

(No Model.)

3 Sheets—Sheet 1.

G. A. CLEVELAND.
ORE PULVERIZING MACHINE.

No. 570,745.

Patented Nov. 3, 1896.

Fig. 1

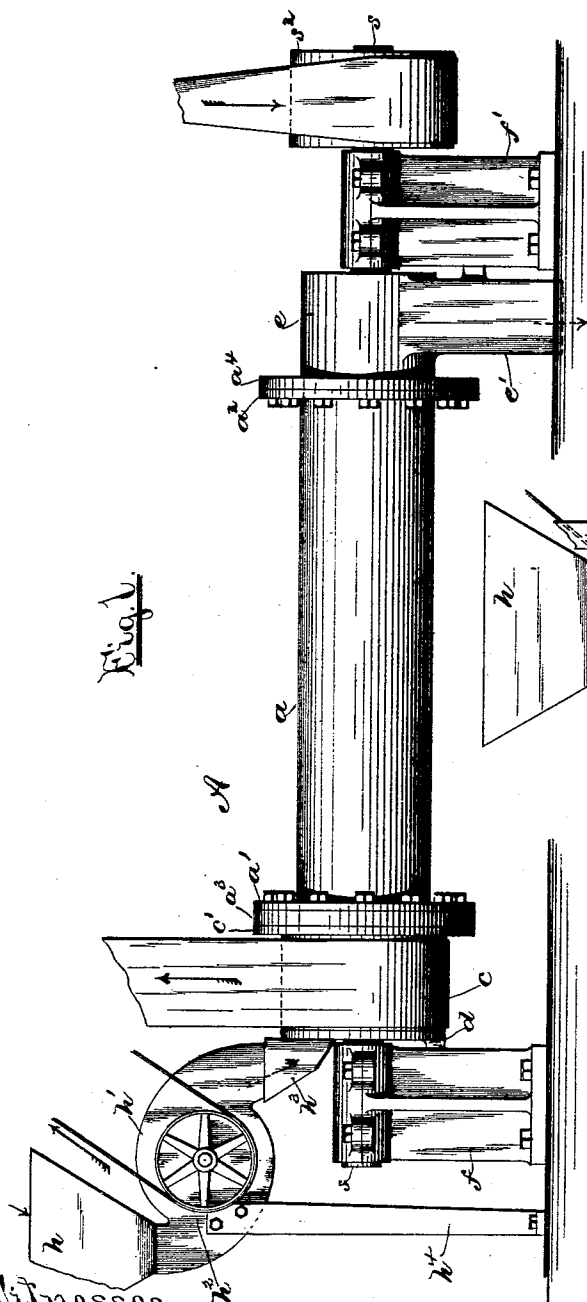
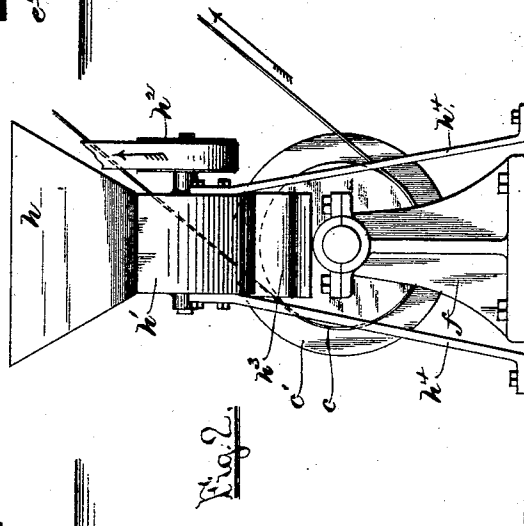


Fig. 2



Witnesses.

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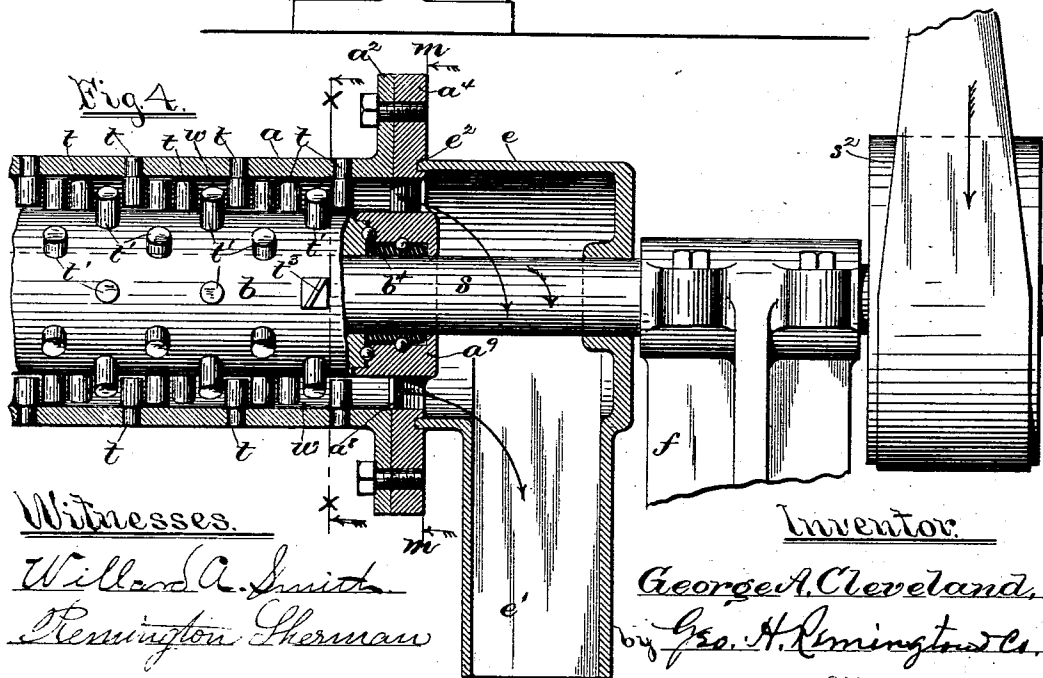
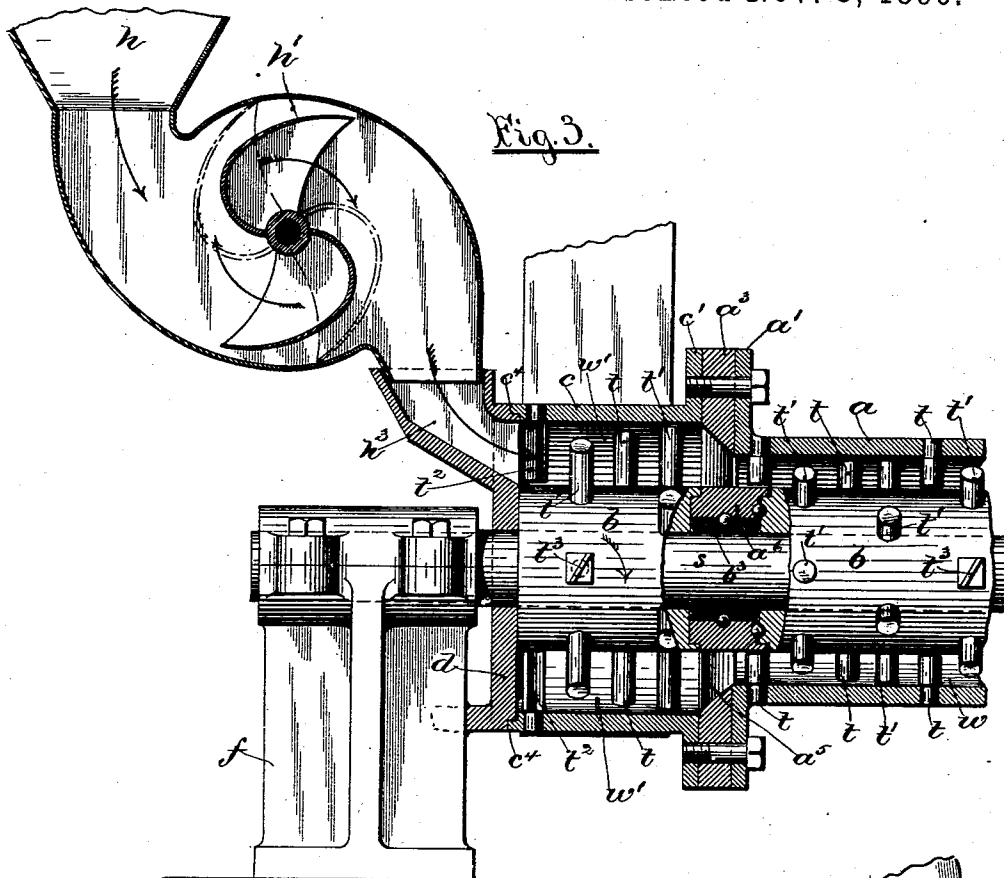
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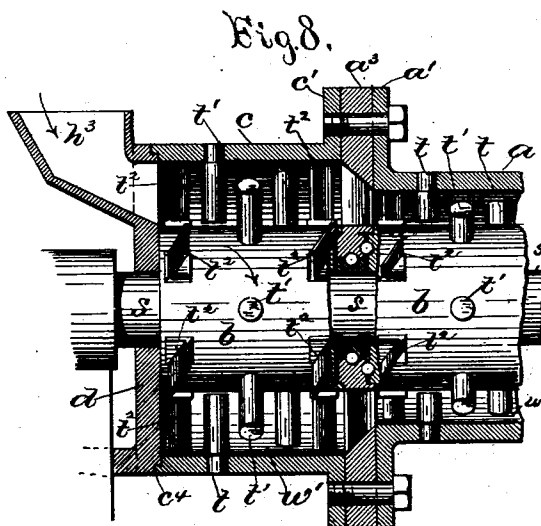
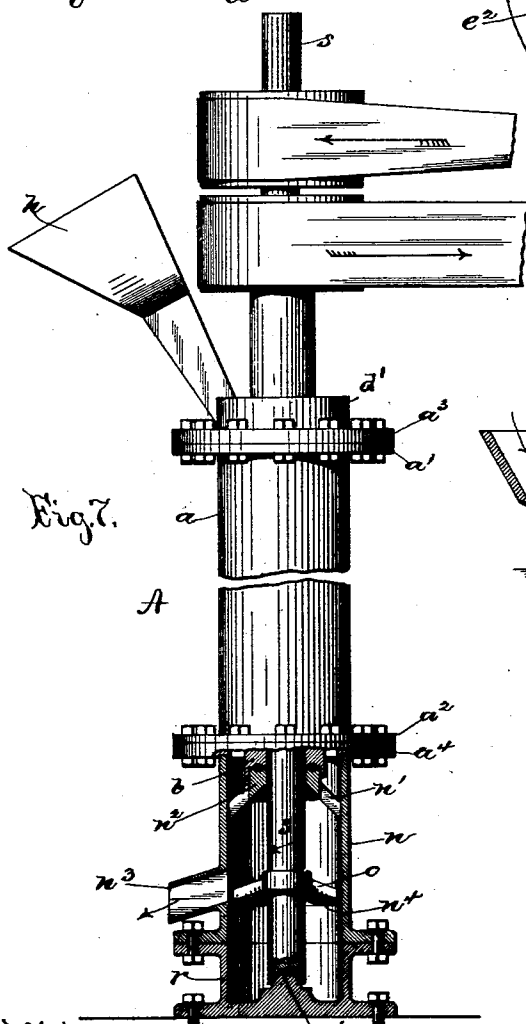
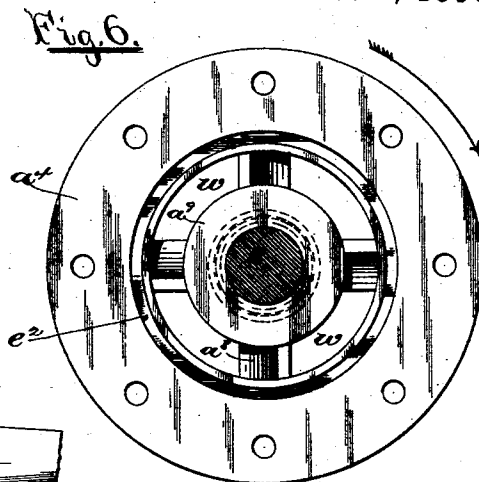
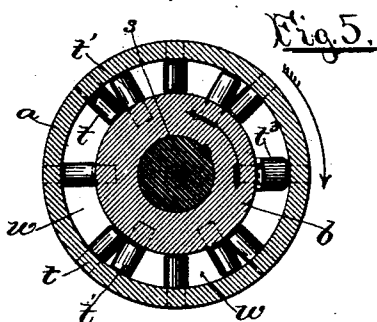
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UNITED STATES PATENT OFFICE.

GEORGE A. CLEVELAND, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR OF
ONE-THIRD TO EDGAR G. DURFEE, OF SAME PLACE.

ORE-PULVERIZING MACHINE.

SPECIFICATION forming part of Letters Patent No. 570,745, dated November 3, 1896.

Application filed February 17, 1896. Serial No. 579,585. (No model.)

To all whom it may concern:

Be it known that I, GEORGE A. CLEVELAND, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Ore-Pulverizing Machines; 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 appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention relates to machines for pulverizing ore or other materials capable of being reduced to a state of fine dust or powder by subjecting it to a continuous series of blows, the device being more particularly adapted for the reduction of graphite, mica, &c.

In certain types of ore-pulverizing machines heretofore made it has been usual to employ one or more revoluble cylinders provided with radially-extending arms or teeth, which operate to disintegrate the ore or material fed into the machines. In some cases the shells of the outer or larger cylinder have been apertured, the reduced material passing through said apertures by centrifugal force being collected in a closed casing surrounding the whole.

The object I have in view is to produce an ore-pulverizing machine capable of developing greater efficiency and capacity than machines of the types just referred to.

To that end my invention consists, essentially, of an outer cylinder provided with series of inwardly-extending teeth, an inner cylinder arranged concentrically within said outer cylinder having outwardly-projecting teeth capable of passing between the teeth of the other cylinder, the free ends of both series of teeth extending close to the walls of the adjacent cylinders, respectively, and forming an annular space between the walls, and means for feeding the ore or material into said space and discharging it therefrom, all as will be more fully hereinafter set forth and claimed.

By means of my improvement the capacity of ore-pulverizing machines may be multi-

plied several fold and the product is more uniform in fineness. I prefer to arrange the two pulverizing-cylinders concentrically, one within the other, and capable of being revolved rapidly in opposite directions, the rate of speed of the inner cylinder, however, exceeding that of the outer one. I prefer to employ a slowly-revolving feeding device adapted to conduct the ore from a stationary hopper into the front end portion of the annular space where it is acted upon by the rapidly-moving teeth, the latter subjecting the ore to a continuous series of quickly-delivered hammer-like blows, thereby disintegrating the ore, which in turn is acted upon by the next succeeding teeth to still further reduce it, and so on successively. The greater portion of the product thus discharged from the machine will be found to be reduced to fine atoms or dust, the whole being finally bolted.

In the accompanying three sheets of drawings, Figure 1 is a side elevation of an ore-pulverizing machine embodying my improvements. Fig. 2 is a front end view. Fig. 3 is a central longitudinal section, enlarged, taken through the front portion of the machine. Fig. 4 is a similar view taken through the rear portion of it. Fig. 5 is a transverse section taken on line *xx* of Fig. 4. Fig. 6 is an end view. (See line *mm*, Fig. 4.) Fig. 7 is a side elevation, in partial section, of my improved ore-pulverizing machine arranged as a vertical mill; and Fig. 8 is a central section, corresponding with Fig. 3, showing a modified form of the arrangement of the cylinder-teeth.

A, again referring to the drawings, designates my improved ore-pulverizing machine as a whole. As drawn, there are two cylinders employed, an outer cylinder *a* and an inner cylinder *b*, the latter being arranged concentrically within the cylinder *a*. The inner cylinder is somewhat smaller in diameter than the inner diameter of cylinder *a*, thereby forming an annular space *w* between them. The cylinders, one or both, are revoluble and are provided with insertible teeth or pins. The teeth *t* of cylinder *a* extend radially to or nearly to the surface of cylinder *b*, the teeth *t'* of the latter cylinder in like manner hav-

ing the same relation to the outer cylinder. The teeth are arranged to travel in circular paths, the teeth of one cylinder passing between those of the other cylinder, as clearly shown. I prefer to make the teeth from round steel rods cut to the proper length and hardened. The teeth may be so arranged longitudinally of the cylinders that the distance or space between the teeth laterally gradually decreases from the front or feeding end of the cylinders to the discharge end, substantially as shown in Figs. 3 and 4. By this means the ore is more thoroughly acted upon by the teeth and resulting in a greater portion of finely-divided material discharged from the machine.

At the front or feeding end of the machine is located a pulley *c*. Its annular rim is somewhat thicker than an ordinary pulley-rim. The rear edge of it is enlarged and forms an outwardly-extending flange *c'*, secured to a corresponding flange *a'*, integral with the front end of cylinder *a*. Interposed between and rigidly secured to the said flanges is located a head *a³*, its center or hub portion *a⁶* (see Fig. 3) being adapted to form suitable antifriction or ball bearings for the two cylinders *a* *b*.

I may state here that as drawn the two cylinders revolve in opposite directions, the outer one, *a*, being driven by a belt running over said front pulley *c*, the other or inner cylinder, *b*, being secured to a center shaft *s*, mounted in front and rear bearings *f f'*, and driven by a belt running over a pulley *s²*, secured to the rear end of said shaft. In reducing graphite the outer cylinder may be driven at the rate of some three hundred revolutions per minute, the inner cylinder at the same time being driven, say, twenty per cent. faster.

It will be seen that the cylinder *b* is separated at the point where the said hub *a⁶* of the head *a³* is located, the adjacent edges or faces being recessed to form a close joint. The diameter of the hub is substantially the same as the cylinder *b*. A sleeve *b³* may be secured to the shaft *s* and arranged to form with the bored portion of the hub a ball-bearing. The inner diameter of pulley-rim *c* exceeds the inner diameter of cylinder *a*. Communication between these two members is through the beveled annular opening formed in the head *a³*, integral arms *a⁵*, extending from the latter, serving to unite them to the hub.

The inner surface of pulley *c* and corresponding surface of cylinder *b* are provided with teeth *t t'*, respectively, substantially as in the cylinders proper. In the former, however, the teeth are somewhat longer. I prefer to arrange a circular row of flat teeth *t²* at the front or feeding end of the machine, the same being set at an angle, so as to insure a forward movement of the ore, thereby forming what may be termed "driving-teeth," and in conjunction with the other teeth, &c., operating to advance the ore or material from the front to the rear of the machine. I pre-

fer to secure the said driver-teeth *t²* to the cylinder *b*, substantially as shown in Fig. 8.

The front end of the pulley *c* is closed by a stationary cover or plate *d*, having a hopper-like extension *h³*, communicating with the feeding-head. The adjacent edges of the pulley and plate are grooved to form a packing-joint *c⁴*. (See Fig. 3.)

The machine may be provided with a mechanical feeding device, substantially as shown, the same consisting of a suitable casing *h'*, having a hopper *h*, into which latter the ore or material to be disintegrated is shoveled or dumped from time to time. Within the casing are mounted slowly-revolving buckets, which pick up said material and discharge it into the mouth of the said extension *h³* of the plate *d*.

In my improved ore-pulverizing machine all the joints and connections are practically air and dust tight. Therefore the health of the workmen or attendants is correspondingly increased, because the air inhaled by them is then comparatively free from dust or foreign matter.

By referring to Fig. 4 it will be seen that the delivery end of the machine is provided with a rear head *a⁴*, secured to a corresponding flange *a²*, integral with the cylinder *a*. This head has a central hub *a⁹*, provided with antifriction-bearings, substantially as hereinbefore described with reference to the front head. The annular space through which the material is delivered is provided with a series of angular or fan-shaped arms *a⁸*, arranged with respect to the direction of rotation to insure a free discharge of the material. At the rear of the head *a⁴* and communicating with it is located a stationary casing *e*, having a downward-extending nozzle or outlet *e*, into which the said discharged material falls. This in turn may, if desired, be connected with any suitable conveying apparatus capable of delivering the material therefrom to bolting mechanism or other means adapted to subject it to further treatment, according to the kind and quality of the material or ore acted upon.

At intervals along the barrel of the inner cylinder *b* are inserted flat or angular teeth *t³*. These are arranged at an angle with the cylinder's axis, as clearly shown. Said teeth, while cooperating with the teeth of the outer cylinder to reduce the ore, at the same time also assist in feeding or advancing the material toward the discharge-outlet, thereby preventing it from being compacted in the cylinders. The other teeth, *t t'*, may be made angular or polygonal cross-sectionally in lieu of the round form represented in the drawings. I prefer the latter shape, however, because its action upon the ore is more effective, as such teeth give hammer-like blows which fracture or crush the material more thoroughly than angular-shaped teeth.

In Fig. 7 I have represented my improved

ore-pulverizing machine as being vertically mounted. The cylinders *a* and *b* are constructed substantially as hereinbefore described and are also capable of being revolved in opposite directions. In this case the material is fed into a hopper *h*, terminating in a hollow stationary head *d'*, communicating with the top end or space of the cylinders, the disintegrated material passing out at the bottom. In lieu of the fixed casing *e* (shown in Fig. 4) I employ a cylindrical casting *n*, (also stationary,) having its upper end let into the adjacent head *a'*, thereby forming a joint. The lower end of cylinder *b* rests on the adjacent end of the hub *n'* of the casting, the driving-shaft *s* extending through the latter and being supported in a step *r'* of the base-casting *r*. The part *n* is provided with a closed beveled partition *n'*, communicating directly with the discharge-spout *n'*. To the shaft *s* is secured a scraper *o*, the function of which is to agitate the powdered material and prevent it from being compacted.

From the foregoing description it will be apparent that ore or material deposited in hopper *h* will be mechanically fed into the enlarged annular space *w* at the front end of the machine, the initial action of the rapidly-moving teeth being to break the ore into small pieces, the driver-teeth at the same time further serving to slowly feed the ore into the smaller annular space *w*. The continued and successive action of the teeth therein reduces the greater part of the ore to fine atoms or powder, the ore finally passing through the head *a'* and into the casing *e*.

In case the mill be vertically arranged the material is acted upon substantially as just described, the ore being discharged into the casting or stationary support *n* and is delivered therefrom by means of spout *n'*.

I would add that certain changes or modifications of my improved mill may be made without departing from the spirit of the invention. For example, the axes of the cylinders may be inclined, the outer cylinder may be made stationary or revoluble, as desired, and the material may be fed into the machine without the use of the mechanical feeding device.

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

1. In an ore-pulverizing machine, the combination of an outer cylindrical casing having inwardly-extending teeth or pins secured thereto, a revoluble inner cylinder mounted within and concentric with said outer cylinder having radially-extending teeth adapted to travel in circular paths and at the same time passing between and coacting with the said teeth of the other cylinder, an enlarged feeding chamber or head formed by the continuation of said cylinders, a mechanically-

operated feeding device communicating with said feeding-chamber and a suitable hopper or reservoir, whereby the material or ore is conducted from the latter into the feeding-chamber, and a stationary head or member, communicating with the rear end of the cylinders, into which head the material is discharged, substantially as set forth.

2. In an ore-pulverizing machine, the combination of a pair of toothed cylinders mounted one within the other and capable of being revolved in opposite directions, a driving-pulley secured to the front end of the outer cylinder having teeth extending inwardly from its rim, and having the toothed portion of the inner cylinder prolonged to coact with the teeth of said pulley, substantially as described.

3. In an ore-pulverizing machine, the combination with the outer toothed cylinder and an apertured head member secured thereto provided with a central hub, of a toothed cylinder mounted within and arranged to coact with said outer cylinder, the said head member supporting the adjacent part of the inner cylinder and forming a bearing for the same, substantially as hereinbefore described.

4. The combination with the revoluble outer cylinder *a* and driving-head member *c* secured thereto provided with inwardly-extending teeth, of the oppositely-revoluble inner cylinder *b* provided with teeth adapted to coact with said teeth of the outer cylinder, and further provided with driver-teeth arranged at an angle to the axis of rotation, for the purpose specified.

5. In an ore-pulverizing machine, the combination with a suitably-arranged revoluble inner cylinder provided with teeth, of a toothed cylinder surrounding the said inner cylinder and forming an annular space between them, and having the front portion of said annular space enlarged to form an initial treating-chamber, and means for feeding the disintegrated ore from the front to the rear end of the machine while being acted upon by the teeth, substantially as set forth.

6. In an ore-pulverizing machine, the combination with suitably-supported inner and outer revoluble toothed cylinders arranged to form an annular space between them, of a stationary hollow casting located between the cylinders and communicating with said annular space and having a discharge-outlet, and a revoluble clearer member mounted in said casting, substantially as hereinbefore described and for the purpose set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

GEORGE A. CLEVELAND.

Witnesses:

GEO. H. REMINGTON,
REMINGTON SHERMAN.