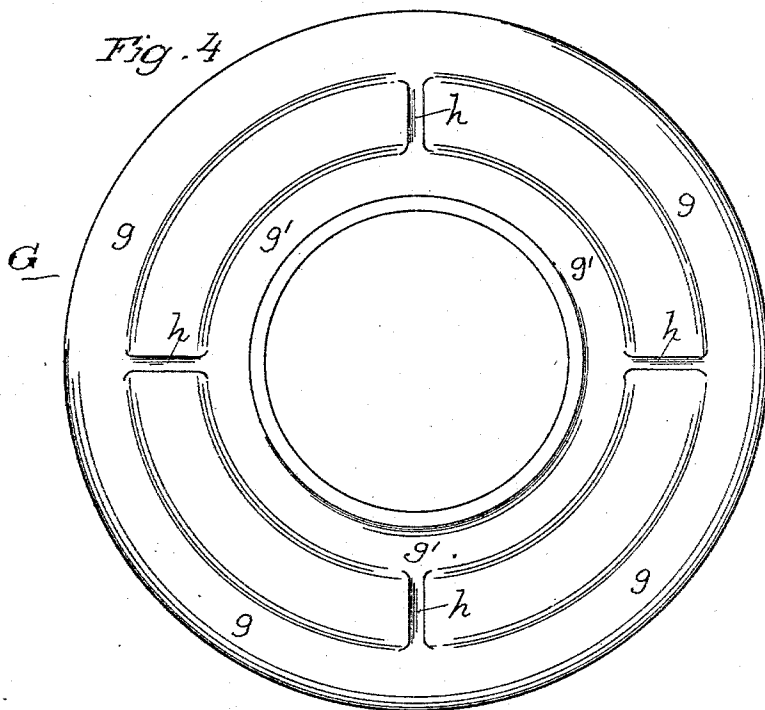


Fig. 4.



Witnesses,
J. H. House
J. H. Bayless

Inventor,
William A. Woods
By Deacy & Co.
attys

UNITED STATES PATENT OFFICE.

WILLIAM A. WOODS, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR OF ONE-HALF TO SOLON PATTEE, OF SAME PLACE.

ORE-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 584,086, dated June 8, 1897.

Application filed March 6, 1894. Renewed November 4, 1896. Serial No. 611,075. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. WOODS, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented an Improvement in Ore-Grinding Machines; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to a machine for grinding and pulverizing ores, which I call a "ball arastra."

My invention consists of the constructions and combinations of devices which I shall hereinafter fully describe and claim.

Figure 1 is a vertical section taken through the center of the apparatus. Fig. 2 is a horizontal section of the pan, the cap J being removed. Fig. 3 is a section of the cap J on the dotted line $x x$ of Fig. 2. Fig. 4 is a bottom view of the die G.

A is a pan, made of iron, which I have shown in the present case with a rounded inner concave at the junction of its sides and bottom and a central hollow sleeve B, through which a vertical driving-shaft C extends, and this has fixed to its upper end a driver D.

E is a step suitably supported below the pan, in which the lower end of the driving-shaft turns, and F F are the beveled gear-wheels through which power is transmitted from a horizontal driving-shaft extending beneath the pan to the driver.

Around the bottom of the pan is fitted a removable shoe or die G of somewhat smaller diameter than the interior of the pan, and it is secured in place by wooden wedges H, so as to leave a space between it and the sides of the pan. These wedges hold the die in place while work is progressing and allow it to be removed for cleaning up when they are taken out. The curve of the lower part of this die is made upon a larger radius opposite the interior curve of the pan, so as to leave a space or channel g between the two for the reception of any amalgam that may be formed and which will pass into this space from time to time as the work proceeds. From this channel radial passages h lead to an interior channel g' beneath the inner edge of the die, where any amalgam or mercury may settle and be undisturbed until it is de-

sired to clean up. The curvature of the interior of the die is essentially the same as that of the balls I, which are fitted to roll upon the die, and the outer periphery is cut away, as shown at G', so that the bearing of the balls is a little the greatest outside of a vertical line through their centers. This, in conjunction with the corresponding curvature of the cap, which rests upon the tops of the balls and acts as a driver, regulates the amount of twisting motion given the balls as they travel around the interior of the pan.

J is a circular cap having a curvature corresponding essentially to that of the balls and adapted to rest upon the top thereof. This cap curves down to a greater degree outside of a vertical central line through the balls than it does on the inside, and this, taken in conjunction with the curvature of the die, counteracts the centrifugal tendency of the balls, and also the tendency to twist as they roll.

The driver D has extensions and lugs D' at the bottom which are adapted to fit into corresponding slots or channels in the ends J', which project down from the cap or disk J, and by the action of this driver the cap J is caused to rotate about the center, and the balls rolling between the cap and the die will gradually crush and pulverize any material which is delivered upon the dies. This work is practically accomplished by both cap and die, since much of the material passes up between the balls and the cap.

Upon the top of the cap J are fitted annular disks K, and annular weights L are secured upon these disks by bolts in any suitable manner. The disks K are also secured to the caps J by bolts, so that the whole are united together while the operation continues.

Upon the top of the pan is fitted a cover M, having flanges around the periphery which are bolted to corresponding flanges upon the top of the pan, as shown. In the center of the cover is made a conical hopper N, and a cylindrical extension N' thereof surrounds the drive-sleeve D at a short distance therefrom, allowing sufficient space all around it for the material fed into the hopper to gradually pass down and be delivered at the lower end.

The operation will then be as follows: Power being applied to rotate the driver, the balls will roll between the cap which rests upon them and the dies upon which they rest, and material being fed into the hopper will be gradually delivered from the lower end and will be thrown outward and up the inclined inner edge of the die into the path of the balls by centrifugal force, so that the balls will constantly grind it between themselves and the cap and die. Wings W are so fixed as to divert the current of pulp and cause a constant circulation between the balls and dies. A sufficient quantity of mercury is introduced from time to time, with such other materials as the character of the ore renders necessary, during the grinding process, and as the metal is extracted from the ore it will unite with the mercury and will be gradually thrown outward by centrifugal force above the upper edge of the die and will pass down between the die and the sides of the pan and be collected in the spaces *g g'* beneath the die, thus preventing the mercury and amalgam from being continually ground and floured by the action of the balls. Whenever a sufficient quantity of amalgam is collected and it is desired to clean up, the top of the pan is removed. The weight L and disk K are also removed, and by screwing eyebolts into the bolt-holes in the cap which travels upon the balls the latter is raised out of its place, after which the balls may be removed and finally the die, thus leaving the interior of the pan clear and accessible for the purpose of cleaning up.

Around the outside of the pan is formed an inclined annular chute P, which is preferably cast with the pan and is highest upon one side, declining gradually as it passes around the pan to the opposite side, where there is a discharge-spout P'.

Q are openings into which screens are fitted, so that any material which is ground sufficiently fine may pass out through these screens and, falling into the inclined chute upon the outside, will gradually be delivered through the discharge P'. These screen-openings are sufficiently high above the dies, so that any coarse material which may be thrown out from between the grinding-surfaces will lodge against the sides of the pan beneath the screen-openings and will not strike the screens, thus reducing the tendency to break the latter.

The cap which travels upon the tops of the balls is so cut away from near the top of the ball inwardly, as shown at J', as to leave a considerable space between the balls and the inner extensions. The object of this is to allow the balls to move inwardly in case any very refractory substance should be lodged upon the dies in the exterior portion of the curve which would tend to throw the balls out of place. This space on the inside will allow the balls a certain amount of movement without breaking any part of the apparatus.

In order to lubricate the parts around the vertical central shaft and within the cone, a hole R is bored into the top of the shaft, extending below the top of the cone, and transverse openings S discharge from this hole inside the cone, so that the lubricant passes down around the shaft without getting into the pan. The hole at the top of the shaft is closed by a screw-pin T, and this is covered by a cap U, which slips down over the end of the shaft and protects the whole from dust when the ore is fed into the hopper at the top.

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

1. The combination, of a grinding-pan having a rounded inner concave at the junction of the sides and bottom, a central vertical sleeve, a vertical driving-shaft, a driver secured thereto extending down into the pan, means for pulverizing the ore, a die fitted within the pan with a space between it and the said inner concave of the pan said die having an annular chamber in its bottom between its inner periphery and the bottom of the pan in which the amalgam or mercury may collect and remain undisturbed.

2. In a grinding-pan, the combination, of the pan having an inner concave at the junction of its sides and bottom, a central vertical sleeve, a vertical driving-shaft, a driver secured thereto and extending down into the pan, a die within the pan, means for pulverizing the ore, means for holding the die away from the inner concave of the pan to provide a space to permit amalgam to pass below the die, and a chamber in the bottom of the die between its inner periphery and the bottom of the pan in which the amalgam may collect and remain undisturbed.

3. In a grinding-pan, the combination, of a pan having an inner concave at the junction of its sides and bottom, and central vertical sleeve, a driving-shaft with a driver secured thereto and extending down into the pan, a die fitted in said pan having a chamber formed in its bottom between its inner periphery and the bottom of the pan, said die being of less diameter than the inner diameter of the pan so as to provide a space between the inner sides of the pan and outer periphery of the die through which amalgam may pass on its way to the collecting-chamber at the inner periphery of the die, means for pulverizing the ore and means for removably securing the die in position.

4. In a grinding-pan, the combination, of a pan having an inner concave at the junction of its sides and bottom, a die of smaller diameter than the interior of the pan, having its exterior curved with a greater radius than that of the interior of said pan, and wedges for removably securing the die in position with its outer periphery away from the inner walls of the pan, said die having a chamber formed in its under surface between its inner periphery and the bottom of the pan, and hav-

ing its upper surface formed with a concave track, balls adapted to travel on said track, an annular cap or shoe, the lower face of which is channeled to fit and rest upon the balls, extensions of said cap on the inner side toward the bottom of the pan, a driver and a central vertical shaft by which it is revolved, said driver having extensions and lugs, and said cap extensions having slots or channels to receive the same whereby the cap or shoe is caused to rotate and the balls to roll between it and the die, substantially as herein described.

5. A pulverizing-pan having an annular concavo-convex die fitted therein with a space between it and the inner walls of the pan, balls adapted to roll in its concave interior channel, a correspondingly-channeled annular cap resting upon the tops of the balls, a central driver with which the cap is connected by extensions therefrom, a central feed-hopper with an extension-sleeve surrounding the central cone and driver whereby material is fed into the center of the apparatus and delivered therefrom by centrifugal force into the space upon the die upon which the balls travel, and wings arranged beneath the driver whereby the material is diverted and thrown upwardly, substantially as herein described.

6. A grinding-pan having an inner concave at the junction of its sides and bottom, a die or dies of smaller diameter and wedges by which the die is fixed so as to leave an annular channel around its periphery, an annular chamber formed between said inner concave of the pan and the bottom of the die, a second annular chamber near the inner periphery of the die formed by a depression in its lower surface, and radial channels connecting the two chambers, a concave track upon the top of the die adapted for the travel of balls which roll therein, a weighted cap with a similar track resting upon and driving the balls, and a central feed and peripheral discharge device as described.

7. In a grinding-pan, the combination, of a pan, pulverizing devices and a die the under surface of which is concaved near its inner periphery so as to form a chamber between said periphery and the bottom pan into which amalgam or mercury may collect and remain undisturbed.

8. In a grinding-pan, the combination, of a pan having a concaved inner angle, a removably-secured die within the pan and separated therefrom to form a passage for amalgamating material, said die having a chamber formed in its under surface between its inner periphery and the bottom of the pan into which the amalgamating material passing through the passage between the die and pan may collect and remain undisturbed.

9. In a grinding-pan, a concavo-convex die fitting the concave interior of the pan and having a ball race or track upon its upper surface, a correspondingly-channeled weighted cap resting upon the balls, a driver loosely connected with arms or extensions from the cap and fixed to a central vertical shaft through which power is imparted to drive the cap and balls, a central feed-funnel inclosing the hollow sleeve in which the vertical shaft turns and having an extension surrounding the central cone and driver to deliver the pulp to the lower inner part of the pan by centrifugal force, wings by which it is diverted outwardly to pass between the rolling grinding-surfaces, screened openings made in the sides of the pan above the dies and ball-races, and an inclined trough or channel surrounding the outside of the pan below the screens to collect the pulp passing through the screens and convey it to a common discharge as described.

In witness whereof I have hereunto set my hand.

WILLIAM A. WOODS.

Witnesses:

S. H. NOURSE,
J. A. BAYLESS.