

No. 726,521.

PATENTED APR. 28, 1903.

E. FERRARIS.

APPARATUS FOR CRUSHING OR CRUSHING AND SORTING ORES, &c.

APPLICATION FILED AUG. 16, 1901.

NO MODEL.

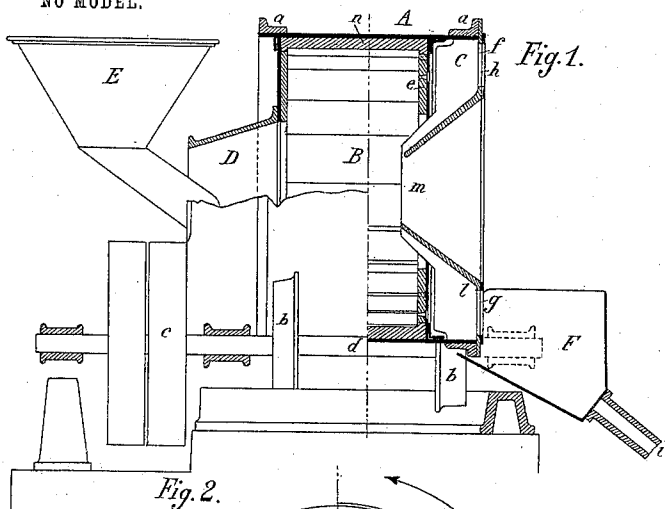


Fig. 2.

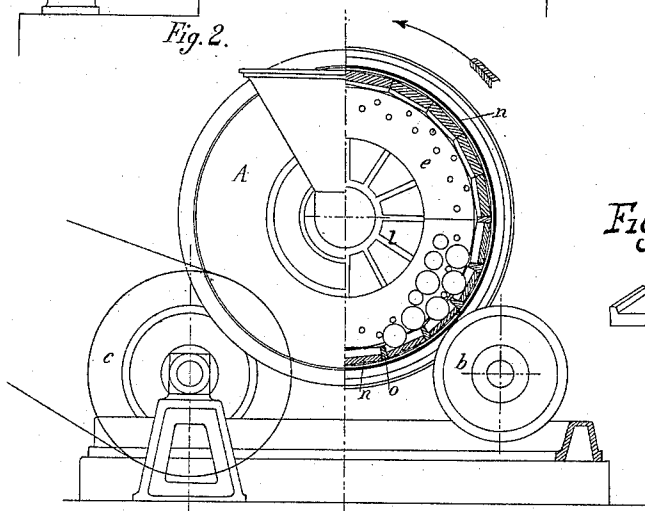


Fig. 6

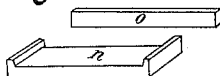


Fig. 5.

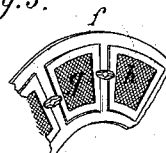


Fig. 3.

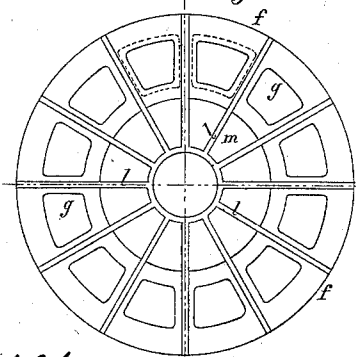
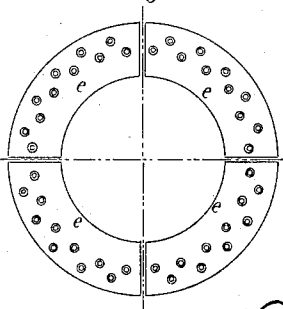


Fig. 4.



Witnesses

W. K. B. Miller

[Signature]

Inventor
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By *[Signature]* Attorney

UNITED STATES PATENT OFFICE.

ERMINIO FERRARIS, OF MONTEPONI, ITALY, ASSIGNOR OF ONE-FOURTH
TO WALTER RENTON INGALLS, OF LYNN, MASSACHUSETTS.

APPARATUS FOR CRUSHING OR CRUSHING AND SORTING ORES, &c.

SPECIFICATION forming part of Letters Patent No. 726,521, dated April 28, 1903.

Application filed August 16, 1901. Serial No. 72,250. (No model.)

To all whom it may concern:

Be it known that I, ERMINIO FERRARIS, a subject of the King of Italy, residing at Monteponi, Sardinia, Italy, have invented certain new and useful Improvements in or Relating to Apparatus for Crushing or Crushing and Sorting Ore or other Materials, (for which I have made application for Letters Patent in Italy, No. 16,262, dated July 26, 1901,) of which the following is a specification.

The object of this apparatus is to crush or crush and sort in a single operation ore or other material, no matter how hard it may be, until the desired fineness is attained.

In the accompanying drawings, Figure 1 shows a front elevation, partly in section, of the apparatus; Fig. 2, a side elevation, partly in section. Fig. 3 shows the head which closes the apparatus at the end where the crushed material is discharged. Fig. 4 represents the annular partition which separates the crushing-chamber from the sorting or classifying chamber, and Fig. 5 shows the screens which cover the discharge-openings in the end of the apparatus through which the crushed material is caused to pass. Fig. 6 shows details of the peripheral lining-plates in the crushing-chamber.

Like letters indicate like parts throughout the drawings.

The crushing device is formed by a drum A, driven from a horizontal shaft *d*, the drum being provided with tires or rings *a*, which rest on four wheels *b*, mounted in pairs on axles, one of which, *d*, is provided on its extension with fast and loose pulleys *c* and communicates by friction its movement of rotation to the drum A.

The material to be crushed and the water or liquid which is intended to carry the crushed product along are introduced through a conical opening D, arranged in one end of the drum. The feeding operation can be effected from a hopper E or from any other regulating apparatus, or it may be done without the assistance of a hopper or regulator. The interior of the drum is divided into two compartments or chambers by means of the annular perforated partition *e*. The wider cham-

ber, situated on the side where the material to be crushed and the liquid are introduced, is lined on its inner sides with plates of hard steel or cast-iron or other suitable material and is provided with loose balls of steel or other suitable material, which roll freely with the material to be crushed. The lining of this chamber B, as represented in the accompanying drawings, shows radially-projecting ribs; but other forms of lining may be employed, as is well known to those who are acquainted with the art, certain of such modifications being described farther on. When the material to be crushed is reduced to pieces smaller than the apertures in the annular partition *e*, they are able to escape through the latter from the crushing-compartment of the drum. The annular perforated partition thus serves the purpose of separating a crushing-compartment from the remainder of the drum and of retaining the material to be crushed in said compartment until it has been reduced to pieces of a certain desired size, while its annular form permits the return to the crushing-compartment, by means which will subsequently be described, of such material as passes through into the classifying-chamber, but is still too coarse to be discharged through the screens *h* in the end of the drum.

The narrower chamber C serves for the classification of the product, which enters it, along with the liquid, through the holes of the partition *e*. It is closed externally by a cover *f*, in which openings *g*, fitted with screens *h*, of any suitable material, are provided. When the product is sufficiently fine to pass with the water through said screens, it escapes from the apparatus and falls into a hopper or chute F and is then conducted away by a tube *i* or by any other means, say, to a washing apparatus or to a depositing vessel. Extending inward toward the center of the drum the cover *f* is conically formed or tapered, as shown, and penetrates into the interior of the drum A sufficiently far to discharge into the crushing-chamber B. This cover is provided with inner radial plates *l*, which divide the classifying-chamber C, as

well as the external surface of the cone *m*, into sections. The classifying-chamber is therefore subdivided radially into a series of smaller chambers; but for facility in description these subdivisions are included in the general expression of "classifying-chamber," as will be readily understood. The material which has penetrated through the holes of the partition *e* into the classifying-chamber *C*, but which is too coarse to pass through the screens of the cover *f*, is by the rotatory movement of the drum and of the cone *m* carried up sufficiently high to slide off the external surface of the cone *m* and to return into the crushing-chamber *B*.

While I speak of the part *m* as a "cone," yet, strictly speaking, it is in the form of a frustum of a cone, and while I designate the part *m* as a "cone" in the description and claims it will be understood that said term is intended to cover a frustum of a cone or any construction adapted to perform the function which the part *m* performs.

The plates *n*, of steel or hard cast-iron, on the inner circumference of the crushing-chamber are held in place by lateral annular plates, which in their turn are fixed to the walls of the drum by conical or other bolts, which do not project toward the interior.

When it is intended to crush easily-pulverized material by the rolling action of the balls, these plates may all be of uniform thickness, as those shown at *n*, Fig. 2. In order to crush hard or refractory substances, bars *O*, which project and which will serve to lift or joggle the balls and the coarse pieces in order to cause them to fall down again from a slight height, can be added to or inserted between the plates *n*, the operation being thus effected by pounding or triturating, as in the case of stamping-mills. The same effect can be obtained by making use of peripheral plates of different thicknesses or of trapezoidal section to form projections of greater or less extent, according to the hardness of the material to be crushed.

This apparatus in comparison with well-known crushing-mills with balls and with stamping or pounding mill offers the advantage that the working parts are not so quickly worn out and that the work can be watched or controlled and repairs executed with greater ease. In comparison with pounding-machines considerably less motive force is required and much greater facility of obtaining a very regular flow of pulverized material and water mixed in the desired proportions is afforded, a circumstance which is very advantageous for the supply of the washing or depositing apparatus. The apparatus can serve at the same time for the crushing and amalgamation of auriferous ores.

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

1. An ore-crushing apparatus consisting of a grinding-cylinder divided into two compart-

ments by a partition parallel with the heads of said cylinder, said partition being provided with an opening for the return of oversize ore and with openings intermediate between the said opening and the outer edge of the partition, means for crushing the ore in one of said compartments, means for sifting the ore which has passed into the other compartment and discharging the sifted ore therefrom, and a return-cone situated in the last-mentioned compartment and adapted to return the oversize ore through the opening provided therefor in the partition into the crushing-compartment for further crushing.

2. An ore-crushing cylinder provided with a partition parallel with the heads of the cylinder, said partition being provided with a central opening and other openings intermediate between the central opening and the outer edge of the partition, in combination with a cone pointing toward the central opening of said partition for the purpose set forth.

3. An ore-crushing apparatus comprising a grinding-cylinder, a perforated partition dividing the cylinder into a smaller and a larger chamber, and a central cone projecting inwardly into the cylinder toward said partition and adapted to discharge into the larger chamber, the said cylinder having a central feed-opening at one end and a series of openings at the other end arranged circumferentially around the aforesaid cone, said series of openings being provided with screens for the purpose of sifting and discharging the ore which is ground sufficiently fine.

4. In an ore-crushing apparatus of the ball-mill type, the combination of a grinding-cylinder having a crushing-compartment at one end and a series of radial subdivisions at the other end, openings covered by screens on the outer side of the said radial subdivisions, to permit the escape from the cylinder of ore sufficiently fine, and openings on the inner side of the said radial subdivisions, communicating with the crushing-compartment, to permit the entrance of the crushed ore into the said radial subdivisions and the return into the crushing-compartment of the ore which is too coarse to escape through the screens, said interior return-openings being arranged at the ends of the radial subdivisions pointing toward the longitudinal axis of the cylinder, whereby the ore being lifted in the radial subdivisions by the rotation of the cylinder is caused by gravity to discharge from said radial subdivisions, through said interior return-openings, into the crushing-compartment of the cylinder.

5. An ore-crushing apparatus comprising a grinding-cylinder, an annular partition parallel with the ends of the cylinder, dividing the cylinder into pulverizing and screening chambers, loose balls of steel or other suitable material in the pulverizing-chamber, a central feed-opening in one end of the cyl-

inder, a series of openings at the other end, screens covering said openings for sifting out the ore ground sufficiently fine, a central cone projecting inwardly and adapted to discharge
5 into the pulverizing-chamber, and radial blades on said cone, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERMINIO FERRARIS.

Witnesses:

SECONDO CORTA,
MAURIZIO CERONE.