(No Model.)

3 Sheets—Sheet 1.

C. M. FITCH.

ORE PULVERIZER.

No. 441,867. Patented Dec. 2, 1890.

Fig. 1.

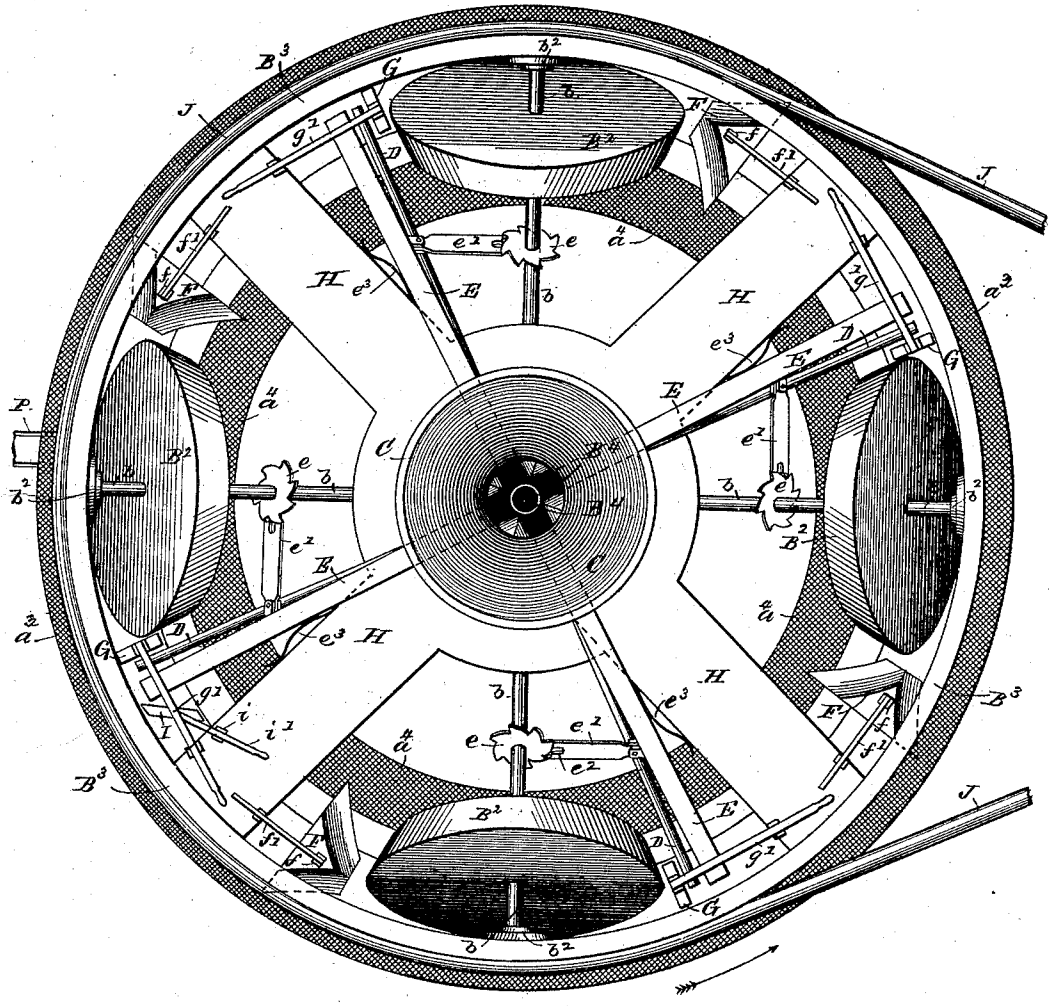
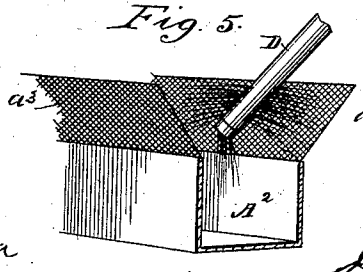


Fig. 5.



Witnesses,
L. F. Mann,
Martin Olsen

Inventor,
Calvin M. Fitch.
By Geo. W. LeKin.
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

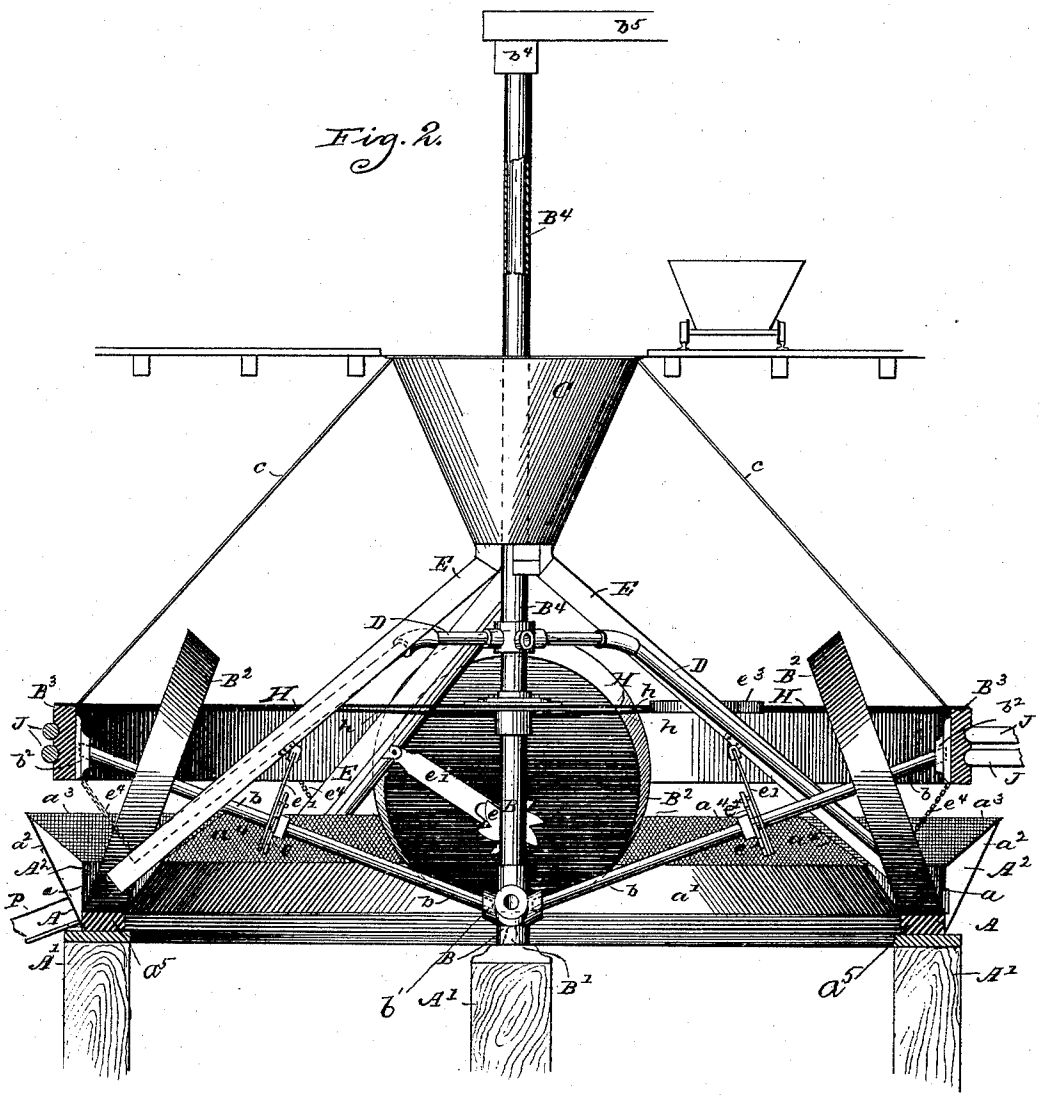
(No Model.) 3 Sheets—Sheet 2.

C. M. FITCH.

ORE PULVERIZER.

No. 441,867. Patented Dec. 2, 1890.

Fig. 2.



Witnesses,
D. F. Mann
Martin Olsen

Inventor,
Calvin M. Fitch.
By, Geo. W. LeKin.
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 3.

C. M. FITCH.

ORE PULVERIZER.

No. 441,867. Patented Dec. 2, 1890.

Fig. 3.

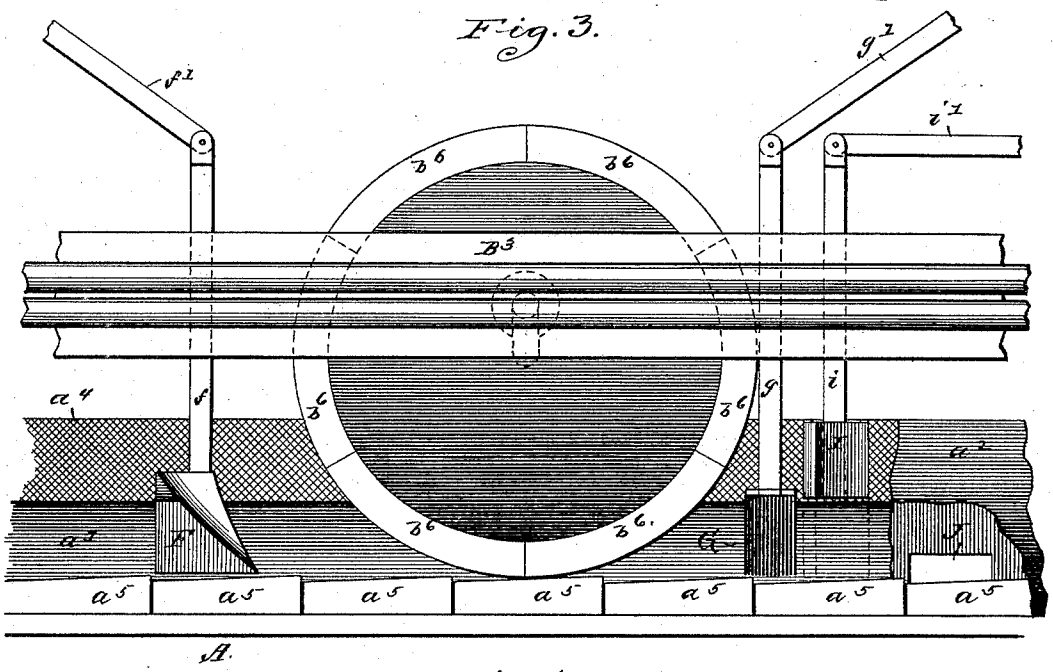
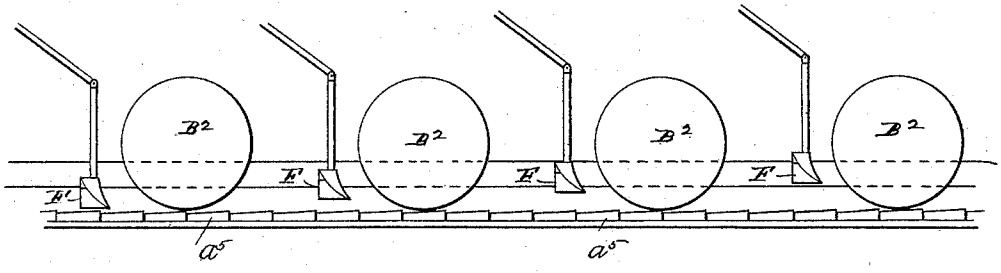


Fig. 4.



Witnesses
L. G. Mann,
Martin Olsen

Inventor,
Calvin M. Fitch.
By, Geo. W. LeVin. Atty,

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CALVIN M. FITCH, OF CHICAGO, ILLINOIS.

ORE-PULVERIZER.

SPECIFICATION forming part of Letters Patent No. 441,867, dated December 2, 1890.

Application filed July 5, 1889. Serial No. 316,632. (No model.)

To all whom it may concern:

Be it known that I, CALVIN M. FITCH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Ore-Pulverizers of the type commonly known as the "Arrastra" or "Chilian Mill," of which the following is a description, reference being had to the accompanying drawings, and the letters of reference marked thereon, which form part of this specification.

My invention relates to the comminution of ore; and it consists in certain additions to the arrastra or Chilian mill, whereby the efficiency of said mill is greatly increased and the product secured in the condition most favorable to subsequent treatment, either by concentration or lixiviation.

The invention consists in certain peculiarities in the construction, arrangement, and combination of the various parts, substantially as hereinafter described, and particularly pointed out in the subjoined claims.

In the accompanying drawings, which illustrate a simple type of ore-pulverizer embodying in the most desirable combinations and forms the several features of my invention, Figure 1 is a top plan view of the same. Fig. 2 is a view of the apparatus in part broken away, substantially showing in elevation the various devices forming part of the machine. Fig. 3 is a broken detail elevation mainly intended to show the operative arrangement of the mold-board, brush, and scraper with reference to the crushing-wheels and ore-trough. Fig. 4 is a detail intended to illustrate the operative arrangement of the mold-boards within the trough when it is desired or becomes necessary to operate the machine without the employment of the screens. Fig. 5 is a broken detail of the arrastra-trough and water-supply pipe, indicating the manner in which the water may be thrown in jets or spray upon the screens for the purpose of facilitating the washing of the duly-pulverized material thrown on same.

Referring by letter to said several described views, A indicates the trough of the arrastra, which is preferably composed of boiler-iron suitably sustained, as by timbers A′, which rest upon bed-rock or solid masonry, not deemed necessary to be shown herewith.

a^4 a^3 are screens formed of wire or perforated metal, carried removably by the upper portions of the several sides of the trough, placed in practice at such angles as may be best adapted to the special work to be done, and so arranged in any preferred manner as shall enable them to be removed from the trough when it shall be desired. Within said trough and forming the working-floor thereof are located steel or chilled-iron dies a^5, each of which increases in thickness in the direction of its length, for the purpose hereinafter fully set forth.

B^2 indicates the crushing-wheels, which, working within said trough A, are fixed to axles b, which journal in bearings b' b^2, fixed, respectively, to or forming part of a concentrically-located upright rotary shaft or standard B, and a driving-cylinder B^3 and rigidly connects together said shaft or standard and cylinder, thus securing a leverage which affords a great efficiency of operation with great economy of power. The bearings b' for the inner ends of said axles are so located with reference to the outer bearings b^2 that a line drawn through a wheel at right angles to its axle would be at a suitable angle—as, for example, sixty degrees—to the horizontal plane of the floor of said trough, with the perimeter so tapered that its working or crushing face presents a plane corresponding with the plane of the floor of the trough, and its outer or longest and inner diameters respectively bear the same ratios to the outer and inner diameters of the trough, thus avoiding a grinding action by the wheels upon the ore as they describe their circuit of the trough and consequent sliming of the ore and lessening their tendency toward a tangential declination from their proper course when run at a high rate of speed.

In practice the arrastra is of large size, being, preferably, not less than twenty-four to thirty-six feet in diameter, and the crushing-wheels, which are ordinarily of cast-iron, are desirably not less than six feet in diameter, having a working-face of not less than ten inches transverse diameter. The said working-face of the wheel is in the form of a steel or chilled-iron tire or shoes b^6, attached in any suitable manner to the core or body of the wheel, enabling removal of the same therefrom for the purpose of repairs, &c., without lifting the wheel from the trough.

The cylinder B^3, which is mainly sustained by the axles *b*, as shown particularly in Fig. 2, is formed of iron or other metal, preferably sixteen to eighteen inches in depth, and sustained, in addition to the support given by said axles *b*, by tie-rods *c*, which being connected therewith are attached to a hopper C, fixedly carried by a hollow upward extension B^4 of the shaft or standard B, the lower end of said shaft or standard B working upon a solidly-sustained pivot B′, (shown in Fig. 2,) and the upper end of said extension B^4 rotatively working in a suitable bearing b^4. (Shown in Fig. 2.) From the bottom of said hopper C are projected at an inclination suitable for the purpose required chutes E, the discharging or terminal points of which are located slightly in advance of each crushing-wheel, the lower ends of the chutes being vibratorily held to the said cylinder B^3, desirably, by means of chains e^4. (Shown in Fig. 2.) The said chutes being intended to deliver the ore from the hopper C to the arrastra-trough are given vibratory or jarring motion in order to insure the effective discharge of the material, preferably by means of a connecting-rod *e*′, which is hinged thereto, and a ratchet-wheel *e*, carried by the axle *b*, the teeth of said wheel being adapted to successively engage with a pin e^2, projecting from said connecting-rod, throwing the same forward, a spring e^3, attached to the platform H, carrying the chute back to its normal position as soon as the said pin is released from its engagement with the tooth of said ratchet-wheel.

From the hollow extension B^4 of the shaft or standard B are radially-projected feed-pipes D, of any desired or necessary number, arranged to terminate within or about the trough A^2, being provided for supplying water to the apparatus.

In the construction herewith shown the hollow extension B^4 is adapted to receive water from a pipe b^5, having connection with a source of supply not shown. The water passing through said extension and said supply-pipe to the arrastra-trough is caused to be discharged partly into the trough and partly in the form of a jet or spray directed upon the screens, against which the pulp is thrown by the devices provided for such purpose.

Within the trough A^2, in front of each crushing-wheel and operatively sustained by the driving-cylinder B^3 or by the platform H, as shown in Fig. 1, is located an ore-distributing brush G, preferably of steel wire, provided for spreading the material to be crushed evenly in the bottom of the arrastra-trough in advance of its corresponding crushing-wheel, the said brush being adapted to be raised or lowered at will toward or from the floor of the trough by means, desirably, of a lifting-lever *g*′, suitably connected with its stem *g*, as shown in Figs. 1 and 3. Following each crushing-wheel within said trough and operatively sustained by said driving-cylinder or by the platform H, as shown, is located a double mold-board F, preferably of steel, adapted to throw the material crushed by the wheel against the screens a^3 a^4, provided on the inner and outer sides, respectively, of the trough, the spray of water discharged from the pipes D against said screens assisting in washing through any material fine enough to pass the meshes of the screens, while the coarser material falls back into the trough to be again passed over by the wheel next following, and so on, *seriatim*. The said mold-boards are adapted to be adjusted in position in relation to the floor of the trough by means, desirably, of levers *f*′, connected with their stems *f*, as shown particularly in Figs. 1 and 2.

When the ore to be comminuted carries metal in lumps, frequent cleaning of the trough A^2 is necessary, and to this end I provide for operation within the trough one or more scrapers I, also sustained by the driving-cylinder or by the platform H, as shown, adapted to be lowered, when desirable, by means of a lever *i*′, connected with its stem *i* to the floor of the trough and to sweep or scrape the same as the cylinder revolves. The side or sides of the trough being provided with one or more suitable openings I, having removable or movable doors or covers, (not shown,) and the scraper being set at an angle suitable for the purpose, such material as is desired may be discharged from the trough through said opening or openings at will.

A continuous gutter or gutters a^2, provided outside the trough A^2, receive all material washed or scraped from the trough A^2, such material passing therefrom through a suitable conveyer or conveyers P to sizing-boxes. (Not shown herewith.)

When the ore to be treated carries a percentage of mica sufficient to clog the screens connected with the trough, or when it is desirable to work the mill beyond the capacity of the screens, the screens may be dispensed with and the discharge of the duly-powdered rock effected by a novel arrangement of the mold-boards which follow the crushing-wheels, as shown in Fig. 4. In such case the mold-boards would be successively set at lessening distances from the floor of the trough. In other words, the mold-board following one crushing-wheel would be set so as to move on a plane near the horizontal plane described by the upper portion of the walls of the trough. The next would be a suitable distance lower within the trough than the first, the third similarly lower than the second, and so on, the last mold-board being set as low within the trough as would admit of its passage over the floor thereof without grinding thereon. By this arrangement, insomuch as the pulp behind the first wheel contains, relatively with that behind the others, a smaller percentage of fine than of coarse material, a smaller percentage of said pulp is by said mold-board skimmed off from the

surface of the pulp. The pulp behind the second wheel contains a relatively larger proportion of fine material than that behind the first; so a relatively larger portion is thrown from the trough, and so with the others.

The dies a^5, forming the floor of the arrastra-trough, are each cast or so adjusted in position as to present a uniform but very slight rise in the direction in which the wheels and other devices are moving. By this construction or arrangement of the dies any possible engagement with the same of the mold-boards or scrapers is effectually prevented. To prevent any displacement of these dies in consequence of sand working beneath them and the therefrom resultant irregularity of surface which would seriously interfere with the working of the mold-board and scraper, as well as interfere with the duty of the wheels, I rigidly secure them in position and thoroughly calk all interstices existing between their contiguous ends and their sides and the sides of the trough by pouring between and around them melted lead or some alloy of lead; but any other material may be employed which will successfully accomplish the same purpose.

The platform H (shown particularly in plan in Fig. 1) extends athwart the area of the driving-cylinder B^3, and consists of radial arms or beams *h*, rigidly connected with the shaft or standard B and the driving-cylinder B^3, and supports a floor H, of any suitable material. The main purpose of this construction is twofold—that of so connecting and strengthening the various working parts of the apparatus that a perfect uniformity and effectiveness of action thereby is secured and the operator is enabled to safely and conveniently reach, regulate, and care for the different parts of the machine without arresting its motion. This structure also conveniently affords support to certain minor parts of the apparatus already referred to.

In the drawings the driving-cylinder is shown to be operated by means of a belt encircling the same, which is manifestly driven by a pulley, forming part of a source of power. (Not shown.) While this is a desirable means for giving motion to the apparatus, I do not limit myself to the employment of such device or devices, as any system of gearing may be substituted therefor, the essential of this feature of my invention being in that the power is applied to or about the perimeter of the cylinder, which secures the most advantageous utilization of power in the most convenient and economical manner.

Manifestly the details of construction herewith shown and described may be varied without departing from the intent and scope of the features of my invention hereinbefore set forth, and I therefore do not limit myself to the exact forms of construction shown.

I claim as my invention and desire to secure by Letters Patent—

1. The combination, with the arrastra-trough, of the concentrically-located rotary shaft or standard, the driving-cylinder adapted to be operated by its perimeter, the angularly arranged and sustained crushing-wheels having tapered working-faces which correspond with the plane of the floor of the trough, the hopper, one or more chutes connected with the hopper, arranged and adapted to convey crushed ore therefrom to the said trough, devices, substantially as set forth, for giving a vibratory or jarring motion to said chute or chutes, and devices for supplying water to the said trough, substantially as and for the purpose described.

2. The combination, with the arrastra-trough, of the concentrically-located rotary shaft or standard, the upper hollow extension of said shaft or standard, the water-supply pipes extended from said hollow extension to said trough, the driving-cylinder adapted to be operated by its perimeter, the angularly-arranged tapered-face crushing-wheels, the hopper provided with one or more chutes adapted to convey ore therefrom to the trough, and the mold-boards, substantially as and for the purpose described.

3. The combination, with the concentrically-located rotary shaft or standard, of the driving-cylinder adapted to be operated by its perimeter, the arrastra-trough provided with inner and outer screens, the angularly-arranged tapered-face crushing-wheels, the hopper provided with ore-conveyers, and the water-supply pipes, all arranged and adapted to be operated substantially as set forth.

4. The combination, with the concentrically-located rotary shaft or standard, of the driving-cylinder, the arrastra-trough provided with a gutter or gutters for receiving the comminuted pulp discharged therefrom, the water-pipes, the crushing-wheels, the mold-boards, the hopper, and the ore-conveyers, all combined and adapted to be operated substantially as and for the purpose described.

5. The combination, with the arrastra-trough, of the concentrically-located rotary shaft or standard, the angularly-arranged tapered-face crushing-wheels, the hopper provided with chutes for conveying the ore therefrom to the trough, the water-supply pipes, the mold-boards, and the brushes for evenly distributing the ore discharged into the trough in advance of the crushing-wheels, substantially as set forth.

6. The combination, with the arrastra-trough provided with gutters for receiving the pulp discharged therefrom, of the crushing-wheels, the water-supply pipes, the mold-boards, one or more scrapers, and one or more openings in said trough adapted to enable the scraper to discharge lumps of metal from the arrastra-trough, substantially as set forth.

7. The combination, with a trough, crushers, and rotary shaft or standard, of a driving-cylinder rigidly connected with said shaft or standard, and a platform intermediate of said cylinder and shaft and comprising a se-

ries of radial arms or beams and a floor supported thereby, substantially as described, and for the purposes specified.

8. The combination, with the arrastra-trough, of a concentrically-located rotary shaft or standard, a driving-cylinder adapted to be operated by its perimeter, crushing-wheels and their axles, said axles having their respective ends received by bearings secured to or forming part of said shaft and cylinder, and a platform located within the area of said cylinder and comprising a series of radial arms or beams and a floor supported thereby.

9. The combination, with the arrastra-trough having its bed presenting a series of slight rises in the direction in which the crushing devices move, of a driving-cylinder operated by its perimeter, a vertical rotary shaft or standard, inclined axles having their respective ends secured to said cylinder and shaft or standard, and crushing-wheels on said axles, said crushing-wheels having their perimeters so tapered that their working or crushing faces will present a plane corresponding with the plane of the bed of the trough, and their outer or longest and inner diameters respectively bear the same ratios to the outer and inner diameter of the trough, substantially as described, and for the purposes specified.

10. The combination, with angularly-arranged tapered-face crushing-wheels and mechanism for operating the same, of a trough and a series of dies forming the bed of said trough and so arranged or formed that they will present a slight rise in the direction in which the crushers move.

11. The combination, with a trough having screens, crushers operating in said trough, and means for throwing the crushed material against said screens, of a hopper, chutes extending therefrom and discharging adjacent to said crushers, and water-supply pipes extending nearly to and discharging against said screens, substantially as described, and for the purposes specified.

12. The combination, with a trough having screens, crushers operating in said trough, and means for throwing the crushed material against said screens, of a hopper, chutes extending therefrom and discharging adjacent to said crushers, means for giving a vibratory motion to said chutes, and water-pipes discharging against said screens.

13. The combination, in an ore-crusher, with the frame, a trough, crushing-wheels, the axles of said crushing-wheels, and mechanism for operating the same, of a hopper, chutes extending therefrom and discharging adjacent to said crushers, ratchet-wheels on said axles, and connecting-rods extending from said chutes to said axles and having pins engaged by the teeth of said ratchet-wheels, all substantially as described, and for the purposes specified.

14. The combination, with a trough and crushers operating therein, of a hopper, chutes connected with the hopper and adapted to convey the ore therefrom to said trough, a shaft having a hollow extension connected with a water-supply, and feed-pipes projecting from said hollow extension and discharging into the trough.

15. The combination, with the frame, trough, and driving mechanism of an ore-crusher, of crushing-wheels operating in said trough, ore-distributing brushes located in front of said crushing-wheels, and means for raising and lowering at will said brushes.

16. The combination, in an ore-crusher, with the trough and driving mechanism, of screens secured to said trough, a hopper, chutes leading from said hopper to said trough, crushing-wheels, double mold-boards following said wheels and throwing the crushed material against said screens, and pipes connected with a water-supply and discharging against said screens.

17. The combination, with the arrastra-trough, the crushing-wheels, and the water-supply, of the mold-boards operatively arranged, each successively lower than the one preceding, and securing the discharge of duly-comminuted material without the employment of screens, substantially as hereinbefore set forth.

18. The combination, with a trough, crushing-wheels, and the axles of said crushing-wheels, of a hopper, chutes extending therefrom and discharging adjacent to said crushing-wheels, and means operated by said axles for vibrating said chutes.

19. The combination, with a trough and angularly-arranged tapered-faced crushing-wheels and their axles, of a hopper, chutes extending therefrom and discharging adjacent to said crushing-wheels, and means for vibrating said chutes, said vibrating means being connected with and operated by said axles.

20. An arrastra-trough, crushing-wheels, the axles of said crushing-wheels, a rotating shaft or standard, and a driving-cylinder adapted to be operated by its perimeter and rigidly connected with said shaft by said axles, in combination with a hopper, chutes extending from said hopper and discharging adjacent to said crushing-wheels, and means connected with and operated by said axles for vibrating said chutes.

21. The combination, with the frame, trough, and driving mechanism of an ore-crusher, of crushing devices operating in said trough, ore-distributing brushes adjacent to said crushing devices, and levers connected with said brushes for raising and lowering the same.

CALVIN M. FITCH.

Witnesses:
GEO. W. LEVIN,
M. L. ALLEN.